United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Polk County, Minnesota

Part I

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**, 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 units 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** 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**. 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 **Contents** 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 **Contents** in Part II shows which table has data on a specific land use for each detailed soil map unit. Also, see the **Contents** in Part I and Part II for other 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 1994. Soil names and descriptions were approved in 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1994. This survey was made cooperatively by the Natural Resources Conservation Service, the Minnesota Agricultural Experiment Station, Polk County, the East Polk Soil and Water Conservation District, and the West Polk Soil and Water Conservation District. The survey is part of the technical assistance furnished to the East Polk Soil and Water Conservation District and the West Polk Soil and Water Conservation District. It was partially funded by the Legislative Commission for Minnesota Resources and by Polk 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: Windbreaks and shelterbelts in an area of the Hedman-Fram-Heimdal association. The trees help to control soil blowing, protect farmsteads and livestock, provide wildlife habitat, and beautify the landscape.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov.

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Foreword

This soil survey contains information that can be used in land-planning programs in Polk 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
State Conservationist
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Soil Survey of
Polk County, Minnesota

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

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; and the kinds of crops and native plants. 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 soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. 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 may 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, variations in slope groupings, and the application of the latest soil classification system.

General Nature of the County

Polk County is in northwestern Minnesota (fig. 1). Crookston is the county seat. The total area of the county is about 1,278,000 acres, or about 2,013 square miles. The total area of water bodies more than 40 acres in size is about 22 square miles, or about 14,000 acres.

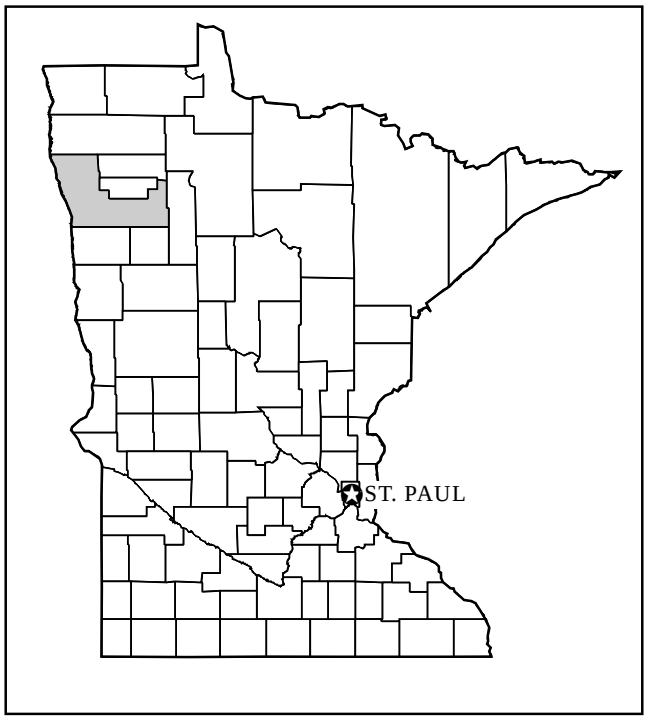

Figure 1.—Location of Polk County in Minnesota.

Farming is the most important enterprise in the county. Wheat, barley, sugar beets, potatoes, corn, soybeans, sunflowers, hay, and wild rice are the main agricultural crops. These crops, along with pasture for livestock production, provide most of the income in the county. Most industries in the county are related to agricultural production. These include companies that process sugar beets and storage facilities for small grain and potatoes. Some light industrial and recreational products also are manufactured.

The soils in Polk County generally are dark and range in texture from clayey to sandy. Soils in the western half of the county formed in silty and clayey lacustrine sediments. Soils in the eastern half of the county formed in loamy glacial till and sandy and gravelly outwash material.

Prior to European settlement of the area, the vegetation in the western half of the county was mainly tall prairie grass species, wetland reeds, and sedges and that in the eastern half was mainly mixed hardwoods.

History

Polk County, which was named for President James Knox Polk, was established by the State Legislature

on July 20, 1858. On October 3, 1863, the Old Crossing Treaty was signed with the Red Lake and Pembina bands of the Chippewa, at the site where the Pembina Trail crossed the Red Lake River. The signing of this treaty opened much of northwestern Minnesota to pioneer settlement.

In 1871, the first permanent settlement in Polk County was established near Climax. Subsequent settlements followed quickly in and around the Climax area, and by 1872 another settlement had been established by a group of Norwegians near Bygland. On September 7, 1873, the Northern Pacific Railroad reached Crookston; it subsequently extended north and west to the county line and beyond. The first township in the county, Huntsville, was organized on March 17, 1874. The organization of Crookston, Vineland, and Fisher Townships followed 2 years later.

The first of the Bonanza Farms was started in 1876 in Keystone Township. In 1895, the Northwest Experiment Station was established in Section 19 of Crookston Township. In 1906, the Northwest School of Agriculture was opened. The first Red River Valley Crop Show was held in downtown Crookston in 1914.

In 1916 the American Crystal Sugar Company plant was built in East Grand Forks. A plant in Crookston was opened in 1954 as a result of the growing sugar industry and its importance to the local economy.

The population of Polk County increased from about 11,433 in 1880 to more than 30,192 in 1890. The population of the county in 1990 was 32,498. The county has 15 incorporated cities: Beltrami, Climax, City of Crookston, City of East Grand Forks, Erskine, Fertile, Fisher, Fosston, Gully, Lengby, McIntosh, Mentor, Nielsville, Trail, and Winger.

The county has four all-weather airports for small aircraft. These airports are in Crookston, Erskine, Fertile, and Fosston. The major highways are U.S. Highways 2, 59, and 75 and State Highways 9, 32, 92, 102, and 220. County and township roads, many of which are paved or blacktopped, serve the rural areas.

Grain elevators are located throughout the county. Locally grown grain is marketed mainly through Duluth and through Minneapolis and St. Paul. Sugar beets are stockpiled at harvest time and are processed at plants in Crookston and East Grand Forks (Polk County Historical Society, 1976).

Physiography, Drainage, and Geology

The highest elevation in Polk County is about 1,560 feet above sea level. It is on the Alexandria glacial moraine, about 2 miles east of Lengby, in the southeast corner of the county. The lowest point in the county, about 785 feet above sea level, is in the northwest corner of the county where the Red River flows north to Canada.

The western half of the county is part of the glacial Lake Agassiz basin. The average distance from the Red River to the first of the major beaches deposited by glacial Lake Agassiz is about 20 miles. The elevation of the Red River is about 150 feet lower than the top of the first beach and is about 350 feet lower than the highest of the glacial lake beaches. Most of this elevation drop occurs in the first few miles west of the beaches; very little change in elevation occurs nearer the river. The soils in the Lake Agassiz basin formed in lacustrine sediments. The soils in the basin proper are deep-water clays and silts. Textures are progressively coarser toward the east, grading to very fine sand and gravel near the glacial lake beaches.

The eastern half of the county is part of a glacial till plain with complex upland areas consisting of short, uneven slopes and many shallow depressions and natural drainageways. Slopes range from nearly level to very steep.

The southeast corner of the county is part of a glacial till moraine complex with steep, complex slopes and deep depressions that are filled with organic soils.

The soils in the eastern half of the county formed in loamy glacial till and, in places along major stream channels, in outwash or alluvium. All of the major drainage systems of the county empty into the Red River. The primary tributaries are the Sand Hill River, which drains the southern part of the county; the Red Lake River, which drains the northeastern and central parts of the county; and the Snake River, which flows from Marshall County and drains the northwestern part of Polk County. Many natural draws, coulees, and creeks also help drain the county and flow into larger drainage systems. An extensive system of ditches has been constructed to drain excess water from areas of farmland.

Agriculture

The farms in Polk County are decreasing in number but increasing in size. There were 2,055 farms in 1980 and 2,008 farms in 1990. During this period the average size of the farms increased from 572 to 659 acres.

Wheat is the most important crop in the county. Sugar beets are the second most important crop. Barley has the second most acreage but is the third most important crop. The trend has been toward a decrease in acreage of flax, oats, rye, and sunflowers and an increase in acreage of wheat and barley. In 1990, about 429,000 acres was planted to wheat and produced 19,890,700 bushels (Minnesota Agricultural

Statistics Service, 1991). That same year, the county had 159,300 acres of barley and 103,100 acres of sugar beets. The acreage used for wheat varies annually in response to market prices. Other crops grown in the county are corn, hay, potatoes, soybeans, and sunflowers.

Generally, the number of livestock in Polk County has decreased over recent years. The number of farms raising livestock also has decreased, but the number of livestock per farm has increased. The main types of livestock are beef cattle and dairy cows. In 1990, the county had about 28,000 beef cattle and calves and 5,100 dairy cows.

Forest Land

Approximately 91,800 acres in Polk County is forested. Small woodlots are scattered throughout the county. The eastern quarter of the county and the central lakes area have the most and the largest tracts of uncleared land. The main species are aspen, basswood, birch, bur oak, northern red oak, maples, and some small stands of white pine. Aspen, elm, eastern cottonwood, bur oak, and shrubs are common on sandy lacustrine and outwash sediments. Black spruce, tamarack, and willows commonly grow in areas of organic bog soils.

The early settlers, mainly loggers, came to eastern Polk County to harvest this timber.

Climate

The three tables at the end of this section (“Temperature and Precipitation,” “Freeze Dates in Spring and Fall,” and “Growing Season”) give climate data for the survey area as recorded at Crookston and Fosston in the period 1961 to 1990.

In winter the average temperature is 8 degrees F in Crookston and Fosston. The average daily minimum temperature is -1 degree at Crookston and -2 degrees at Fosston. The lowest temperature on record at Crookston, which occurred on February 15, 1936, is -51 degrees; the lowest temperature on record at Fosston, which occurred on February 4, 1989, is -43 degrees.

In summer the average temperature is 68 degrees at Crookston and 66 degrees at Fosston. The average daily maximum temperature is 80 degrees at Crookston and 79 degrees at Fosston. The highest recorded temperature at Crookston, which occurred on July 12, 1936, is 105 degrees; the highest recorded temperature at Fosston, which occurred on August 19, 1976, is 103 degrees.

Growing degrees, which are shown in the table “Temperature and Precipitation,” 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 at Crookston is 19.88 inches. Of this, 15.4 inches, or about 77 percent, usually falls in April through September. The growing season for most crops falls within this period. The total annual precipitation at Fosston is 24.02 inches; of this, 17.72 inches, or about 74 percent, usually falls in April through September. In 2 years out of 10, the rainfall in April through September is less than 7.34 inches at Crookston and less than 9.12 inches at Fosston. The heaviest 1-day rainfall on record was 5.85 inches at Crookston (on August 31, 1908) and 6 inches at Fosston (on June 25, 1950). Thunderstorms occur on about 32 days each year in the survey area, and most occur in July.

The average seasonal snowfall is 36.8 inches at Crookston and 43.4 inches at Fosston. The greatest snow depth at any one time during the period of record was 27 inches at Crookston and 36 inches at Fosston. On the average, 12 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year. The heaviest 1-day snowfall on record was more than 11 inches.

The average relative humidity in midafternoon is about 62 percent. Humidity is higher at night, and the average at dawn is about 81 percent. The sun shines about 67 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 14 miles per hour, in April.

Temperature and Precipitation

(Recorded in the period 1961-90 at Crookston and Fosston, Minnesota.)

Month	Temperature: Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Precipitation: Average	2 years in 10 will have-- Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
CROOKSTON:											
January----	13.9	-5.9	4.0	42	-36	0	0.53	0.22	0.79	1	9.5
February---	20.3	.1	10.2	43	-32	0	.47	.18	.71	1	6.2
March------	33.7	14.9	24.3	62	-22	13	.78	.36	1.20	2	6.1
April------	53.2	31.3	42.3	82	6	154	1.46	.64	2.34	3	1.9
May--------	68.8	42.9	55.8	91	21	492	2.46	1.06	3.65	5	.2
June-------	77.2	52.9	65.0	93	36	751	3.45	1.92	4.80	6	.0
July-------	82.7	57.7	70.2	97	42	935	2.78	1.20	4.12	5	.0
August-----	81.2	55.3	68.3	98	37	875	2.88	1.72	3.93	5	.0
September--	69.7	45.5	57.6	92	25	528	2.37	.80	3.66	4	.0
October----	56.7	34.5	45.6	82	13	222	1.53	.51	2.37	3	.7
November---	35.6	18.7	27.1	62	-12	21	.68	.18	1.08	1	4.8
December---	19.4	1.4	10.4	46	-29	0	.49	.23	.71	1	7.4
Yearly:											
Average---	51.0	29.1	40.1	---	---	---	---	---	---	---	---
Extreme---	105	-51	---	99	-37	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,989	19.88	16.38	23.14	37	36.8
FOSSTON:											
January----	14.2	-7.3	3.4	41	-37	0	0.73	0.33	1.17	2	9.7
February---	21.4	-1.1	10.1	47	-34	0	.48	.28	.69	2	6.1
March------	35.3	14.1	24.7	63	-23	14	1.04	.50	1.51	3	7.7
April------	53.0	29.7	41.4	81	5	141	1.79	.69	2.82	4	3.5
May--------	67.8	41.9	54.8	89	21	464	2.80	1.34	4.05	6	.2
June-------	75.9	51.5	63.7	92	34	708	3.92	2.36	5.33	7	.0
July-------	81.4	56.0	68.7	96	40	887	3.20	1.53	4.65	6	.0
August-----	79.6	53.8	66.7	96	36	826	3.30	2.03	4.45	6	.0
September--	68.4	43.9	56.2	90	24	488	2.71	1.17	4.03	5	.0
October----	56.1	33.8	44.9	83	12	212	2.46	.72	3.87	4	1.1
November---	35.9	18.6	27.2	64	-13	21	.81	.37	1.29	2	6.0
December---	19.9	1.0	10.5	46	-31	0	.78	.36	1.14	3	9.1
Yearly:											
Average---	50.7	28.0	39.4	---	---	---	---	---	---	---	---
Extreme---	103	-43	---	98	-39	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,762	24.02	15.48	29.05	50	43.4

* 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 Crookston and Fosston, Minnesota.)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
CROOKSTON:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 10	May 23	May 28
2 years in 10 later than--	May 4	May 17	May 23
5 years in 10 later than--	Apr. 22	May 6	May 14
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 28	Sept. 17	Sept. 6
2 years in 10 earlier than--	Oct. 3	Sept. 21	Sept. 11
5 years in 10 earlier than--	Oct. 14	Sept. 30	Sept. 21
FOSSTON:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 9	May 19	May 31
2 years in 10 later than--	May 3	May 15	May 27
5 years in 10 later than--	Apr. 23	May 6	May 19
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 24	Sept. 14	Sept. 4
2 years in 10 earlier than--	Sept. 30	Sept. 19	Sept. 9
5 years in 10 earlier than--	Oct. 12	Sept. 30	Sept. 19

Growing Season

(Recorded in the period 1961-90 at Crookston and Fosston, Minnesota.)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
CROOKSTON:			
9 years in 10	145	121	105
8 years in 10	152	129	113
5 years in 10	165	144	129
2 years in 10	177	160	144
1 year in 10	184	168	153
FOSSTON:			
9 years in 10	137	121	104
8 years in 10	145	128	110
5 years in 10	161	141	122
2 years in 10	176	154	135
1 year in 10	184	160	141

General Soil Map Units

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

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

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

1. Bygland-Lindaas-Colvin Association

Nearly level to sloping, poorly drained and moderately well drained soils that formed in silty and clayey lacustrine sediments

Setting

Landform and position on the landform: Bygland—flats, rises, and backslopes on lake plains; Lindaas—flats and swales on lake plains; Colvin—flats on lake plains
Slope range: 0 to 12 percent

Composition

Percent of the survey area: 1
Extent of the components in the association:
Bygland soils—35 percent
Lindaas soils—30 percent
Colvin soils—15 percent
Minor soils—20 percent

Soil Properties and Qualities

Bygland

Drainage class: Moderately well drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silty clay loam

Lindaas

Drainage class: Poorly drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silty clay loam

Colvin

Drainage class: Poorly drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silty clay loam

Minor Soils

- The moderately well drained Overly soils on slight rises
- The somewhat poorly drained and moderately well drained Bearden soils on slight rises
- The very poorly drained Rauville soils in oxbows on flood plains
- The moderately well drained Fairdale soils on rises on flood plains

Use and Management

Major uses: Primary use—cropland; secondary use—forest land
Major management factors: Bygland—wind erosion and water erosion; Lindaas and Colvin—wetness

2. Colvin-Bearden-Perella Association

Nearly level and gently sloping, poorly drained to moderately well drained soils that formed in silty lacustrine sediments (fig. 2)

Setting

Landform and position on the landform: Colvin—flats on lake plains; Bearden—slight rises on lake plains; Perella—swales on lake plains
Slope range: 0 to 6 percent

Composition

Percent of the survey area: 24

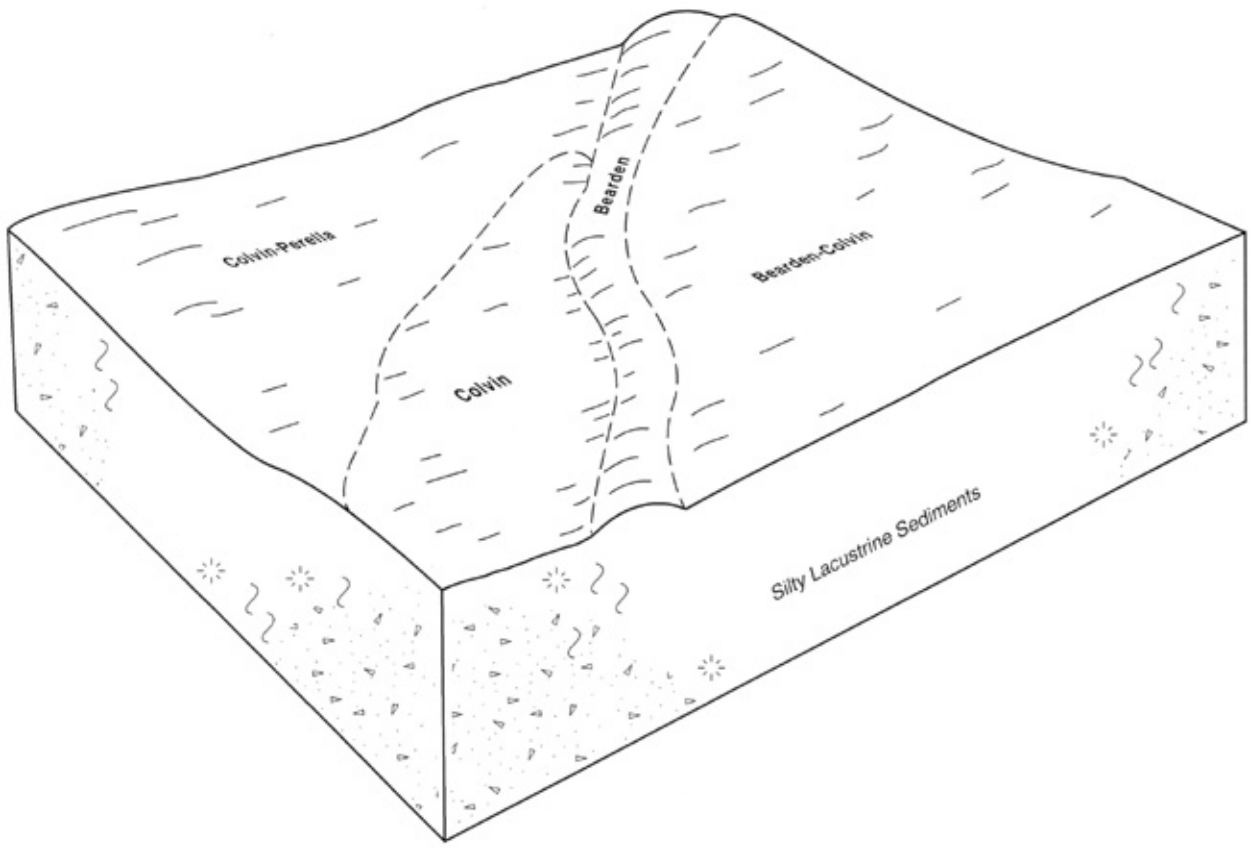

Figure 2.—Typical pattern of soils and underlying material in the Colvin-Bearden-Perella association.

Extent of the components in the association:
Colvin soils—45 percent
Bearden soils—30 percent
Perella soils—15 percent
Minor soils—10 percent

Soil Properties and Qualities

Colvin

Drainage class: Poorly drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silty clay loam

Bearden

Drainage class: Somewhat poorly drained and moderately well drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silt loam and silty clay loam

Perella

Drainage class: Poorly drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silty clay loam

Minor Soils

- The poorly drained Borup and Fargo soils in swales and on flats
- The somewhat poorly drained Glyndon soils on slight rises

Use and Management

Major uses: Primary use—cropland
Major management factors: Colvin—wetness and wind erosion; Bearden—wind erosion and wetness; Perella—wetness

3. Fargo-Hegne-Colvin Association

Nearly level, poorly drained soils that formed in silty and clayey lacustrine sediments (fig. 3)

Setting

Landform and position on the landform: Fargo—flats

and swales on lake plains; Hegne—flats on lake plains; Colvin—flats on lake plains
Slope range: 0 to 1 percent

Composition

Percent of the survey area: 9
Extent of the components in the association:
Fargo soils—45 percent
Hegne soils—25 percent
Colvin soils—20 percent
Minor soils—10 percent

Soil Properties and Qualities

Fargo

Drainage class: Poorly drained
Parent material: Clayey lacustrine sediments
Texture of the surface layer: Silty clay

Hegne

Drainage class: Poorly drained
Parent material: Clayey lacustrine sediments
Texture of the surface layer: Silty clay

Colvin

Drainage class: Poorly drained
Parent material: Silty lacustrine sediments
Texture of the surface layer: Silty clay loam

Minor Soils

- The somewhat poorly drained Bearden soils on slight rises
- The poorly drained Perella soils in swales

Use and Management

Major uses: Primary use—cropland

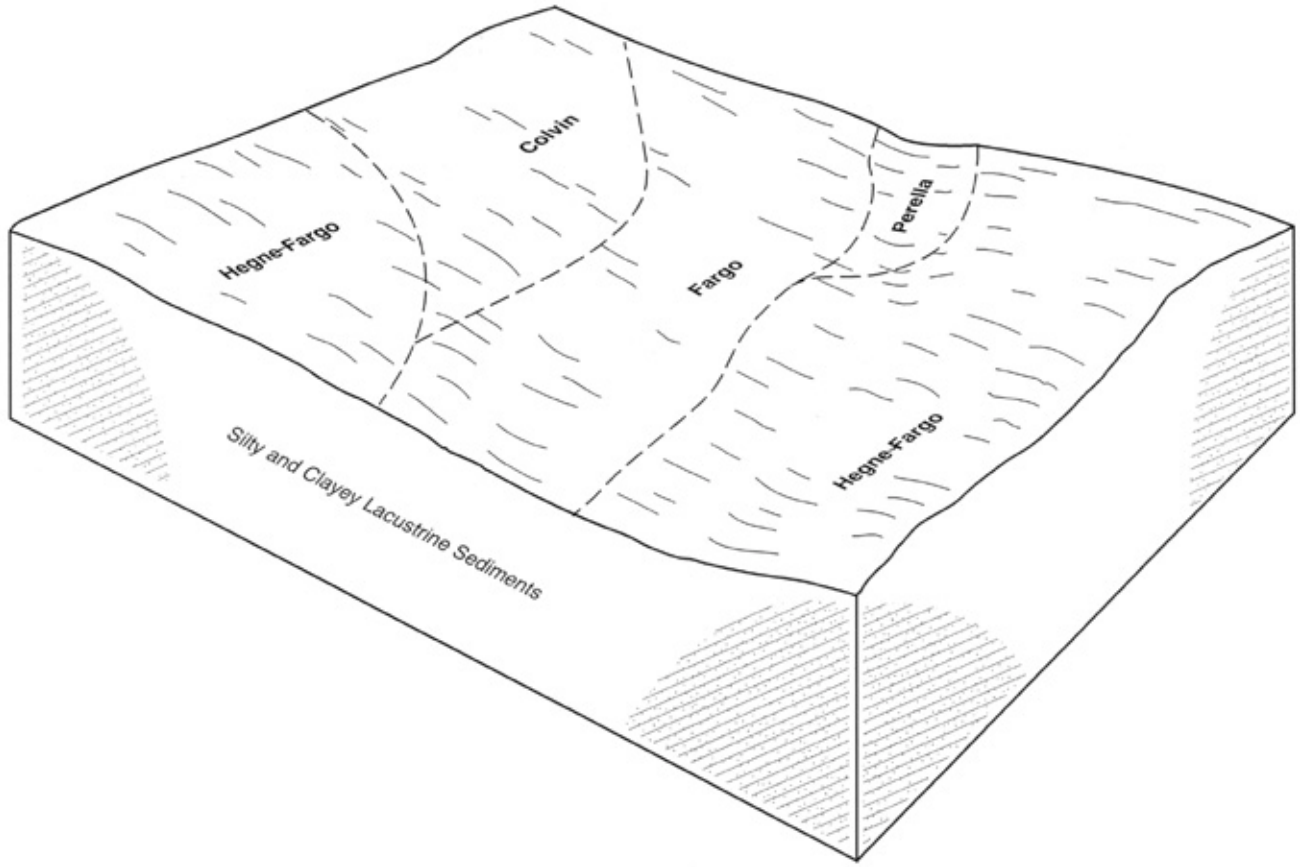

Figure 3.—Typical pattern of soils and underlying material in the Fargo-Hegne-Colvin association.

Major management factors: Wetness, tilth, wind erosion

4. Nielsville-Reis-Clearwater Association

Nearly level, poorly drained soils that formed in silty and clayey glaciolacustrine deposits and till on glacial lake plains

Setting

Landform and position on the landform: Nielsville—flats on lake plains; Reis—flats on lake plains; Clearwater—flats and swales on lake plains
Slope range: 0 to 2 percent

Composition

Percent of the survey area: 3
Extent of the components in the association:
Nielsville soils—40 percent
Reis soils—30 percent
Clearwater soils—20 percent
Minor soils—10 percent

Soil Properties and Qualities

Nielsville

Drainage class: Poorly drained
Parent material: Silty glaciolacustrine deposits over clayey glacial till
Texture of the surface layer: Silty clay loam

Reis

Drainage class: Poorly drained
Parent material: Clayey glacial till
Texture of the surface layer: Clay

Clearwater

Drainage class: Poorly drained
Parent material: Clayey glacial till
Texture of the surface layer: Clay

Minor Soils

- The poorly drained Augsburg and Fargo soils in swales

Use and Management

Major uses: Primary use—cropland
Major management factors: Wetness, tilth

5. Wheatville-Glyndon-Borup Association

Nearly level and gently sloping, very poorly drained to somewhat poorly drained soils that formed in silty, loamy, and clayey glaciolacustrine deposits on glacial lake plains

Setting

Landform and position on the landform: Wheatville—slight rises on lake plains; Glyndon—flats, slight rises, and backslopes on lake plains; Borup—flats and swales on lake plains
Slope range: 0 to 6 percent

Composition

Percent of the survey area: 6
Extent of the components in the association:
Wheatville soils—35 percent
Glyndon soils—30 percent
Borup soils—15 percent
Minor soils—20 percent

Soil Properties and Qualities

Wheatville

Drainage class: Somewhat poorly drained
Parent material: Silty over clayey glaciolacustrine deposits
Texture of the surface layer: Very fine sandy loam

Glyndon

Drainage class: Somewhat poorly drained
Parent material: Silty glaciolacustrine deposits
Texture of the surface layer: Very fine sandy loam

Borup

Drainage class: Very poorly drained and poorly drained
Parent material: Silty glaciolacustrine deposits
Texture of the surface layer: Very fine sandy loam

Minor Soils

- The poorly drained Augsburg and Clearwater soils on flats and in swales
- The somewhat poorly drained Huot soils on slight rises
- The moderately well drained Ulen soils on slight rises

Use and Management

Major uses: Primary use—cropland
Major management factors: Wetness, wind erosion

6. Strathcona-Grimstad Association

Nearly level, very poorly drained to somewhat poorly drained soils that formed in loamy and sandy

glaciolacustrine deposits and till on glacial lake plains

Setting

Landform and position on the landform: Strathcona—flats and swales on lake plains; Grimstad—slight rises on lake plains
Slope range: 0 to 3 percent

Composition

Percent of the survey area: 9
Extent of the components in the association:
Strathcona soils—40 percent
Grimstad soils—30 percent
Minor soils—30 percent

Soil Properties and Qualities

Strathcona

Drainage class: Very poorly drained and poorly drained
Parent material: Loamy and sandy glaciolacustrine deposits over loamy glacial till
Texture of the surface layer: Fine sandy loam

Grimstad

Drainage class: Somewhat poorly drained
Parent material: Loamy and sandy glaciolacustrine deposits over loamy glacial till
Texture of the surface layer: Fine sandy loam

Minor Soils

- The poorly drained Hedman, Kratka, Mavie, Roliss, and Vallers soils on flats and in swales
- The somewhat poorly drained and moderately well drained Hamerly, Foldahl, Fram, Ulen, and Wyrene soils on slight rises
- The excessively drained Sandberg soils on backslopes

Use and Management

Major uses: Primary use—cropland; secondary use—pasture
Major management factors: Strathcona—wetness; Grimstad—wetness and wind erosion

7. Clearwater-Huot-Thiefriver Association

Nearly level, poorly drained and somewhat poorly drained soils that formed in clayey, loamy, and sandy glaciolacustrine deposits and till on glacial lake plains

Setting

Landform and position on the landform: Clearwater—flats and swales on lake plains; Huot—slight rises on lake plains; Thiefriver—flats on lake plains
Slope range: 0 to 2 percent

Composition

Percent of the survey area: 4
Extent of the components in the association:
Clearwater soils—35 percent
Huot soils—25 percent
Thiefriver soils—20 percent
Minor soils—20 percent

Soil Properties and Qualities

Clearwater

Drainage class: Poorly drained
Parent material: Clayey glacial till
Texture of the surface layer: Clay

Huot

Drainage class: Somewhat poorly drained
Parent material: Loamy and sandy over clayey glaciolacustrine deposits
Texture of the surface layer: Fine sandy loam

Thiefriver

Drainage class: Poorly drained
Parent material: Loamy and sandy over clayey glaciolacustrine deposits
Texture of the surface layer: Fine sandy loam

Minor Soils

- The poorly drained Augsburg, Rosewood, and Espelie soils on flats and in swales
- The moderately well drained Hilaire soils on slight rises

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture and hayland
Major management factors: Clearwater—wetness; Huot and Thiefriver—wetness and wind erosion

8. Sandberg-Radium-Syrene Association

Nearly level to steep, poorly drained to excessively drained soils that formed in sandy and loamy beach deposits on beach plains, beach ridges, outwash plains, and lake plains (fig. 4)

Setting

Landform and position on the landform: Sandberg—summits and backslopes on beach ridges; Radium—slight rises on beach ridges; Syrene—

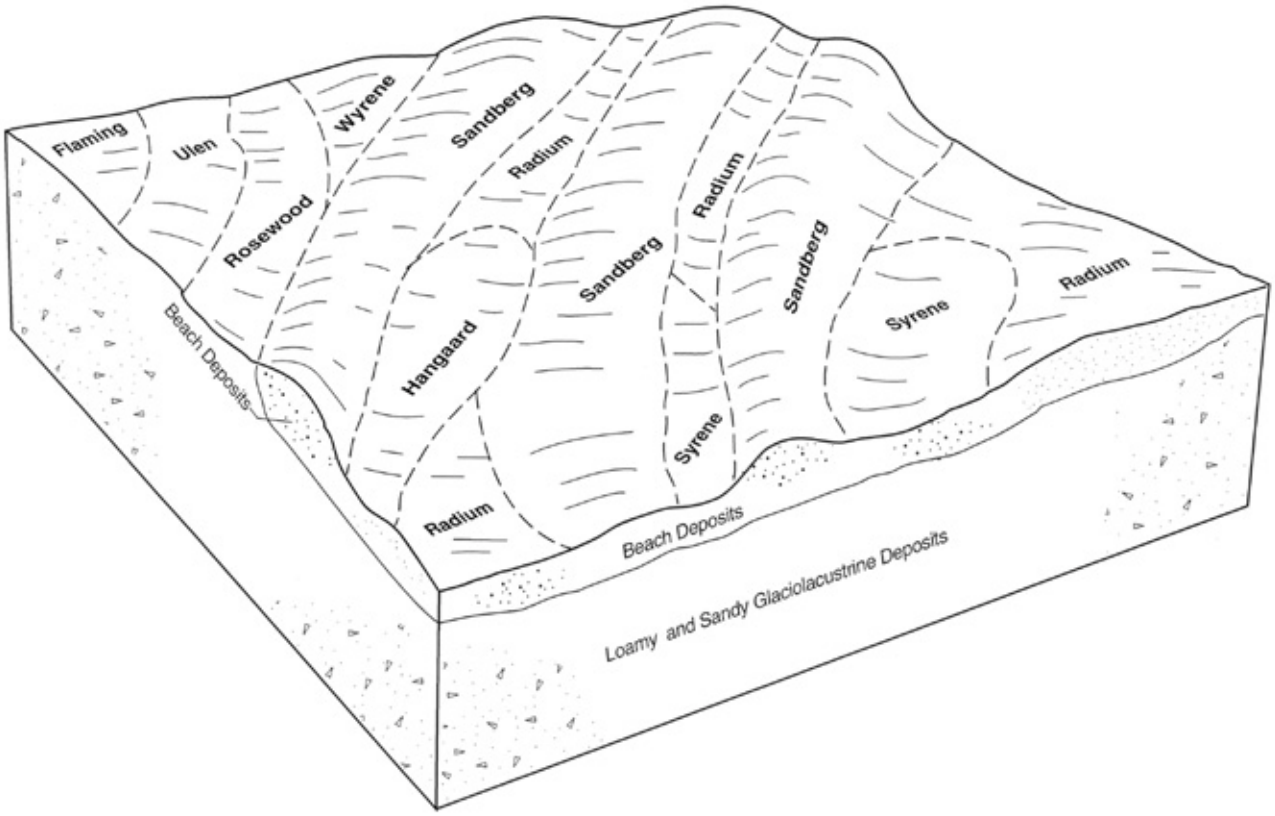

Figure 4.—Typical pattern of soils and underlying material in the Sandberg-Radium-Syrene association.

flats on beach plains, outwash plains, and lake plains
Slope range: 0 to 30 percent

Composition

Percent of the survey area: 7
Extent of the components in the association:
Sandberg soils—40 percent
Radium soils—25 percent
Syrene soils—15 percent
Minor soils—20 percent

Soil Properties and Qualities

Sandberg

Drainage class: Excessively drained
Parent material: Sandy and gravelly beach deposits
Texture of the surface layer: Loamy sand

Radium

Drainage class: Moderately well drained
Parent material: Sandy and gravelly beach deposits
Texture of the surface layer: Loamy sand

Syrene

Drainage class: Poorly drained
Parent material: Loamy and sandy glaciolacustrine deposits
Texture of the surface layer: Sandy loam

Minor Soils

- The poorly drained Hangaard and Rosewood soils on flats and in swales
- The somewhat poorly drained Wyrene soils on slight rises
- The moderately well drained, well drained, and somewhat excessively drained Arvilla, Flaming, Maddock, and Ulen soils on slight rises, rises, backslopes, and summits

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture and hayland
Major management factors: Sandberg and Radium—wind erosion and droughtiness; Syrene—wetness

9. Ulen-Rosewood-Flaming Association

Nearly level, very poorly drained, poorly drained, and moderately well drained soils that formed in loamy and sandy glaciolacustrine deposits on outwash plains and glacial lake plains (fig. 5)

Setting

Landform and position on the landform: Ulen—slight rises on lake plains; Rosewood—flats and swales on lake plains; Flaming—slight rises on lake plains and outwash plains
Slope range: 0 to 3 percent

Composition

Percent of the survey area: 8
Extent of the components in the association:
Ulen soils—35 percent
Rosewood soils—30 percent
Flaming soils—20 percent
Minor soils—15 percent

Soil Properties and Qualities

Ulen

Drainage class: Moderately well drained
Parent material: Sandy glaciolacustrine deposits
Texture of the surface layer: Loamy fine sand

Rosewood

Drainage class: Very poorly drained and poorly drained
Parent material: Loamy and sandy glaciolacustrine deposits
Texture of the surface layer: Fine sandy loam

Flaming

Drainage class: Moderately well drained
Parent material: Sandy glaciolacustrine deposits
Texture of the surface layer: Loamy fine sand

Minor Soils

- The poorly drained and very poorly drained Hamar and Strathcona soils on flats and in swales

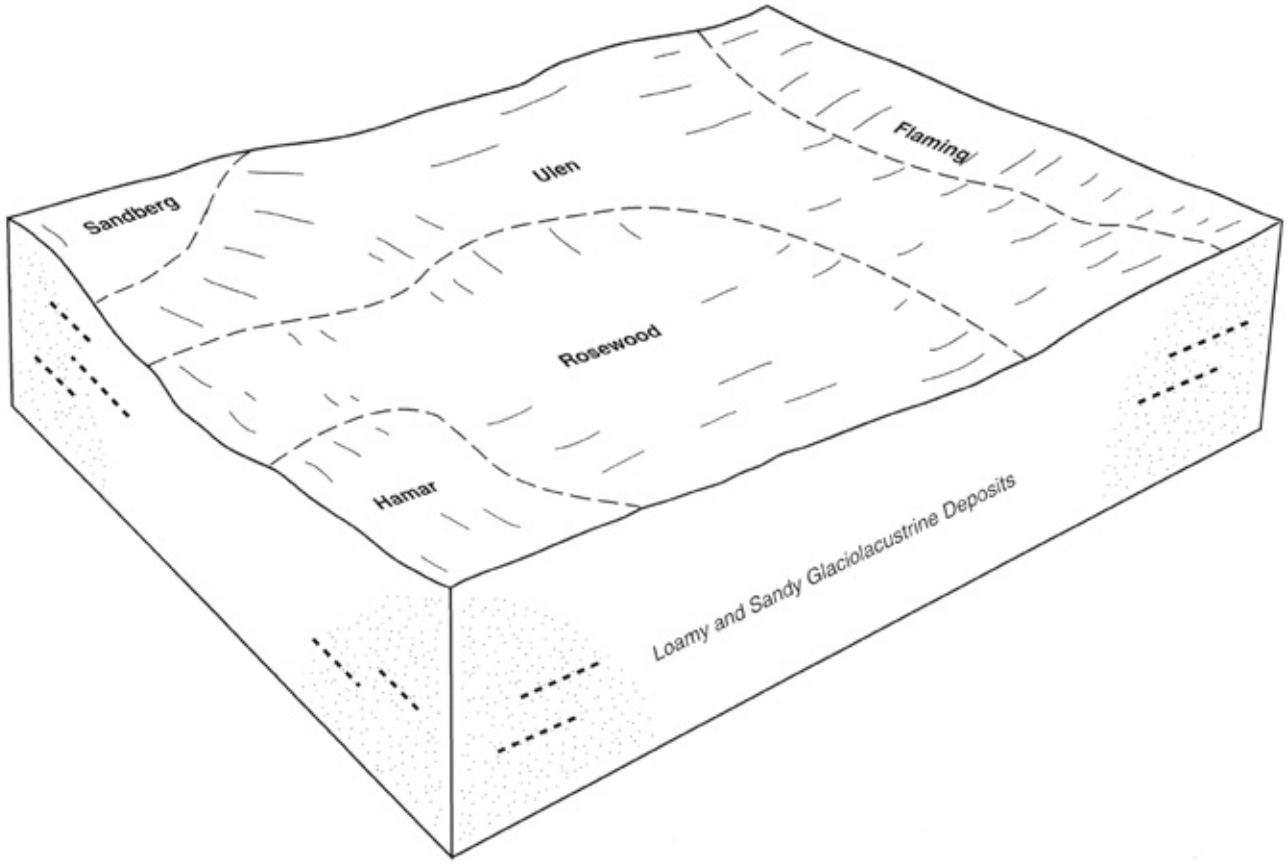

Figure 5.—Typical pattern of soils and underlying material in the Ulen-Rosewood-Flaming association.

- The somewhat poorly drained Grimstad soils on slight rises
- The excessively drained Sandberg soils on summits and backslopes

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture and hayland
Major management factors: Ulen—wind erosion; Rosewood—wetness and wind erosion; Flaming—wind erosion

10. Smiley-Reiner-Kratka Association

Nearly level, very poorly drained, poorly drained, and moderately well drained soils that formed in loamy and sandy glaciolacustrine deposits and till on glacial lake plains (fig. 6)

Setting

Landform and position on the landform: Smiley—flats and swales on lake plains; Reiner—slight rises on lake plains; Kratka—flats and swales on lake plains
Slope range: 0 to 3 percent

Composition

Percent of the survey area: 2
Extent of the components in the association:
Smiley soils—40 percent
Reiner soils—20 percent
Kratka soils—15 percent
Minor soils—25 percent

Soil Properties and Qualities

Smiley

Drainage class: Poorly drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Reiner

Drainage class: Moderately well drained

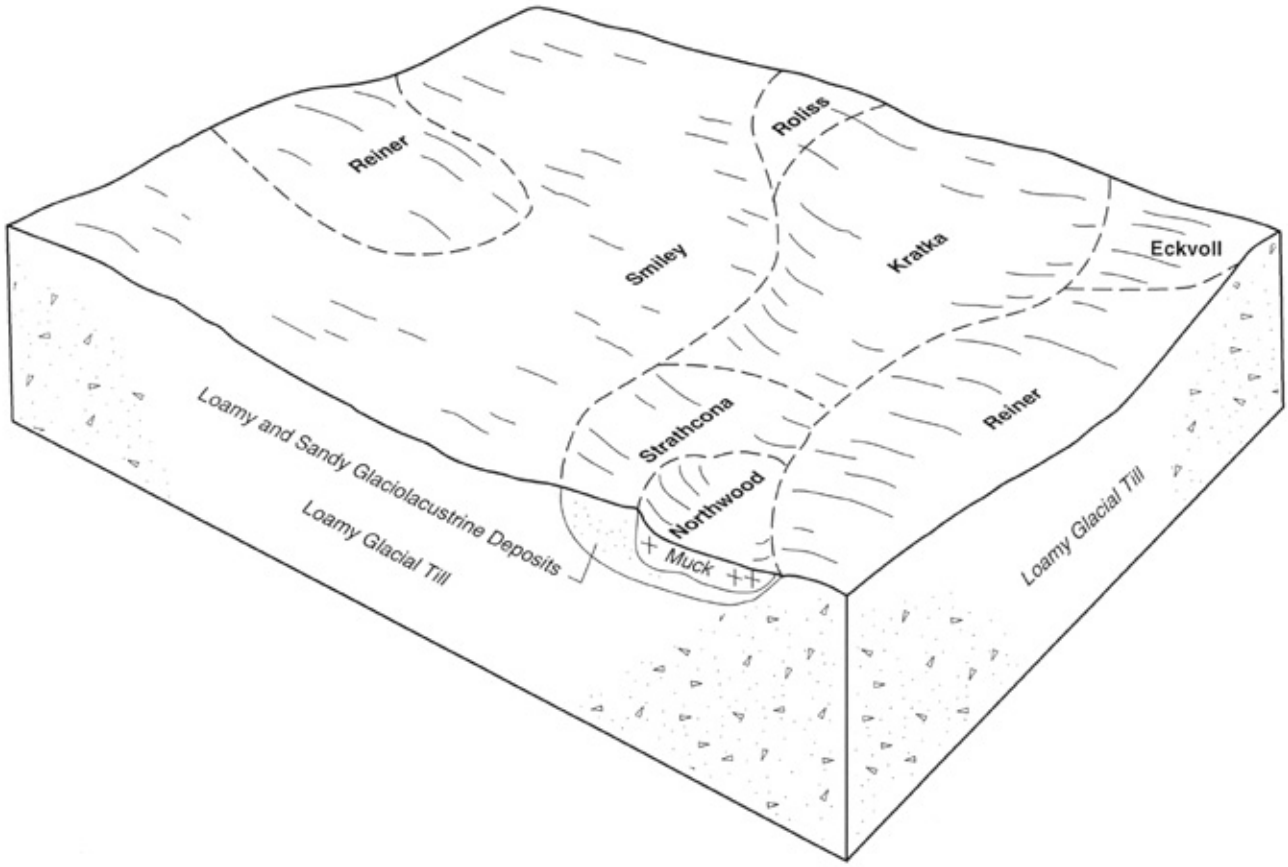

Figure 6.—Typical pattern of soils and underlying material in the Smiley-Reiner-Kratka association.

Parent material: Loamy glacial till
Texture of the surface layer: Fine sandy loam

Kratka

Drainage class: Very poorly drained and poorly drained
Parent material: Loamy and sandy glaciolacustrine deposits over loamy glacial till
Texture of the surface layer: Fine sandy loam

Minor Soils

- The very poorly drained Hamre and Northwood soils in depressions
- The poorly drained Roliss, Strathcona, and Vallers soils on flats and in swales
- The somewhat poorly drained and moderately well drained Eckvoll, Grimstad, and Hamerly soils on slight rises

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture and hayland
Major management factors: Smiley—wetness; Reiner—wind erosion; Kratka—wetness

11. Cathro-Northwood-Seelyeville Association

Nearly level, very poorly drained soils that formed in organic materials and loamy and sandy glaciolacustrine deposits on glacial lake plains

Setting

Landform and position on the landform: Depressions on lake plains
Slope range: 0 to 1 percent

Composition

Percent of the survey area: 2
Extent of the components in the association:
Cathro soils—35 percent
Northwood soils—25 percent
Seelyeville soils—20 percent
Minor soils—20 percent

Soil Properties and Qualities

Cathro

Drainage class: Very poorly drained
Parent material: Organic materials over loamy glaciolacustrine deposits
Texture of the surface layer: Muck

Northwood

Drainage class: Very poorly drained
Parent material: Organic materials over loamy and sandy glaciolacustrine deposits
Texture of the surface layer: Muck

Seelyeville

Drainage class: Very poorly drained
Parent material: Organic materials
Texture of the surface layer: Muck

Minor Soils

- The very poorly drained Markey soils
- The poorly drained Kratka, Strathcona, Roliss, and Vallers soils on flats and slight rises

Use and Management

Major uses: Primary uses—pasture and wildlife; secondary use—cropland
Major management factors: Wetness

12. Halverson-Maddock-Chapett Association

Gently sloping to steep, well drained soils that formed in sandy and loamy glacial outwash and till on outwash plains and moraines (fig. 7)

Setting

Landform and position on the landform: Halverson—rises, summits, and backslopes on moraines; Maddock—rises, summits, and backslopes on outwash plains; Chapett—summits and backslopes on outwash plains and moraines
Slope range: 1 to 40 percent

Composition

Percent of the survey area: 2
Extent of the components in the association:
Halverson soils—30 percent
Maddock soils—25 percent
Chapett soils—25 percent
Minor soils—20 percent

Soil Properties and Qualities

Halverson

Drainage class: Well drained
Parent material: Sandy outwash deposits over loamy glacial till
Texture of the surface layer: Loamy fine sand

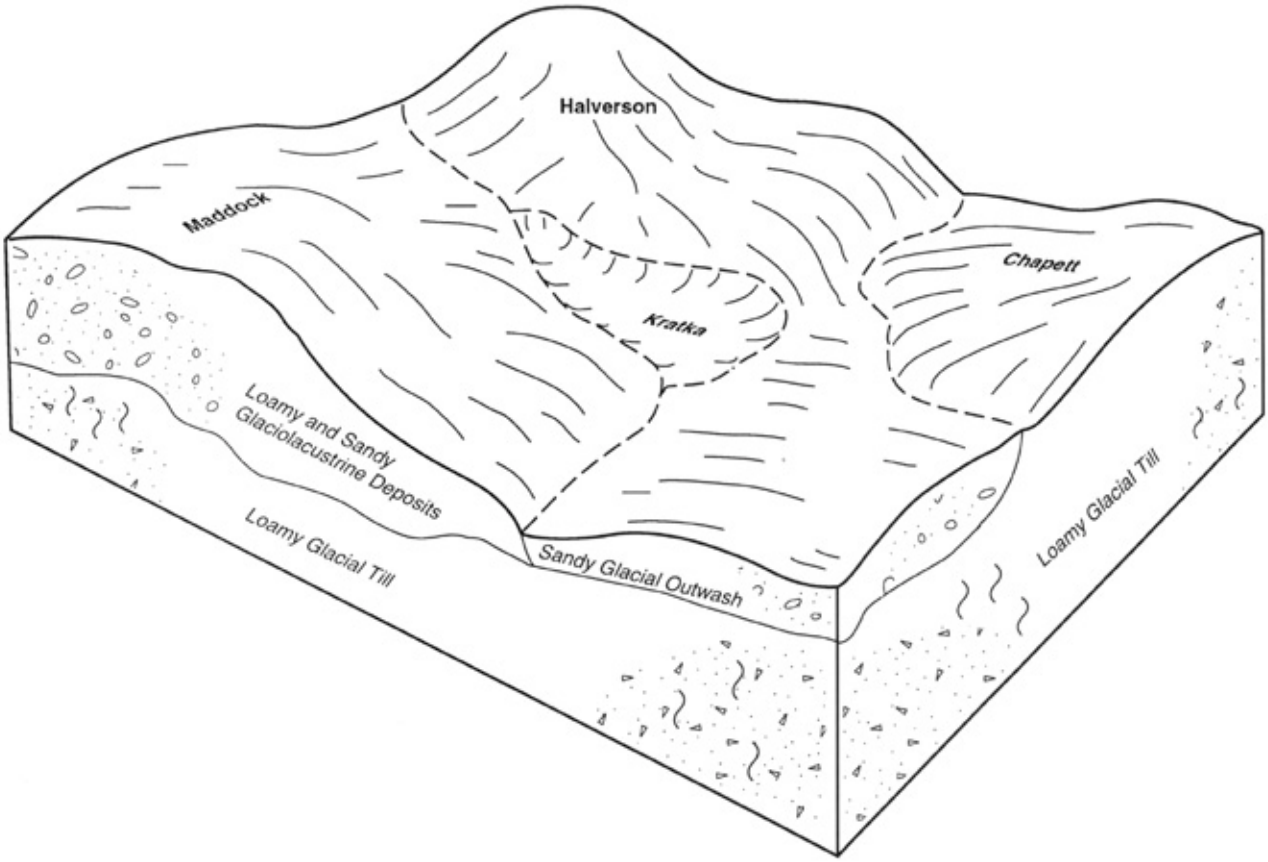

Figure 7.—Typical pattern of soils and underlying material in the Halverson-Maddock-Chapett association.

Maddock

Drainage class: Well drained
Parent material: Sandy glaciolacustrine deposits
Texture of the surface layer: Loamy fine sand

Chapett

Drainage class: Well drained
Parent material: Loamy glacial till
Texture of the surface layer: Fine sandy loam

Minor Soils

- The poorly drained and very poorly drained Kratka and Hedman soils on flats and in swales
- The moderately well drained Foldahl and Knute soils on flats and slight rises
- The excessively drained Serden soils on backslopes and summits

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture, hayland, and forest land

Major management factors: Halverson and Maddock—wind erosion and droughtiness; Chapett—erosion control on slopes

13. Chapett-Knute-Brandsvold Association

Nearly level to steep, poorly drained, moderately well drained, and well drained soils that formed in loamy till (fig. 8)

Setting

Landform and position on the landform: Chapett—summits and backslopes on moraines; Knute—rises on moraines; Brandsvold—flats and swales on moraines
Slope range: 0 to 40 percent

Composition

Percent of the survey area: 11

Extent of the components in the association:
Chapett soils—50 percent
Knute soils—20 percent
Brandsvold soils—15 percent
Minor soils—15 percent

Soil Properties and Qualities

Chapett

Drainage class: Well drained
Parent material: Loamy glacial till
Texture of the surface layer: Fine sandy loam

Knute

Drainage class: Moderately well drained
Parent material: Loamy glacial till
Texture of the surface layer: Fine sandy loam

Brandsvold

Drainage class: Poorly drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Minor Soils

- The very poorly drained Hamre soils in depressions
- The poorly drained and very poorly drained Hedman soils on flats and in swales
- The somewhat poorly drained to moderately well drained Fram soils on flats and slight rises
- The well drained Esmond and Heimdal soils on summits, backslopes, and shoulder slopes

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture, hayland, and forest land
Major management factors: Chapett—erosion control on slopes; Knute—wind erosion and water erosion; Brandsvold—wetness

14. Hedman-Fram-Heimdal Association

Nearly level to hilly, very poorly drained to well drained soils that formed in loamy till (fig. 9)

Setting

Landform and position on the landform: Hedman—flats on moraines; Fram—rises on moraines; Heimdal—summits and backslopes on moraines
Slope range: 0 to 20 percent

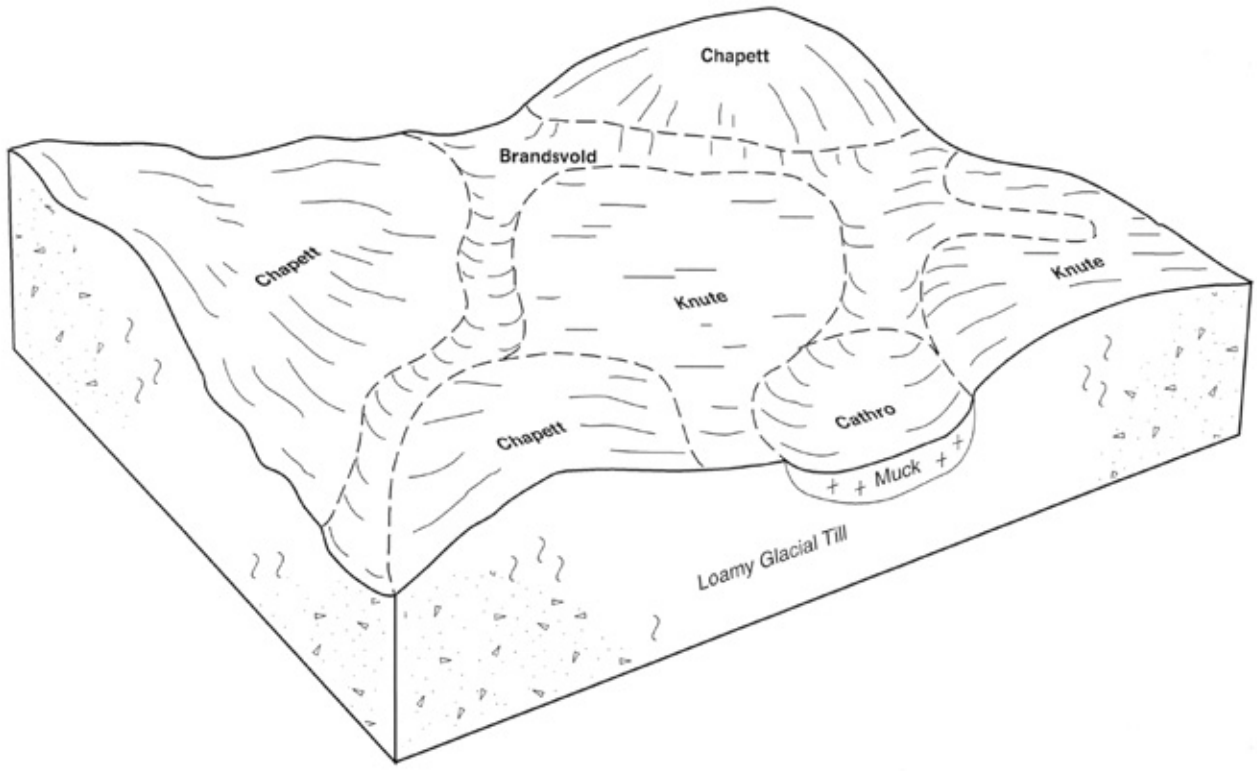

Figure 8.—Typical pattern of soils and underlying material in the Chapett-Knute-Brandsvold association.

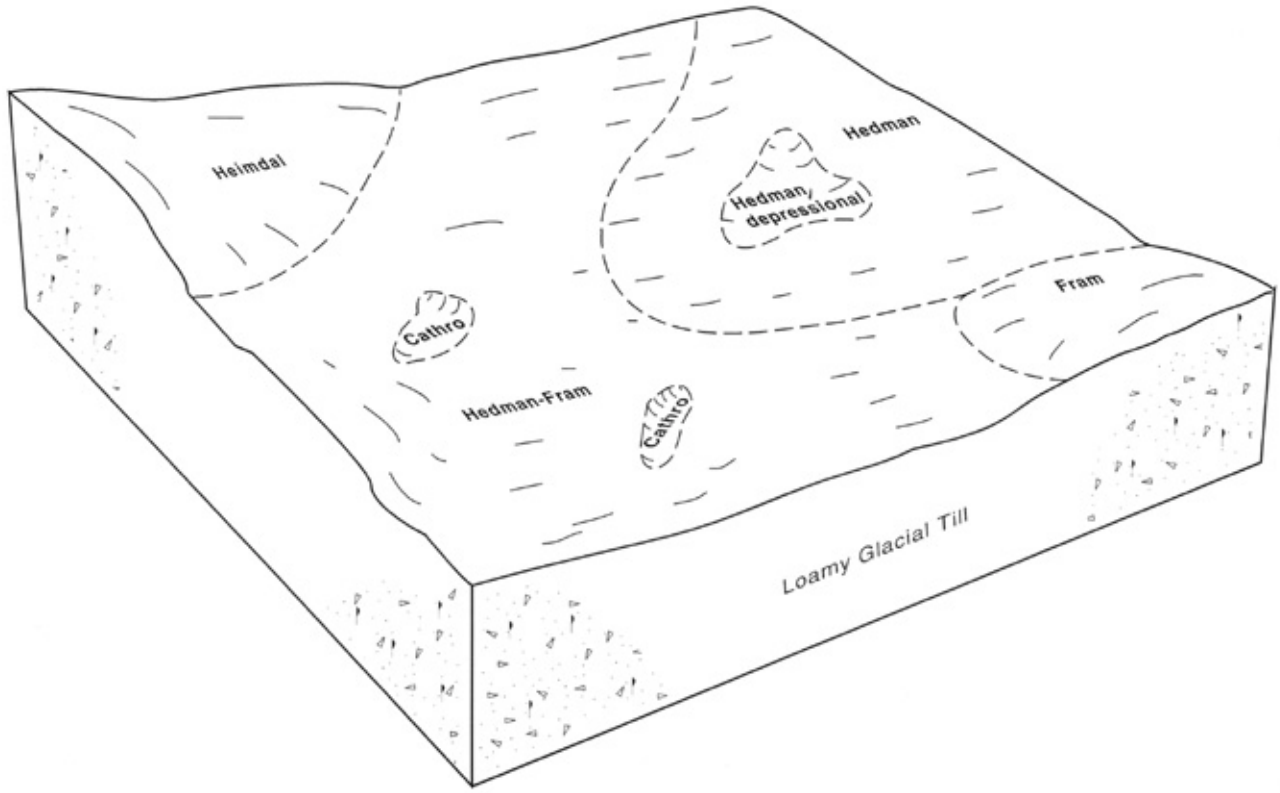

Figure 9.—Typical pattern of soils and underlying material in the Hedman-Fram-Heimdal association.

Composition

Percent of the survey area: 6
Extent of the components in the association:
Hedman soils—40 percent
Fram soils—30 percent
Heimdal soils—15 percent
Minor soils—15 percent

Soil Properties and Qualities

Hedman

Drainage class: Poorly drained and very poorly drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Fram

Drainage class: Somewhat poorly drained and moderately well drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Heimdal

Drainage class: Well drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Minor Soils

- The very poorly drained Cathro soils in depressions
- The well drained Chapett and Esmond soils on summits and backslopes

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture and hayland
Major management factors: Hedman and Fram—wetness; Heimdal—erosion control on slopes

15. Waukon-Langhei-Roliss Association

Nearly level to steep, very poorly drained, poorly drained, and well drained soils that formed in loamy glacial till

Setting

Landform and position on the landform: Waukon—summits and backslopes on moraines; Langhei—

shoulder slopes on moraines; Roliss—flats and swales on lake plains
Slope range: 0 to 20 percent

Composition

Percent of the survey area: 3
Extent of the components in the association:
Waukon soils—45 percent
Langhei soils—25 percent
Roliss soils—15 percent
Minor soils—15 percent

Soil Properties and Qualities

Waukon

Drainage class: Well drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Langhei

Drainage class: Well drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Roliss

Drainage class: Poorly drained and very poorly drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Minor Soils

- The very poorly drained Cathro soils in depressions
- The poorly drained Smiley soils on flats and in swales
- The moderately well drained Reiner soils on slight rises

Use and Management

Major uses: Primary use—cropland; secondary uses—forest land and pasture
Major management factors: Waukon and Langhei—erosion control on slopes; Roliss—wetness

16. Naytahwaush-Seelyeville Association

Nearly level to steep, well drained and very poorly drained soils that formed in clayey and loamy glacial till and organic materials

Setting

Landform and position on the landform:
Naytahwaush—summits and backslopes on moraines; Seelyeville—depressions on moraines
Slope range: 0 to 30 percent

Composition

Percent of the survey area: 3
Extent of the components in the association:
Naytahwaush soils—60 percent
Seelyeville soils—20 percent
Minor soils—20 percent

Soil Properties and Qualities

Naytahwaush

Drainage class: Well drained
Parent material: Loamy glacial till
Texture of the surface layer: Loam

Seelyeville

Drainage class: Very poorly drained
Parent material: Organic materials
Texture of the surface layer: Muck

Minor Soils

- The very poorly drained Cathro soils in depressions
- The poorly drained Auganaush, Roliss, and Smiley soils on flats and in swales
- The moderately well drained Mahkonce and Reiner soils on flats and rises

Use and Management

Major uses: Primary use—cropland; secondary uses—pasture, hayland, and forest land
Major management factors: Naytahwaush—erosion control on slopes; Seelyeville—wetness

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1996 and 1999). 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," at the end of this section, shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve 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; type of saturation; 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 Calciaquolls (*Calci*, referring to an accumulation of secondary carbonates, plus *aquolls*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup 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 taxonomic class. 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 Calciaquolls.

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, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, superactive, frigid Typic Calciaquolls.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. An example is the Colvin series.

Classification of the Soils

Soil name	Family or higher taxonomic class
Arvilla	Sandy, mixed Udic Haploborolls
Auganaush	Fine, smectitic, frigid Mollic Albaqualfs
Augsburg	Coarse-silty over clayey, mixed over smectitic, superactive, frigid Typic Calciaquolls
Bearden	Fine-silty, mixed, superactive, frigid Aeric Calciaquolls
Berner	Loamy, mixed, euic Terric Borosaprists
Borup	Coarse-silty, mixed, superactive, frigid Typic Calciaquolls
Bowstring	Euic Fluvaquentic Borosaprists
Brandsvold	Fine-loamy, mixed, superactive, frigid Typic Argiaquolls
Bygland	Fine, smectitic Aquertic Argiborolls
Cathro	Loamy, mixed, euic Terric Borosaprists
Chapett	Fine-loamy, mixed, superactive Boralfic Udic Argiborolls
Clearwater	Fine, smectitic, frigid Typic Epiaquerts
Colvin	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Darnen	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Deerwood	Sandy, mixed, frigid Histic Humaquepts
Eckvoll	Loamy, mixed, superactive Aquic Arenic Eutroboralfs
Esmond	Coarse-loamy, mixed, superactive Udic Calciborolls
Espelie	Sandy over clayey, mixed over smectitic, frigid Typic Epiaquolls
Fairdale	Fine-loamy, mixed, superactive, calcareous, frigid Mollic Udifluvents
Fargo	Fine, smectitic, frigid Typic Epiaquerts
Flaming	Sandy, mixed Aquic Haploborolls
Fluvaquents	Loamy Fluvaquents
Foldahl	Sandy over loamy, mixed, superactive Aquic Haploborolls
Foxhome	Sandy-skeletal over loamy, mixed, superactive Aquic Haploborolls
Fram	Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls
Glyndon	Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls
Grimstad	Sandy over loamy, mixed, superactive, frigid Aeric Calciaquolls
Gunclub	Fine-silty, mixed, superactive, frigid Aeric Calciaquolls
Halverson	Loamy, mixed, superactive Arenic Argiborolls
Hamar	Sandy, mixed, frigid Typic Endoaquolls
Hamerly	Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls
Hamre	Fine-loamy, mixed, superactive, nonacid, frigid Histic Humaquepts
Hangaard	Sandy, mixed, frigid Typic Endoaquolls
Haploborolls	Loamy Haploborolls
Haslie	Coprogenous, euic Limnic Borosaprists
Hattie	Fine, smectitic, frigid Typic Hapluderts
Hedman	Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls
Hegne	Fine, smectitic, frigid Typic Calciaquerts
Heimdal	Coarse-loamy, mixed, superactive Udic Haploborolls
Hilaire	Sandy over clayey, mixed over smectitic Aquic Haploborolls
Huot	Sandy over clayey, mixed over smectitic Aquic Calciborolls
Knute	Fine-loamy, mixed, superactive Aquic Argiborolls
Kratka	Sandy over loamy, mixed, superactive, frigid Typic Endoaquolls
LaDelle	Fine-silty, mixed, superactive Cumulic Udic Haploborolls
Langhei	Fine-loamy, mixed, superactive, frigid Typic Eutrochrepts
Lindaas	Fine, smectitic, frigid Typic Argiaquolls
Linveldt	Coarse-loamy, mixed, superactive Aquic Argiborolls
Lizzie	Fine-silty, mixed, superactive Boralfic Udic Argiborolls
Maddock	Sandy, mixed Udorthentic Haploborolls
Mahkonce	Fine, smectitic Aquic Eutroboralfs
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Marquette	Loamy-skeletal, mixed, superactive Ochreptic Eutroboralfs
Mavie	Sandy-skeletal over loamy, mixed, superactive, frigid Typic Calciaquolls
Naytahwaush	Fine, smectitic Mollic Eutroboralfs
Nielsville	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Northwood	Sandy over loamy, mixed, superactive, nonacid, frigid Histic Humaquepts
Onstad	Coarse-loamy, mixed, superactive Aquic Haploborolls
Overly	Fine-silty, mixed, superactive Pachic Udic Haploborolls
Perella	Fine-silty, mixed, superactive, frigid Typic Endoaquolls
Radium	Sandy, mixed Aquic Haploborolls
Rauville	Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Reiner	Fine-loamy, mixed, superactive Abruptic Udic Argiborolls
Reis	Fine, smectitic, frigid Typic Calciaquerts
Roliss	Fine-loamy, mixed, superactive, calcareous, frigid Typic Endoaquolls
Rosewood	Sandy, mixed, frigid Typic Calciaquolls
Sandberg	Sandy, mixed Udorthentic Haploborolls
Seelyeville	Euic Typic Borosaprists
Serden	Mixed, frigid Typic Udipsamments
Smiley	Fine-loamy, mixed, superactive, frigid Typic Argiaquolls
Strathcona	Sandy over loamy, mixed, superactive, frigid Typic Calciaquolls
Sugarbush	Coarse-loamy, mixed, superactive Typic Eutroboralfs
Syrene	Sandy, mixed, frigid Typic Calciaquolls
Thiefriver	Sandy over clayey, mixed over smectitic, frigid Typic Calciaquolls
Udipsamments	Udipsamments
Ulen	Sandy, mixed, frigid Aeric Calciaquolls
Vallers	Fine-loamy, mixed, superactive, frigid Typic Calciaquolls
Venlo	Sandy, mixed, frigid Typic Endoaquolls
Waukon	Fine-loamy, mixed, superactive Mollic Eutroboralfs
Wheatville	Coarse-silty over clayey, mixed over smectitic, superactive, frigid Aeric Calciaquolls
Winterfield	Mixed, frigid Aquic Udipsamments
Wyrene	Sandy, mixed, frigid Aeric Calciaquolls
Zell	Coarse-silty, mixed, superactive Udic Calciborolls

Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
20B	Chapett fine sandy loam, 2 to 6 percent slopes	50,777	4.0
20C2	Chapett fine sandy loam, 6 to 12 percent slopes, eroded	12,359	1.0
20D2	Chapett fine sandy loam, 12 to 20 percent slopes, eroded	5,471	0.4
20E	Chapett fine sandy loam, 20 to 40 percent slopes	447	*
38B	Waukon loam, 2 to 6 percent slopes	4,775	0.4
38C2	Waukon loam, 6 to 12 percent slopes, eroded	2,725	0.2
38D2	Waukon loam, 12 to 20 percent slopes, eroded	963	*
45B	Maddock loamy fine sand, 1 to 6 percent slopes	10,234	0.8
45C	Maddock loamy fine sand, 6 to 12 percent slopes	2,357	0.2
45E	Maddock loamy fine sand, 12 to 30 percent slopes	2,097	0.2
47	Colvin silty clay loam	51,986	4.1
57A	Fargo silty clay, 0 to 1 percent slopes	1,389	0.1
59	Grimstad fine sandy loam	50,966	4.0
65	Foxhome sandy loam	1,526	0.1
66	Flaming loamy fine sand	15,272	1.2
67A	Bearden silt loam, 0 to 2 percent slopes	20,202	1.6
67B	Bearden silt loam, 2 to 6 percent slopes	6,301	0.5
93A	Bearden silty clay loam, 0 to 2 percent slopes	8,439	0.7
111	Hangaard sandy loam	1,030	*
184A	Hamerly loam, 0 to 3 percent slopes	3,581	0.3
185D2	Hattie clay, 6 to 18 percent slopes, eroded	1,495	0.1
236	Vallers loam	8,079	0.6
242B	Marquette loamy sand, 1 to 8 percent slopes	612	*
242D	Marquette loamy sand, 8 to 30 percent slopes	471	*
258B	Sandberg loamy sand, 1 to 6 percent slopes	21,527	1.7
258C	Sandberg loamy sand, 6 to 12 percent slopes	2,272	0.2
258E	Sandberg loamy sand, 12 to 30 percent slopes	1,705	0.1
296	Fram loam	26,431	2.1
341B	Arvilla sandy loam, 1 to 4 percent slopes	3,012	0.2
348	Borup loam, depressional	397	*
372	Hamar loamy fine sand	2,864	0.2
387	Roliss loam, depressional	1,503	0.1
412	Mavie fine sandy loam	3,519	0.3
422A	Bygland silty clay loam, 0 to 2 percent slopes	8,758	0.7
422B	Bygland silty clay loam, 2 to 6 percent slopes	2,390	0.2
422C2	Bygland silty clay loam, 6 to 12 percent slopes, eroded	510	*
426	Foldahl loamy fine sand	10,104	0.8
435	Syrene sandy loam	2,784	0.2
439	Strathcona fine sandy loam	28,312	2.2
450	Rauville silty clay loam	2,304	0.2
481	Kratka fine sandy loam	5,771	0.5
494B	Darnen loam, 2 to 6 percent slopes	16	*
506	Overly silty clay loam	1,888	0.1
540	Seelyeville muck	12,285	1.0
543	Markey muck	4,564	0.4
544	Cathro muck	13,942	1.1
547	Deerwood muck	2,638	0.2
563	Northwood muck	6,394	0.5
565	Eckvoll loamy fine sand	438	*
573D	Serden fine sand, 6 to 30 percent slopes	1,130	*
582	Roliss loam	6,627	0.5
641	Clearwater clay	13,920	1.1
642	Clearwater loam	22,234	1.7
643	Huot fine sandy loam	16,564	1.3
645	Espelie fine sandy loam	724	*
647	Hilaire loamy fine sand	4,423	0.3
650	Reiner fine sandy loam	3,756	0.3
651	Thiefriver fine sandy loam	2,096	0.2
667B	Fairdale silt loam, 1 to 6 percent slopes, occasionally flooded	11,505	0.9
667C2	Fairdale silt loam, 6 to 15 percent slopes, eroded, occasionally flooded	1,143	*
670	Knute fine sandy loam	11,656	0.9

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
671	Onstad loam	9,147	0.7
681	Brandsvold loam	4,993	0.4
694D2	Zell silt loam, 6 to 20 percent slopes, eroded	3,953	0.3
704	Wyrene sandy loam	5,251	0.4
707A	Lizzie silt loam, 1 to 3 percent slopes	1,902	0.1
712	Rosewood fine sandy loam	24,141	1.9
713	Linveldt fine sandy loam	759	*
718B	Naytahwaush loam, 2 to 8 percent slopes	3,971	0.3
718C	Naytahwaush loam, 8 to 15 percent slopes	8,926	0.7
718E	Naytahwaush loam, 15 to 30 percent slopes	4,367	0.3
733	Berner muck	1,447	0.1
735B	Halverson loamy fine sand, 1 to 6 percent slopes	5,018	0.4
735C	Halverson loamy fine sand, 6 to 15 percent slopes	1,493	0.1
737	Mahkonce loam	792	*
746	Haslie muck	2,351	0.2
749	Colvin silt loam, occasionally flooded	421	*
765	Smiley loam	3,763	0.3
767	Auganaush loam	543	*
791	Winterfield loamy fine sand, occasionally flooded	1,392	0.1
827B	Heimdal-Esmond complex, 2 to 6 percent slopes	16,217	1.3
827C2	Heimdal-Esmond complex, 6 to 12 percent slopes, eroded	3,923	0.3
908	Bearden-Fargo complex	18,205	1.4
935	Hegne-Fargo complex	4,862	0.4
967B	Waukon-Langhei complex, 2 to 6 percent slopes	46	*
967C2	Waukon-Langhei complex, 6 to 12 percent slopes, eroded	1,630	0.1
979D2	Langhei-Waukon complex, 12 to 20 percent slopes, eroded	730	*
1006	Fluvaquents-Haploborolls complex, 0 to 30 percent slopes	3,719	0.3
1030	Pits, gravel-Udipsamments complex	3,189	0.2
1113	Haslie, Seelyeville, and Cathro soils, ponded	5,794	0.5
1117	Hedman loam	21,645	1.7
1119	Nielsville silty clay loam	15,486	1.2
1121	Hedman loam, depressional	2,356	0.2
1122	Nielsville-Perella complex	4,851	0.4
1142	Hedman-Fram complex	41,771	3.3
1144	Strathcona and Kratka soils, depressional	3,083	0.2
1152B	Sugarbush loamy sand, 1 to 8 percent slopes	665	*
1152C	Sugarbush loamy sand, 8 to 15 percent slopes	838	*
1152E	Sugarbush loamy sand, 15 to 30 percent slopes	370	*
1233D	Esmond-Heimdal complex, 12 to 20 percent slopes, eroded	3,472	0.3
1264	Ulen loamy fine sand	42,521	3.3
1278	Rosewood-Venlo complex	3,796	0.3
1279	Vallers-Hamerly complex	10,691	0.8
1280	Gunclub silty clay loam	2,751	0.2
1283	Reis-Clearwater complex	15,082	1.2
1297	Augsburg very fine sandy loam	4,756	0.4
1299	Borup very fine sandy loam	6,118	0.5
1304A	Glyndon very fine sandy loam, 0 to 2 percent slopes	26,823	2.1
1304B	Glyndon very fine sandy loam, 2 to 6 percent slopes	405	*
1315A	Wheatville very fine sandy loam, 0 to 2 percent slopes	18,882	1.5
1323B	LaDelle silt loam, 0 to 3 percent slopes, occasionally flooded	502	*
1325	Bowstring-Fluvaquents complex, frequently flooded	5,556	0.4
1356	Water, miscellaneous	1,319	0.1
1422	Northwood muck, marl subsoil	3,263	0.3
1866	Colvin-Perella complex	100,239	7.9
1871	Fargo silty clay, swales	1,053	*
1874	Radium loamy sand	14,023	1.1
1878	Hamre muck	6,284	0.5
1879	Seelyeville muck, calcareous, 0 to 3 percent slopes	4,038	0.3
1882	Rosewood, Strathcona, and Berner soils, seepy	679	*

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
1916	Lindaas silty clay loam	2,893	0.2
1963	Bearden-Colvin complex	194,148	15.3
1964	Colvin-Fargo complex	28,427	2.2
W	Water	20,609	1.6
	Total	1,278,000	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 associated detailed soil map units.

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, 1999). 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 soil maps in 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. 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 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 soil 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, Chapett fine sandy loam, 2 to 6 percent slopes, is a phase of the Chapett 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 or miscellaneous areas 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. Waukon-Langhei complex, 2 to 6 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. Haslie, Seelyeville, and Cathro soils, ponded, 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 component of the 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 Contents in Part II) 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.

Arvilla Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Upper part—moderately rapid; lower part—rapid and very rapid
Landform: Outwash plains and lake plains
Parent material: Glacial outwash
Slope range: 1 to 4 percent
Taxonomic classification: Sandy, mixed Udic Haploborolls

Typical Pedon

Arvilla sandy loam, 1 to 4 percent slopes, 1,100 feet south and 400 feet west of the northeast corner of sec. 8, T. 149 N., R. 40 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate medium granular structure; very friable; common fine roots; 1 percent gravel; neutral; clear smooth boundary.

BA—8 to 11 inches; 90 percent dark brown (10YR 3/3) and 10 percent black (10YR 2/1) coarse sandy loam; brown (10YR 5/3) dry; moderate medium subangular blocky structure; friable; common fine roots; 3 percent gravel; neutral; clear smooth boundary.

Bw—11 to 16 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; moderate medium subangular blocky structure; friable; few very fine roots; 4 percent gravel; neutral; abrupt smooth boundary.

2BC—16 to 24 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; few very fine roots; 8 percent gravel; slightly alkaline; clear smooth boundary.

2C1—24 to 44 inches; brown (10YR 5/3) sand; single grain; loose; 6 percent gravel; slightly effervescent; moderately alkaline; clear smooth boundary.

2C2—44 to 68 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; 26 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2C3—68 to 80 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; 18 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 25 inches
Thickness of the mollic epipedon: 7 to 20 inches
Depth to sand and gravel: 14 to 25 inches
Content of rock fragments: 0 to 6 percent gravel in the A and Bw horizons and 5 to 35 percent in the 2C horizon
Other features: Some pedons have a 2Bw or Bk horizon.

A horizon:
Value—2 or 3

Bw horizon:
Hue—7.5YR, 10YR, or 2.5Y
Value—2 to 5
Chroma—1 to 4

Texture—coarse sandy loam, sandy loam, or loam

2C horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 4
Texture—coarse sand, sand, loamy sand, or loamy coarse sand or the gravelly analogs of these textures

341B—Arvilla sandy loam, 1 to 4 percent slopes

Composition

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

Setting

Landform: Beach plains and outwash plains
Position on the landform: Rises and backslopes
Slope range: 1 to 4 percent

Component Description

Texture of the surface layer: Sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Outwash
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches (low)
Content of organic matter 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

- Hangaard and similar soils
- Radium and similar soils
- Sandberg and similar soils
- Maddock and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Auganaush Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine, smectitic, frigid Mollic Albaqualfs

Typical Pedon

Auganaush loam, 1,000 feet west and 100 feet north of the southeast corner of sec. 5, T. 147 N., R. 36 W. (Clearwater County):

A—0 to 4 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; 2 percent gravel; slightly acid; abrupt smooth boundary.

E—4 to 9 inches; light brownish gray (2.5Y 6/2) fine sandy loam, light gray (2.5Y 7/2) dry; few fine prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; moderate fine subangular blocky structure; very friable; 2 percent gravel; neutral; clear smooth boundary.

Btg1—9 to 18 inches; olive gray (5Y 4/2) clay; common medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; moderate medium angular blocky structure; very firm; many faint dark olive gray (5Y 3/2) clay films on faces of peds and in pores; 2 percent gravel; neutral; clear smooth boundary.

Btg2—18 to 25 inches; olive gray (5Y 4/2) clay; common medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; strong medium angular blocky structure; very firm; many faint dark olive gray (5Y 3/2) clay films on faces of peds and in pores; 2 percent gravel; neutral; clear wavy boundary.

Btkg—25 to 32 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and olive yellow (5Y 6/6) redoximorphic concentrations; weak medium subangular blocky structure; firm; common faint dark olive gray (5Y 3/2) clay films in old root channels; common medium irregularly shaped carbonates in seams and masses; 4 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bkg—32 to 60 inches; light olive gray (5Y 6/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and olive yellow (5Y 6/6) redoximorphic concentrations; weak medium subangular blocky structure; common medium

irregularly shaped carbonates in seams and masses; firm; 6 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 30 inches
Content of rock fragments: 1 to 8 percent gravel throughout
Other features: Some pedons have a thin B/E or E/B horizon.

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—fine sandy loam, loam, silt loam, or very fine sandy loam

Btg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay, silty clay, clay loam, or silty clay loam

Bkg horizon:
Hue—2.5Y or 5Y
Value—5 to 7
Chroma—1 or 2
Texture—clay loam or silty clay loam

767—Auganaush loam

Composition

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

Setting

Landform: Moraines
Position on the landform: Swales
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)
Content of organic matter 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

- Cathro and similar soils
- Mahkonce and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Augsburg Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Coarse-silty over clayey, mixed over smectitic, superactive, frigid Typic Calciaquolls

Typical Pedon

Augsburg very fine sandy loam, 300 feet east and 2,550 feet north of the southwest corner of sec. 11, T. 147 N., R. 46 W.

Ap—0 to 12 inches; black (2.5Y 2.5/1) very fine sandy loam, very dark gray (2.5Y 3/1) dry; weak fine subangular blocky structure; friable; common very fine and fine roots; few fine irregularly shaped white (2.5Y 8/2) masses of carbonate; slightly effervescent; moderately alkaline; abrupt smooth boundary.

BAk—12 to 19 inches; 60 percent grayish brown (2.5Y 5/2) and 40 percent black (2.5Y 2.5/1) very fine sandy loam; common fine and medium

distinct light yellowish brown (2.5Y 6/4) redoximorphic concentrations; weak fine subangular blocky structure; friable; common very fine and fine roots; few fine irregularly shaped white (2.5Y 8/2) masses of carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—19 to 25 inches; dark grayish brown (2.5Y 4/2) very fine sandy loam; common fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak fine subangular blocky structure; friable; common very fine and fine roots; common fine and medium irregularly shaped white (2.5Y 8/2) masses of carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bg1—25 to 39 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; common fine and medium distinct light yellowish brown (2.5Y 6/4) and prominent yellowish brown (10YR 5/8) redoximorphic concentrations; moderate fine and medium subangular blocky structure; friable; common very fine and fine roots; common fine and medium irregularly shaped white (2.5Y 8/2) masses of carbonate and few fine rounded black (2.5Y 2.5/1) iron-manganese concretions; strongly effervescent; slightly alkaline; abrupt smooth boundary.

2Bg2—39 to 54 inches; dark olive gray (5Y 3/2) clay; massive; firm; common fine rounded and irregularly shaped white (2.5Y 8/2) masses of carbonate; 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg1—54 to 68 inches; olive gray (5Y 4/2) clay; massive; firm; common fine rounded and irregularly shaped white (2.5Y 8/2) masses of carbonate; 4 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg2—68 to 80 inches; olive gray (5Y 4/2) clay; massive; firm; common fine faint olive (5Y 5/3) redoximorphic concentrations; common fine rounded white (2.5Y 8/2) masses of carbonate; 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Thickness of sandy or loamy material: 20 to 40 inches
Content of rock fragments: Typically none in the upper material; 0 to 5 percent gravel in the 2Cg horizon

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

BAk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Texture—loam, very fine sandy loam, silt loam, or loamy very fine sand

Bk horizon:
Hue—10YR, 2.5Y, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—loamy very fine sand, very fine sandy loam, silt loam, or loam

Bg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loamy very fine sand, very fine sandy loam, silt loam, very fine sand, or loam

2Bg and 2Cg horizons:
Hue—2.5Y or 5Y
Value—3 to 6
Chroma—1 or 2
Texture—clay or silty clay; thin strata of very fine sandy loam, silt loam, or loamy very fine sand in some pedons

1297—Augsburg very fine sandy loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Flats and swales
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Very fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.8 inches (high)
Content of organic matter 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

- Glyndon and similar soils
- Wheatville and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Bearden Series

Depth class: Very deep
Drainage class: Somewhat poorly drained and moderately well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Lacustrine sediments
Slope range: 0 to 6 percent
Taxonomic classification: Fine-silty, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon

Bearden silty clay loam, in an area of Bearden-Fargo complex, 1,805 feet west and 2,275 feet south of the northeast corner of sec. 6, T. 150 N., R. 48 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—10 to 17 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; very friable; few fine roots; common very dark gray (10YR 3/1) coatings of organic matter on ped exteriors; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—17 to 26 inches; light olive brown (2.5Y 5/4) silt loam; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; few fine irregularly shaped light gray (10YR 7/1) masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

C1—26 to 43 inches; light olive brown (2.5Y 5/4) silt loam; few medium prominent dark brown (7.5YR 4/4) redoximorphic concentrations; moderate medium platy structure; friable; slightly effervescent; slightly alkaline; clear smooth boundary.

C2—43 to 58 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent dark brown (7.5YR 4/4) redoximorphic concentrations; weak medium platy structure; friable; slightly effervescent; slightly alkaline; clear smooth boundary.

C3—58 to 71 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) and few fine prominent brownish yellow (10YR 6/8) redoximorphic concentrations; weak medium platy structure parting to weak medium subangular blocky; friable; few fine irregularly shaped white (2.5Y 8/2) masses of carbonate and few fine rounded black (2.5Y 2.5/1) iron-manganese concretions; strongly effervescent; slightly alkaline; clear smooth boundary.

C4—71 to 82 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; weak medium platy structure; friable; few fine irregularly shaped white (2.5Y 8/2) masses of carbonate and few fine rounded black (2.5Y 2.5/1) iron-manganese concretions; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches

Ap horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silt loam

Bk horizon:
Hue—10YR or 2.5Y
Value—3 to 7
Chroma—1 to 4

C horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Other features—strata of very fine sand in some pedons

67A—Bearden silt loam, 0 to 2 percent slopes

Composition

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

Setting

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

Component Description

Texture of the surface layer: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)
Content of organic matter 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

- Colvin and similar soils
- Fargo and similar soils
- Glyndon and similar soils
- Wheatville and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

67B—Bearden silt loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Lake plains
Position on the landform: Rises
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)
Content of organic matter 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

- Colvin and similar soils
- Zell and similar soils
- Glyndon and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

93A—Bearden silty clay loam, 0 to 2 percent slopes

Composition

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

Setting

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

Component Description

Texture of the surface layer: Silty clay loam

Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)
Content of organic matter 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

- Colvin and similar soils
- Fargo and similar soils
- Glyndon and similar soils
- Wheatville and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

908—Bearden-Fargo complex

Composition

Bearden and similar soils: About 50 percent
Fargo and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Bearden—slight rises; Fargo—flats and swales
Slope range: Bearden—0 to 2 percent; Fargo—0 to 1 percent

Component Description

Bearden

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)
Content of organic matter in the surface layer: About 5 percent (high)

Fargo

Texture of the surface layer: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter in the surface layer: About 7 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

- Hegne and similar soils
- Colvin and similar soils
- Perella and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

1963—Bearden-Colvin complex

Composition

Bearden and similar soils: About 50 percent
Colvin and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Bearden—flats and slight rises; Colvin—swales (fig. 10)
Slope range: Bearden—0 to 2 percent; Colvin—0 to 1 percent

Figure 10.—A typical area of Bearden-Colvin complex. The Bearden soil is in the light-colored areas, and the poorly drained Colvin soil is in the darker areas. These soils account for almost 200,000 acres in Polk County.

Component Description

Bearden

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)
Content of organic matter in the surface layer: About 5 percent (high)

Colvin

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter 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

- Fargo and similar soils
- Perella and similar soils
- Hegne and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Berner Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderate; middle part—rapid; lower part—moderate or moderately slow
Landform: Lake plains
Parent material: Organic materials over glaciolacustrine deposits and till
Slope range: 0 to 1 percent
Taxonomic classification: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Berner muck, 1,800 feet west and 1,250 feet north of the southeast corner of sec. 33, T. 149 N., R. 44 W.

Oa1—0 to 12 inches; black (10YR 2/1) muck; weak medium platy structure parting to weak fine subangular blocky; very friable; many fine roots; neutral; clear wavy boundary.
Oa2—12 to 32 inches; black (10YR 2/1) muck; weak medium subangular blocky structure; very friable; few fine roots; neutral; clear smooth boundary.
A—32 to 36 inches; very dark gray (10YR 3/1) sandy loam; common fine faint dark gray (10YR 4/1) redoximorphic depletions; massive; friable; 2 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
Bg—36 to 45 inches; grayish brown (2.5Y 5/2) sand; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose; 6 percent gravel; slightly effervescent; slightly alkaline; abrupt wavy boundary.
2Cg1—45 to 58 inches; olive gray (5Y 5/2) fine sandy loam; common medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; massive; firm; 5 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.
2Cg2—58 to 69 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; massive; firm; few fine irregularly shaped white (10YR 8/1) masses of carbonate; 5 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.
2Cg3—69 to 80 inches; light brownish gray (2.5Y 6/2) fine sandy loam; many medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; massive; firm; 5 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to 2C material and carbonates: 30 to 45 inches
Thickness of the organic material: 16 to 34 inches
Content of rock fragments: 0 to 10 percent gravel in the mineral horizons

Oa horizon:
Hue—10YR or 7.5YR
Value—2 to 4
Chroma—1 to 3
Texture—fiber content of the muck is 10 to 40 percent unrubbed and 0 to 10 percent rubbed; layers of mucky peat less than 10 inches thick in some pedons

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 to 4
Chroma—0 to 2
Texture—sandy loam, fine sandy loam, or loamy fine sand

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—sand, fine sand, loamy sand, or loamy fine sand

2Cg horizon:
Value—4 to 6
Chroma—1 or 2
Texture—fine sandy loam, loam, clay loam, or sandy loam

733—Berner muck

Composition

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

Setting

Landform: Lake plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches

Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits and till
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 17.2 inches (high)
Content of organic matter in the surface layer: About 87.5 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

- Northwood and similar soils
- Seelyeville and similar soils
- Cathro and similar soils
- Markey and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- "Wildlife Habitat" section

Borup Series

Depth class: Very deep
Drainage class: Very poorly drained and poorly drained
Permeability: Moderately rapid
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-silty, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Borup very fine sandy loam, 1,150 feet east and 1,200 feet south of the northwest corner of sec. 16, T. 150 N., R. 46 W.

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

Bkg—10 to 22 inches; gray (10YR 5/1) very fine sandy loam; weak medium subangular blocky structure; very friable; few fine irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Cg1—22 to 40 inches; grayish brown (2.5Y 5/2) loamy very fine sand; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; massive; very friable; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—40 to 57 inches; light brownish gray (2.5Y 6/2) very fine sand; common medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; massive; very friable; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg3—57 to 71 inches; light gray (2.5Y 7/2) very fine sand; common fine and medium prominent brownish yellow (10YR 6/8) and few medium prominent yellow (10YR 8/8) redoximorphic concentrations; massive; very friable; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg4—71 to 80 inches; light gray (5Y 7/1) very fine sand; common fine and medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; very friable; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—very fine sandy loam or loam

Bkg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loamy very fine sand, very fine sandy loam, loam, or silt loam

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 7
Chroma—0 to 3
Texture—very fine sand, loamy very fine sand, very fine sandy loam, loam, or silt loam

348—Borup loam, depressional

Composition

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

Setting

Landform: Lake plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 11.0 inches (high)
Content of organic matter 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

- Augsburg and similar soils
- Glyndon and similar soils
- Rosewood and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

1299—Borup very fine sandy loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Flats and swales
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Very fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Augsburg and similar soils
- Glyndon and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Bowstring Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Landform: Flood plains
Parent material: Organic material and alluvium
Slope range: 0 to 1 percent
Taxonomic classification: Euic Fluvaquentic Borosaprists

Typical Pedon

Bowstring muck, in an area of Bowstring-Fluvaquents complex, frequently flooded, 250 feet south and 220 feet east of the northwest corner of sec. 3, T. 151 N., R. 39 W.

Oa1—0 to 9 inches; black (10YR 2/1) muck, very dark gray (10YR 3/1) crushed and dry; weak fine granular structure; loose; many fine roots; very

slightly effervescent; slightly alkaline; abrupt wavy boundary.

Oa2—9 to 19 inches; black (10YR 2/1) muck, dark gray (10YR 4/1) dry; common fine prominent yellowish red (5YR 5/6) redoximorphic concentrations; weak fine subangular blocky structure; very friable; common fine roots; common prominent light brownish gray (10YR 6/2) discontinuous skeletans (sand) on horizontal faces of peds; very slightly effervescent; slightly alkaline; abrupt smooth boundary.

C—19 to 20 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; common fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

O´a—20 to 30 inches; black (10YR 2/1) muck; common fine prominent yellowish red (5YR 5/6) redoximorphic concentrations; weak medium platy structure parting to weak medium subangular blocky; very friable; common fine roots; many snail shells; common prominent light brownish gray (10YR 6/2) discontinuous skeletans (sand) on horizontal faces of peds; neutral; abrupt smooth boundary.

C´—30 to 31 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; neutral; abrupt smooth boundary.

O´´a—31 to 65 inches; black (10YR 2/1) muck; few thin layers of light brownish gray (2.5Y 6/2) fine sand; weak medium platy structure parting to weak fine subangular blocky; very friable; neutral; abrupt smooth boundary.

C´´—65 to 77 inches; light brownish gray (10YR 6/2) fine sand; few fine distinct light yellowish brown (10YR 6/4) redoximorphic concentrations; weak thin platy structure; friable; neutral; clear smooth boundary.

C´´´—77 to 87 inches; grayish brown (2.5Y 5/2) fine sand; weak medium platy structure; friable; neutral.

Range in Characteristics

Thickness of the organic material: More than 51 inches

Oa horizon:
Hue—5YR, 7.5YR, or 10YR
Value—2 or 3
Chroma—1 or 2

C horizon:
Hue—7.5YR, 10YR, 2.5Y, or 5Y
Value—2 to 6
Chroma—1 to 3
Texture—fine sand, sand, or loamy sand

1325—Bowstring-Fluvaquents complex, frequently flooded

Composition

Bowstring and similar soils: About 45 percent
Fluvaquents and similar soils: About 45 percent
Inclusions: About 10 percent

Setting

Landform: Flood plains
Position on the landform: Flats
Slope range: Bowstring—0 to 1 percent; Fluvaquents—0 to 2 percent

Component Description

Bowstring

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic material and alluvium
Flooding: Frequent
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)
Content of organic matter in the surface layer: About 65 percent (very high)

Fluvaquents

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over alluvium
Flooding: Frequent
Water table depth: 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 7.0 inches (moderate)
Content of organic matter in the surface layer: About 6.5 percent (high)

Taxonomic unit descriptions with range in characteristics are 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

- Hamar and similar soils
- Hangaard and similar soils
- Hedman and similar soils
- Rosewood and similar soils
- Kratka and similar soils

Major Uses of the Unit

- Wildlife habitat
- Hayland
- Pasture

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

- “Agronomy” section
- “Wildlife Habitat” section

Brandsvold Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, superactive, frigid Typic Argiaquolls

Typical Pedon

Brandsvold loam, 1,320 feet west and 1,450 feet south of the northeast corner of sec. 18, T. 148 N., R. 43 W.

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

Btg—10 to 19 inches; grayish brown (2.5Y 5/2) sandy clay loam; common fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots in cracks; few faint very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 5 percent gravel; neutral; clear wavy boundary.

Bkg—19 to 36 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common medium prominent light olive brown (2.5Y 5/6) and few medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; weak thin platy structure; friable; few fine roots in cracks; few distinct light gray (10YR 7/2) carbonate coatings on horizontal faces of peds; 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg1—36 to 52 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common fine distinct light olive brown (2.5Y 5/4) and common medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; weak medium platy soil fragments; friable; few very fine roots in cracks; few distinct light gray (10YR 7/1) carbonate coatings on horizontal faces of soil fragments; 5 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—52 to 68 inches; light yellowish brown (2.5Y 6/3) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; weak thin and medium platy soil fragments parting to weak fine subangular blocky; firm; few distinct light gray (10YR 7/1) carbonate coatings on horizontal faces of soil fragments; 4 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg3—68 to 80 inches; light yellowish brown (2.5Y 6/3) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) redoximorphic concentrations; moderate medium platy soil fragments parting to weak fine subangular blocky; firm; few distinct light gray (10YR 7/1) carbonate coatings on horizontal faces of soil fragments; 4 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 2 to 12 percent gravel throughout
Other features: Some pedons have an E horizon 2 to 6 inches thick. Also, some pedons have a BC horizon, and some pedons do not have a Bk horizon.

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Btg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 6
Chroma—0 to 3
Texture—sandy clay loam, fine sandy loam, sandy loam, or loam

Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 3

Texture—fine sandy loam, loam, or sandy loam

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 to 4
Texture—fine sandy loam, loam, or sandy loam

681—Brandsvold loam

Composition

Brandsvold 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

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)
Content of organic matter 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

- Fram and similar soils
- Hamre and similar soils
- Knute and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Bygland Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow or slow
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 12 percent
Taxonomic classification: Fine, smectitic Aquertic Argiborolls

Typical Pedon

Bygland silty clay loam, 0 to 2 percent slopes, 1,100 feet east and 100 feet north of the southwest corner of sec. 11, T. 148 N., R. 49 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 15 inches; very dark grayish brown (10YR 3/2) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate fine angular blocky; firm; common fine roots; many faint very dark brown (10YR 2/2) clay films on faces of peds; neutral; clear wavy boundary.

Bt2—15 to 29 inches; brown (10YR 4/3) silty clay; common fine faint dark yellowish brown (10YR 4/4) redoximorphic concentrations; moderate coarse subangular blocky structure; firm; few very fine roots; many faint dark grayish brown (10YR 4/2) clay films on faces of peds; slightly alkaline; gradual wavy boundary.

BC—29 to 37 inches; brown (10YR 5/3) silty clay; common fine faint light gray (10YR 7/2) redoximorphic depletions and many fine distinct brown (7.5YR 5/4) redoximorphic concentrations; moderate thin platy structure; friable; few very fine roots; slightly effervescent; moderately alkaline; gradual wavy boundary.

C1—37 to 47 inches; grayish brown (10YR 5/2) silty clay loam; common fine faint light gray (10YR 7/2) redoximorphic depletions and many fine prominent brownish yellow (10YR 6/6) redoximorphic concentrations; moderate medium platy soil fragments (varving); firm; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—47 to 80 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct light gray (10YR 7/2) redoximorphic depletions and many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate thick

platy soil fragments (varving); firm; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Other features: Some pedons have a Bk horizon.

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Bt horizon:
Hue—10YR or 2.5Y
Value—2 to 4
Chroma—2 to 4
Texture—silty clay, clay, or silty clay loam

BC horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 5
Texture—silty clay, silty clay loam, or silt loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—2 to 4
Other features—lenses of loamy very fine sand or very fine sand

422A—Bygland silty clay loam, 0 to 2 percent slopes

Composition

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

Setting

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

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter 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

- Lindaas and similar soils
- Bearden and similar soils
- Overly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

422B—Bygland silty clay loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Lake plains
Position on the landform: Rises
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Lindaas and similar soils
- Bearden and similar soils
- Overly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

422C2—Bygland silty clay loam, 6 to 12 percent slopes, eroded

Composition

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

Setting

Landform: Lake plains
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Lindaas and similar soils
- Zell and similar soils
- Fairdale and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Cathro Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderately rapid to moderately slow; lower part—moderate or moderately slow
Landform: Moraines and lake plains
Parent material: Organic materials and till
Slope range: 0 to 1 percent
Taxonomic classification: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 2,330 feet west and 1,450 feet north of the southeast corner of sec. 10, T. 151 N., R. 39 W.

Op—0 to 10 inches; black (5YR 2/1) muck; about 30 percent fiber, 10 percent rubbed; weak fine granular structure; nonsticky; neutral; clear wavy boundary.

Oa1—10 to 24 inches; black (5YR 2/1) muck; about 25 percent fiber, 5 percent rubbed; weak medium platy structure parting to weak medium subangular blocky; nonsticky; slightly acid; clear smooth boundary.

Oa2—24 to 42 inches; black (10YR 2/1) muck; about 2 percent fiber, trace rubbed; weak fine and medium subangular blocky structure; nonsticky; neutral; abrupt smooth boundary.

A—42 to 46 inches; black (2.5Y 2.5/1) loam; massive; friable; 1 percent gravel; slightly alkaline; clear wavy boundary.

Cg1—46 to 62 inches; olive gray (5Y 5/2) loam; common medium prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations;

massive; friable; 4 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—62 to 70 inches; gray (5Y 5/1) loam; common medium prominent yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; massive; firm; few discontinuous prominent black (2.5Y 2.5/1) manganese stains on faces of peds and in pores; 2 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg3—70 to 82 inches; grayish brown (2.5Y 5/2) loam; common coarse prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; firm; few discontinuous prominent black (2.5Y 2.5/1) manganese stains on faces of peds and in pores; 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Content of rock fragments: 1 to 4 percent gravel in the underlying material

O horizons:
Hue—5YR, 7.5YR, 10YR, or neutral
Value—2 or 3
Chroma—0 to 3

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam, sandy loam, or fine sandy loam

C horizons:
Hue—5YR, 7.5YR, 10YR, 2.5Y, 5Y, 5GY, or 5BG
Value—4 to 6
Chroma—1 to 3
Texture—sandy loam, fine sandy loam, loam, or clay loam

544—Cathro muck

Composition

Cathro 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

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials and till
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 21.9 inches (high)
Content of organic matter in the surface layer: About 72.5 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

- Berner and similar soils
- Seelyeville and similar soils
- Hedman and similar soils
- Roliss and similar soils
- Hamre and similar soils

Major Uses of the Unit

- Wildlife habitat
- Cropland
- Pasture

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

- “Wildlife Habitat” section
- “Agronomy” section

Chapett Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 40 percent
Taxonomic classification: Fine-loamy, mixed, superactive Boralfic Udic Argiborolls

Typical Pedon

Chapett fine sandy loam (fig. 11), 2 to 6 percent

slopes, 1,820 feet east and 2,220 feet north of the southwest corner of sec. 29, T. 148 N., R. 43 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure parting to weak fine granular; friable; few fine roots; 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—8 to 13 inches; dark brown (10YR 4/3) sandy clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; many light brownish gray (10YR 6/2) sand and silt coatings on ped faces when dry; common faint dark brown (10YR 3/3) clay films on ped exteriors; 4 percent gravel; slightly acid; gradual irregular boundary.

Bt2—13 to 19 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; common faint dark yellowish brown (10YR 3/4) clay films on ped exteriors; 4 percent gravel; neutral; gradual wavy boundary.

Bk—19 to 30 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak thin platy structure; friable; common prominent light gray (10YR 7/2) carbonate threads and masses; 8 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

BCk—30 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; moderate coarse prismatic soil fragments parting to moderate medium platy; friable; few prominent light gray (10YR 7/2) carbonate threads and masses; 10 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—60 to 80 inches; light yellowish brown (2.5Y 6/3) fine sandy loam; moderate coarse prismatic soil fragments parting to moderate thick platy; firm; common discontinuous distinct dark yellowish brown (10YR 4/4) iron stains on fractures; common medium distinct light gray (10YR 7/2) carbonate coatings on faces of fragments; 8 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 22 inches
Thickness of the mollic epipedon: 7 to 10 inches
Content of rock fragments: 2 to 10 percent gravel
Other features: Some pedons have a thin E or BE horizon.

Ap horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—sandy clay loam, fine sandy loam, loam, or sandy loam

Bk and BCk horizons:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 6
Texture—fine sandy loam, loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 6
Texture—fine sandy loam, loam, or sandy loam

20B—Chapett fine sandy loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Fine sandy 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)
Content of organic matter 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

- Brandsvold and similar soils
- Halverson and similar soils
- Esmond and similar soils
- Knute and similar soils
- Hamre and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

20C2—Chapett fine sandy loam, 6 to 12 percent slopes, eroded

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Fine sandy 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter 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

- Halverson and similar soils
- Esmond and similar soils
- Brandsvold and similar soils
- Knute and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

20D2—Chapett fine sandy loam, 12 to 20 percent slopes, eroded

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Fine sandy 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)
Content of organic matter 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

- Brandsvold and similar soils
- Esmond and similar soils
- Halverson and similar soils
- Heimdal and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

20E—Chapett fine sandy loam, 20 to 40 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits, backslopes, and shoulder slopes
Slope range: 20 to 40 percent

Component Description

Texture of the surface layer: Fine sandy 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter 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

- Brandsvold and similar soils
- Esmond and similar soils
- Halverson and similar soils
- Heimdal and similar soils

Major Uses of the Unit

- Forest land
- Wildlife habitat

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

- “Forest Land” section
- “Wildlife Habitat” section

Clearwater Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine, smectitic, frigid Typic Epiaquerts

Typical Pedon

Clearwater clay, 120 feet east and 1,870 feet south of the northwest corner of sec. 7, T. 149 N., R. 45 W.

Ap—0 to 10 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderately fine subangular blocky; friable; few very fine roots; 2 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bssg1—10 to 17 inches; olive gray (5Y 4/2) clay; few fine distinct olive (5Y 4/4) redoximorphic concentrations; moderate medium prismatic structure parting to moderate very fine angular blocky; firm; 4 percent gravel; few intersecting slickensides tilted less than 45 degrees from the horizontal; cracks 1/2 inch to 3 inches wide and 2 to 4 feet apart filled with material from the A horizon; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bssg2—17 to 30 inches; olive gray (5Y 4/2) clay; few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; moderate medium prismatic structure parting to moderate very fine angular blocky; firm; 4 percent gravel; few intersecting slickensides tilted less than 60 degrees from the horizontal; cracks 1/4 to 1 inch wide and 2 to 4 feet apart filled with material from the A horizon; slightly effervescent; slightly alkaline; gradual wavy boundary.

Cg1—30 to 54 inches; olive gray (5Y 4/2) clay; few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; moderate medium angular blocky soil fragments; firm; 4 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.

Cg2—54 to 68 inches; olive gray (5Y 4/2) clay; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium angular blocky soil fragments; firm; 5 percent gravel; common fine white (10YR 8/1) carbonate threads; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg3—68 to 80 inches; olive gray (5Y 4/2) clay; few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; moderate fine and medium angular blocky soil fragments; firm; 3 percent gravel; common fine irregularly shaped white (10YR 8/1) masses of carbonate; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 2 to 8 percent gravel throughout

Ap horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay or loam

Bssg horizon:
Hue—2.5Y or 5Y
Value—3 to 5
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—stratified silty clay, clay, or silty clay loam below a depth of 36 inches in some pedons

641—Clearwater clay

Composition

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

Setting

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

Component Description

Texture of the surface layer: Clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Content of organic matter 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

- Reis and similar soils
- Espelie and similar soils
- Thiefriver and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

642—Clearwater loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter 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

- Huot and similar soils
- Wheatville and similar soils
- Reis and similar soils
- Espelie and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Colvin Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Landform: Lake plains, outwash channels, and flood plains
Parent material: Lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Colvin silty clay loam, 1,420 feet east and 500 feet north of the southwest corner of sec. 36, T. 152 N., R. 49 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—9 to 18 inches; dark gray (10YR 4/1) silty clay loam; weak medium subangular blocky structure; friable; few fine roots; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk2—18 to 24 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium faint light brownish gray (2.5Y 6/2) and few fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; massive; friable; few fine irregularly shaped light gray (10YR 7/2) threads of carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—24 to 54 inches; light brownish gray (2.5Y 6/2) silt loam; common medium prominent strong brown (7.5YR 5/6) and distinct olive brown (2.5Y 4/4) redoximorphic concentrations; moderate medium platy soil fragments; friable; slightly effervescent; slightly alkaline; gradual wavy boundary.

C2—54 to 65 inches; grayish brown (2.5Y 5/2) silt loam; many medium prominent dark yellowish brown (10YR 4/6) and dark reddish brown (5YR 3/2) redoximorphic depletions; moderate medium platy soil fragments; friable; slightly effervescent; slightly alkaline; gradual wavy boundary.

C3—65 to 80 inches; light brownish gray (2.5Y 6/2) silt loam; many medium and coarse prominent strong brown (7.5YR 5/6), common fine and medium dark reddish brown (10YR 3/3), and many fine prominent brownish yellow (10YR 6/8) redoximorphic concentrations; moderate medium platy soil fragments; friable; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silt loam

Bk horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 7
Chroma—0 to 2
Texture—silty clay loam or silt loam

C horizon:
Hue—2.5Y or 5Y
Value—3 to 6
Chroma—1 to 4
Texture—very fine sandy loam, silty clay loam, or silt loam below a depth of 40 inches in some pedons

47—Colvin silty clay loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Flats
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter 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

- Bearden and similar soils
- Perella and similar soils
- Fargo and similar soils
- Hegne and similar soils
- Nielsville and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

749—Colvin silt loam, occasionally flooded

Composition

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

Setting

Landform: Outwash channels and stream terraces
Position on the landform: Flats and swales
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: Occasional
Water table depth: 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 11.5 inches (high)
Content of organic matter 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

- Darnen and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

1866—Colvin-Perella complex

Composition

Colvin and similar soils: About 50 percent
Perella and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Colvin—flats; Perella—swales
Slope range: 0 to 1 percent

Component Description

Colvin

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

Perella

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Bearden and similar soils
- Fargo and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

1964—Colvin-Fargo complex

Composition

Colvin and similar soils: About 50 percent
Fargo and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Colvin—flats; Fargo—swales
Slope range: 0 to 1 percent

Component Description

Colvin

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

Fargo

Texture of the surface layer: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter in the surface layer: About 7 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

- Bearden and similar soils
- Hegne and similar soils
- Perella and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Darnen Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Colluvial material over glacial till
Slope range: 2 to 6 percent
Taxonomic classification: Fine-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon

Darnen loam, 2 to 6 percent slopes, 300 feet west and 2,000 feet south of the northeast corner of sec. 9, T. 144 N., R. 41 W. (Mahnomen County):

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky

structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—10 to 28 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; few fine roots; 1 percent gravel; neutral; clear smooth boundary.

Bw—28 to 38 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; few fine roots; 2 percent gravel; neutral; gradual smooth boundary.

BC—38 to 47 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; 4 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—47 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 24 to 48 inches
Content of rock fragments: 0 to 5 percent throughout

A horizons:
Value—2 or 3
Chroma—1 or 2

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 6
Texture—loam or clay loam

BC horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 6
Texture—loam or clay loam

C horizon:
Value—4 to 6
Chroma—2 to 6
Texture—loam or clay loam

494B—Darnen loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Footslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Colluvial material over till
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches (high)
Content of organic matter 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

- Brandsvold and similar soils
- Esmond and similar soils
- Hedman and similar soils
- Heimdal and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Deerwood Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Lake plains
Parent material: Organic material over glaciolacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Sandy, mixed, frigid Histic Humaquepts

Typical Pedon

Deerwood muck, 100 feet north and 1,600 feet east of the southwest corner of sec. 15, T. 151 N., R. 39 W.

Oa—0 to 14 inches; black (10YR 2/1) muck;

moderate very fine granular structure; friable; many very fine roots; slightly acid; abrupt smooth boundary.

A—14 to 21 inches; very dark gray (10YR 3/1) loamy fine sand; weak medium subangular blocky structure; very friable; few very fine roots; neutral; clear smooth boundary.

Cg1—21 to 35 inches; light brownish gray (2.5Y 6/2) loamy fine sand; few medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; few very fine roots; slightly effervescent; slightly alkaline; gradual wavy boundary.

Cg2—35 to 48 inches; grayish brown (2.5Y 5/2) sand; many medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 5 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

Cg3—48 to 63 inches; grayish brown (2.5Y 5/2) fine sand; few fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 1 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

Cg4—63 to 72 inches; grayish brown (2.5Y 5/2) fine sand; few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; single grain; loose; slightly effervescent; slightly alkaline; gradual wavy boundary.

Cg5—72 to 80 inches; grayish brown (2.5Y 5/2) fine sand; many medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 4 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 8 to 16 inches
Content of rock fragments: 0 to 35 percent gravel in the mineral soil material

Oa horizon:
Hue—10YR, 7.5YR, 5YR, or neutral
Value—2 or 3
Chroma—0 to 2

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loamy fine sand, fine sand, loamy sand, loamy coarse sand, sandy loam, coarse sandy loam, or sand or the mucky analogs of these textures

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—loamy fine sand, sand, coarse sand, fine sand, loamy coarse sand, or loamy sand or the gravelly analogs of these textures

547—Deerwood muck

Composition

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

Setting

Landform: Lake plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 70 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

- Markey and similar soils
- Rosewood and similar soils
- Syrene and similar soils

Major Uses of the Unit

- Wildlife habitat
- Cropland
- Pasture

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

- “Wildlife Habitat” section
- “Agronomy” section

Eckvoll Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—rapid; lower part—moderate
Landform: Moraines and lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Loamy, mixed, superactive Aquic Arenic Eutroboralfs

Typical Pedon

Eckvoll loamy fine sand, 75 feet north and 50 feet west of the southeast corner of sec. 21, T. 149 N., R. 40 W.

Ap—0 to 7 inches; 70 percent very dark grayish brown (10YR 3/2) and 30 percent dark brown (10YR 3/3) loamy fine sand; grayish brown (10YR 5/2) dry; few fine faint very pale brown (10YR 7/3) redoximorphic concentrations; weak medium granular structure; very friable; common fine roots; 1 percent gravel; slightly acid; abrupt smooth boundary.

E1—7 to 17 inches; 60 percent grayish brown (10YR 5/2) and 40 percent dark brown (10YR 4/3) fine sand; light brownish gray (10YR 6/2) dry; single grain; loose; common fine roots; 2 percent gravel; neutral; gradual wavy boundary.

E2—17 to 26 inches; 70 percent brown (10YR 5/3) and 30 percent dark yellowish brown (10YR 4/4) loamy fine sand; 70 percent light brownish gray (10YR 6/2) and 30 percent dark yellowish brown (10YR 4/4) dry; few fine faint dark grayish brown (10YR 4/2) redoximorphic depletions in the lower 2 inches of the horizon; weak fine and medium subangular blocky structure; very friable; few fine roots between peds; 1 percent gravel; neutral; clear wavy boundary.

2Bt—26 to 35 inches; 60 percent dark brown (10YR 4/3) and 40 percent dark yellowish brown (10YR 4/4) sandy clay loam; common fine faint dark grayish brown (10YR 4/2) redoximorphic depletions; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; few fine roots between peds; few distinct grayish brown (10YR 5/2) patchy skeletans (sand or silt) on vertical faces of peds; common very dark grayish brown (10YR 3/2) continuous and few dark brown (10YR 3/3) discontinuous clay films on faces of peds and in pores; 3 percent gravel; neutral; clear wavy boundary.

2C1—35 to 48 inches; 60 percent yellowish brown (10YR 5/4) and 30 percent grayish brown (2.5Y 5/2) fine sandy loam; common fine and medium distinct light brownish gray (10YR 6/2) and common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; weak thin platy structure; friable; few distinct very dark gray (10YR 3/1) patchy clay films in root channels and pores; 4 percent gravel; common fine irregular light gray (2.5Y 7/2) carbonate threads; strongly effervescent; moderately alkaline; clear smooth boundary.

2C2—48 to 61 inches; light brownish gray (10YR 6/2) fine sandy loam; common fine distinct brownish yellow (10YR 6/6) and few fine prominent yellowish red (5YR 4/6) redoximorphic concentrations; weak or moderate thin platy structure; friable; 5 percent gravel; common fine and medium irregular white (10YR 8/1) carbonate threads; strongly effervescent; moderately alkaline; clear smooth boundary.

2C3—61 to 72 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine prominent yellowish red (5YR 4/6) and common fine and medium distinct yellowish brown (10YR 5/4) redoximorphic concentrations; weak or moderate thin platy structure; friable; 5 percent gravel; common medium irregular white (10YR 8/1) carbonate threads; strongly effervescent; moderately alkaline; clear smooth boundary.

2C4—72 to 85 inches; light brownish gray (2.5Y 6/2) fine sandy loam; many medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; moderate thin platy structure; friable; 6 percent gravel; common medium irregular white (10YR 8/1) carbonate threads; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 48 inches
Content of rock fragments: 0 to 10 percent gravel throughout
Thickness of sandy material: 20 to 36 inches

A horizon:
Value—2 or 3
Chroma—1 to 3

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Texture—fine sand, loamy fine sand, sand, or loamy sand

2Bt horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6
Chroma—2 to 4

Texture—sandy clay loam, loam, or clay loam

2C horizon:
Value—4 to 6
Texture—fine sandy loam, loam, sandy loam, or clay loam

565—Eckvoll loamy fine sand

Composition

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

Setting

Landform: Lake plains and moraines
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 2.5 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)
Content of organic matter 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

- Kratka and similar soils
- Reiner and similar soils
- Halverson and similar soils
- Grimstad and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Esmond Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 20 percent
Taxonomic classification: Coarse-loamy, mixed, superactive Udic Calciborolls

Typical Pedon

Esmond loam, in an area of Heimdal-Esmond complex, 2 to 6 percent slopes, 450 feet east and 540 feet south of the northwest corner of sec. 31, T. 147 N., R. 40 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; few very fine roots; 5 percent gravel; few fine yellowish brown (10YR 5/4) masses of carbonate; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk—8 to 22 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; few very fine roots; 5 percent gravel; few fine irregularly shaped white (10YR 8/2) masses of carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

C1—22 to 53 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak thin platy soil fragments; friable; 5 percent gravel; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate on the lower surfaces of soil fragments; slightly effervescent; slightly alkaline; clear smooth boundary.

C2—53 to 67 inches; light olive brown (2.5Y 5/4) fine sandy loam; few fine prominent reddish brown (5YR 4/4) relict redoximorphic concentrations; weak thin platy soil fragments parting to weak fine subangular blocky; firm; 4 percent gravel; few fine irregularly shaped white (10YR 8/1) masses of carbonate on the lower surfaces of soil fragments; slightly effervescent; slightly alkaline; clear smooth boundary.

C3—67 to 80 inches; olive brown (2.5Y 4/4) fine sandy loam; few fine prominent strong brown (7.5YR 5/8) relict redoximorphic concentrations; weak thin platy soil fragments parting to weak fine subangular blocky; firm; 5 percent gravel; few fine irregularly shaped white (10YR 8/1) masses of carbonate on the lower surfaces of soil

fragments and few fine distinct black (2.5Y 2.5/1) manganese stains; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 14 inches
Content of rock fragments: 1 to 10 percent gravel throughout

Ap horizon:
Value—2 or 3

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, sandy loam, or fine sandy loam

C horizon:
Hue—10YR or 2.5Y
Chroma—2 to 4
Texture—loam, sandy loam, or fine sandy loam

1233D—Esmond-Heimdal complex, 12 to 20 percent slopes, eroded

Composition

Esmond and similar soils: About 60 percent
Heimdal and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Esmond—summits and shoulder slopes; Heimdal—backslopes
Slope range: 12 to 20 percent

Component Description

Esmond

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.6 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Heimdal

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter 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

- Hedman and similar soils
- Fram and similar soils
- Onstad and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Espelie Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Sandy over clayey, mixed over smectitic, frigid Typic Epiaquolls

Typical Pedon

Espelie fine sandy loam, 750 feet south and 1,410 feet west of the northeast corner of sec. 10, T. 147 N., R. 45 W.

Ap—0 to 9 inches; black (2.5Y 2.5/1) fine sandy loam, very dark gray (2.5Y 3/1) dry; moderate medium granular structure; friable; 2 percent gravel; slightly alkaline; abrupt smooth boundary.

Bw1—9 to 12 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; few fine distinct brown (10YR 5/3) redoximorphic concentrations and common fine distinct dark gray (10YR 4/1) redoximorphic depletions; weak medium subangular blocky

structure; very friable; 1 percent gravel; slightly alkaline; clear wavy boundary.

Bw2—12 to 22 inches; grayish brown (2.5Y 5/2) loamy fine sand; many medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations and few fine distinct dark gray (5Y 4/1) redoximorphic depletions; weak fine subangular blocky structure; very friable; 2 percent gravel; slightly alkaline; abrupt wavy boundary.

2Cg1—22 to 47 inches; gray (5Y 5/1) clay; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak very fine subangular blocky structure; firm; 4 percent gravel; strongly effervescent; slightly alkaline; clear wavy boundary.

2Cg2—47 to 66 inches; olive gray (5Y 4/2) clay; few fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; very firm; few medium irregular white (10YR 8/1) masses of carbonate; 3 percent gravel; strongly effervescent; slightly alkaline; clear wavy boundary.

2Cg3—66 to 80 inches; olive gray (5Y 4/2) clay; few fine prominent light yellowish brown (2.5Y 6/4) redoximorphic concentrations; massive; very firm; common medium irregular white (10YR 8/1) masses of carbonate; 3 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 1 to 10 percent gravel
Thickness of sandy material: 20 to 40 inches

Ap horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

Bg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loamy fine sand, loamy sand, fine sand, or sand

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Texture—clay, silty clay, clay loam, or silty clay loam

645—Espelie fine sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.8 inches (moderate)
Content of organic matter 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

- Thiefriver and similar soils
- Huot and similar soils
- Hilaire and similar soils
- Clearwater and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Fairdale Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains and terraces

Parent material: Alluvium
Slope range: 1 to 15 percent
Taxonomic classification: Fine-loamy, mixed, superactive, calcareous, frigid Mollic Udifluvents

Typical Pedon

Fairdale silt loam, 1,850 feet south and 250 feet east of the northwest corner of sec. 6, T. 155 N., R. 52 W. (Walsh County, North Dakota):

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; slightly effervescent; slightly alkaline; abrupt smooth boundary.

C1—7 to 10 inches; fine strata of dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; few large root channels; few wormcasts; few snail-shell fragments; slightly effervescent; slightly alkaline; abrupt smooth boundary.

C2—10 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine to medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; few large root channels; many fine pores; few wormcasts; few snail shells; slightly effervescent; moderately alkaline; clear smooth boundary.

C3—16 to 48 inches; dark grayish brown (2.5Y 4/2) and brown (10YR 5/3), stratified loam, silt loam, and very fine sandy loam, light brownish gray (2.5Y 6/2) and very pale brown (10YR 7/3) dry; few fine prominent brown (7.5YR 5/4) redoximorphic concentrations in the lower part; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few fine white (10YR 8/1) irregularly shaped masses of carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

Ab1—48 to 60 inches; very dark brown (10YR 2/2) and very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; few fine prominent brown (7.5YR 5/4) redoximorphic concentrations; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few roots and fine pores; slightly effervescent; moderately alkaline; clear smooth boundary.

Ab2—60 to 67 inches; black (10YR 2/1) and olive brown (2.5Y 4/3) silty clay loam, dark gray (10YR 4/1) dry; massive; hard, friable, sticky and plastic; many fine white (10YR 8/1) irregularly shaped masses of carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

C´—67 to 80 inches; dark brown (10YR 4/3) and grayish brown (2.5Y 5/2) silty clay loam, light yellowish brown (2.5Y 6/3) dry; massive; hard, firm, sticky and plastic; many fine white (10YR 8/1) irregularly shaped masses of carbonate; strongly effervescent; moderately alkaline.

Range in Characteristics

Ap horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

C horizon:
Chroma—1 to 4
Textures—loam, silt loam, clay loam, silty clay loam, very fine sandy loam, or fine sandy loam

667B—Fairdale silt loam, 1 to 6 percent slopes, occasionally flooded

Composition

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

Setting

Landform: Flood plains and terraces
Position on the landform: Rises
Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Alluvium
Flooding: Occasional
Water table depth: 3 to 5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 12.2 inches (high)
Content of organic matter 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

- Zell and similar soils
- Rauville and similar soils
- Fluvaquents and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

667C2—Fairdale silt loam, 6 to 15 percent slopes, eroded, occasionally flooded

Composition

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

Setting

Landform: Flood plains and terraces
Position on the landform: Rises and backslopes
Slope range: 6 to 15 percent

Component Description

Texture of the surface layer: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Alluvium
Flooding: Occasional
Water table depth: 3 to 5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 12.2 inches (high)
Content of organic matter 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

- Zell and similar soils
- Rauville and similar soils
- Fluvaquents and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Fargo Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic classification: Fine, smectitic, frigid Typic Epiaquerts

Typical Pedon

Fargo silty clay (fig. 12), in an area of Hegne-Fargo complex, 2,300 feet west and 2,150 feet north of the southeast corner of sec. 8, T. 152 N., R. 48 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few fine roots; neutral; abrupt smooth boundary.

Bssg—10 to 20 inches; olive gray (5Y 4/2) clay; few fine prominent olive brown (2.5Y 4/4) redoximorphic concentrations; moderate coarse prismatic structure parting to moderate fine angular blocky; firm; few fine roots; common black (10YR 2/1) coatings of organic matter in channels; common distinct black (5Y 2.5/1) slickensides on vertical faces of peds; neutral; gradual wavy boundary.

Cg1—20 to 28 inches; olive gray (5Y 5/2) clay; few fine prominent olive brown (2.5Y 4/4) redoximorphic concentrations; massive; firm; very sticky; slightly effervescent; moderately alkaline; clear wavy boundary.

Cg2—28 to 51 inches; olive gray (5Y 5/2) silty clay; common medium faint olive gray (5Y 4/2) and few medium prominent olive brown (2.5Y 4/4) redoximorphic concentrations; massive; firm; very sticky; slightly effervescent; moderately alkaline; clear wavy boundary.

Cg3—51 to 69 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish red (5YR 4/6) and common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate thick platy structure parting to moderate medium angular blocky; friable;

strongly effervescent; moderately alkaline; clear wavy boundary.

Cg4—69 to 80 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent yellowish red (5YR 4/6) and common medium prominent yellowish brown (10YR 5/4) redoximorphic concentrations; moderate thick platy structure; friable; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 11 to 25 inches
Thickness of the mollic epipedon: 8 to 24 inches
Other features: Some pedons have a Bkg horizon.

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Chroma—0 or 1

Bssg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 or 4
Chroma—1 or 2
Texture—clay or silty clay

Cg horizon:
Value—3 to 6
Chroma—1 to 3

57A—Fargo silty clay, 0 to 1 percent slopes

Composition

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

Setting

Landform: Lake plains
Position on the landform: Flats and swales
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter in the surface layer: About 7 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

- Colvin and similar soils
- Hegne and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

1871—Fargo silty clay, swales

Composition

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

Setting

Landform: Lake plains
Position on the landform: Swales and depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot above to 1.0 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter 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

- Colvin and similar soils
- Perella and similar soils
- Hegne and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Flaming Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 3 percent
Taxonomic classification: Sandy, mixed Aquic Haploborolls

Typical Pedon

Flaming loamy fine sand, 550 feet east and 110 feet south of the northwest corner of sec. 25, T. 149 N., R. 42 W.

Ap—0 to 12 inches; black (10YR 2/1) loamy fine sand, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; few fine roots; neutral; clear wavy boundary.

Bw1—12 to 28 inches; dark brown (10YR 3/3) fine sand; weak fine subangular blocky structure; very friable; few fine roots; neutral; clear wavy boundary.

Bw2—28 to 36 inches; brown (10YR 4/3) fine sand; few fine distinct dark yellowish brown (10YR 4/6) redoximorphic concentrations; weak medium subangular blocky structure; loose; neutral; clear wavy boundary.

C1—36 to 45 inches; light olive brown (2.5Y 5/4) fine sand; common medium prominent yellowish brown (10YR 4/6) and few fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; single grain; loose; neutral; clear wavy boundary.

C2—45 to 56 inches; grayish brown (2.5Y 5/2) fine sand; common medium prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; single grain; loose; neutral; clear wavy boundary.

C3—56 to 67 inches; light yellowish brown (2.5Y 6/4) fine sand; common fine and medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; single grain; loose; neutral; clear wavy boundary.

C4—67 to 80 inches; gray (5Y 6/1) fine sand; common medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 80 inches
Thickness of the mollic epipedon: 10 to 16 inches

Ap horizon:
Value—2 or 3
Chroma—1 or 2

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—fine sand, loamy fine sand, loamy sand, or sand

C horizon:
Value—4 to 6
Texture—fine sand or sand

66—Flaming loamy fine sand

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 5.3 inches (low)
Content of organic matter 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

- Hamar and similar soils

- Ulen and similar soils
- Sandberg and similar soils
- Grimstad and similar soils
- Huot and similar soils
- Radium and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Fluvaquents

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or rapid
Landform: Flood plains
Parent material: Recent alluvium
Slope range: 0 to 2 percent
Taxonomic classification: Loamy Fluvaquents

Typical Pedon

Fluvaquents, in an area of Bowstring-Fluvaquents complex, frequently flooded, 1,700 feet west and 650 feet south of the northeast corner of sec. 33, T. 149 N., R. 41 W.

A—0 to 11 inches; black (N 2.5/0) fine sandy loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; few strata of dark grayish brown (2.5Y 4/2) loamy sand 1/4 to 1/2 inch thick; many very fine and fine roots; slightly alkaline; clear smooth boundary.

Cg—11 to 17 inches; grayish brown (2.5Y 5/2) loamy fine sand; common fine distinct light olive yellow (2.5Y 5/6) redoximorphic concentrations; weak fine subangular blocky structure; very friable; common very fine roots; neutral; abrupt smooth boundary.

Ab—17 to 19 inches; very dark gray (2.5Y 3/1) silt loam; weak thin platy structure; very friable; slightly effervescent; slightly alkaline; abrupt smooth boundary.

C´g1—19 to 33 inches; dark gray (5Y 4/1) loamy sand; common medium prominent light olive yellow (2.5Y 5/6) redoximorphic concentrations; single grain; loose; slightly alkaline; clear smooth boundary.

C´g2—33 to 37 inches; light brownish gray (2.5Y 6/2) fine sandy loam; weak fine subangular blocky structure; very friable; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A´b—37 to 39 inches; dark olive brown (2.5Y 3/3) fine sandy loam; weak fine subangular blocky structure; very friable; strongly effervescent; slightly alkaline; abrupt smooth boundary.

C´´g—39 to 60 inches; light brownish gray (2.5Y 6/2) loamy sand; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to more than 60 inches

A horizon:
Hue—2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—fine sandy loam, silt loam, or very fine sandy loam or the mucky analogs of these textures

Cg horizons:
Hue—2.5Y, 5Y, or neutral
Value—2 to 6
Chroma—0 to 2
Texture—variable

Ab horizons:
Hue—2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—variable

1006—Fluvaquents-Haploborolls complex, 0 to 30 percent slopes

Composition

Fluvaquents and similar soils: About 45 percent
Haploborolls and similar soils: About 45 percent
Inclusions: About 10 percent

Setting

Landform: Flood plains
Position on the landform: Fluvaquents—flats and swales; Haploborolls—backslopes and shoulder slopes
Slope range: Fluvaquents—0 to 2 percent; Haploborolls—2 to 30 percent

Component Description

Fluvaquents

Texture of the surface layer: Very fine sandy loam

Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Flooding: Frequent
Water table depth: 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 9.4 inches (high)
Content of organic matter in the surface layer: About 6.5 percent (high)

Haploborolls

Texture of the surface layer: Clay loam
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: Rare
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches (high)
Content of organic matter in the surface layer: About 2 percent (moderate)

Taxonomic unit descriptions with range in characteristics are 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

- Rauville and similar soils
- Fairdale and similar soils
- Zell and similar soils

Major Uses of the Unit

- Hayland
- Pasture
- Wildlife habitat

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

- “Agronomy” section
- “Wildlife Habitat” section

Foldahl Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—rapid; lower part—moderately slow or moderate
Landform: Moraines and lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Sandy over loamy, mixed, superactive Aquic Haploborolls

Typical Pedon

Foldahl loamy fine sand, 120 feet north and 510 feet west of the southeast corner of sec. 15, T. 147 N., R. 45 W.

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

A—9 to 12 inches; very dark brown (10YR 2/2) loamy fine sand; weak fine subangular blocky structure; very friable; neutral; few fine roots; gradual wavy boundary.

Bw1—12 to 22 inches; dark brown (10YR 3/3) fine sand; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.

Bw2—22 to 30 inches; dark brown (10YR 4/3) fine sand; few fine distinct yellowish brown (10YR 5/6) redoximorphic concentrations and few fine faint grayish brown (10YR 5/2) redoximorphic depletions; single grain; loose; neutral; gradual wavy boundary.

2C1—30 to 44 inches; light brownish gray (2.5Y 6/2) fine sandy loam; few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; massive; friable; 8 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C2—44 to 58 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak thin platy soil fragments; friable; 8 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.

2C3—58 to 70 inches; grayish brown (2.5Y 5/2) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; weak thin platy soil fragments; firm; 5 percent gravel; common fine irregularly shaped white (10YR 8/1) masses of carbonate; slightly effervescent; moderately alkaline; clear wavy boundary.

2C4—70 to 83 inches; light olive brown (2.5Y 5/3) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak thin platy soil fragments; firm; 6 percent gravel; few fine

irregularly shaped white (10YR 8/1) masses of carbonate and few fine black (10YR 2/1) manganese stains; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 32 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 5 to 15 percent gravel in the underlying till
Thickness of sandy material: 20 to 40 inches
Other features: Some pedons have a C horizon in the sandy sediment.

A horizon:
Value—2 or 3

Bw horizon:
Chroma—2 to 4
Texture—fine sand, sand, loamy sand, or loamy fine sand

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 to 4
Texture—fine sandy loam, loam, or sandy loam

426—Foldahl loamy fine sand

Composition

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

Setting

Landform: Lake plains and moraines
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 2.5 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)
Content of organic matter 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

- Kratka and similar soils
- Fram and similar soils
- Halverson and similar soils
- Grimstad and similar soils
- Foxhome and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Foxhome Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderately rapid; middle part—rapid; lower part—moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Sandy-skeletal over loamy, mixed, superactive Aquic Haploborolls

Typical Pedon

Foxhome sandy loam, 600 feet north and 600 feet west of the southeast corner of sec. 30, T. 148 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; few very fine roots; 2 percent gravel; neutral; clear wavy boundary.
Bw1—10 to 15 inches; dark brown (10YR 3/3) loamy sand; weak fine subangular blocky structure parting to weak fine granular; very friable; few fine roots; 5 percent gravel; neutral; abrupt wavy boundary.
2Bw2—15 to 23 inches; brown (10YR 5/3) very gravelly coarse sand; single grain; loose; 40 percent gravel; slightly alkaline; abrupt smooth boundary.
3C1—23 to 54 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common fine prominent

yellowish brown (10YR 5/6) redoximorphic concentrations; massive; friable; 2 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

3C2—54 to 69 inches; light yellowish brown (2.5Y 6/3) fine sandy loam; common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; weak and moderate fine and medium subangular blocky soil fragments; friable; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; strongly effervescent; slightly alkaline; clear smooth boundary.

3C3—69 to 80 inches; light yellowish brown (2.5Y 6/3) fine sandy loam; common fine and medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; moderate medium subangular blocky soil fragments; firm; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Thickness of the mollic epipedon: 10 to 16 inches
Thickness of sandy material: 20 to 40 inches

Ap horizon:
Value—2 or 3
Chroma—1 or 2
Content of rock fragments—0 to 15 percent gravel

Bw horizon:
Value—3 or 4
Chroma—2 or 3
Texture—loamy sand, sandy loam, or loam
Content of rock fragments—0 to 15 percent gravel

2Bw horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—very gravelly coarse sand, very gravelly loamy sand, or very gravelly sand
Content of rock fragments—35 to 70 percent gravel

3C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Texture—fine sandy loam, loam, sandy loam, or clay loam
Content of rock fragments—1 to 15 percent gravel

65—Foxhome sandy loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter 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

- Mavie and similar soils
- Fram and similar soils
- Roliss and similar soils
- Strathcona and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Fram Series

Depth class: Very deep
Drainage class: Somewhat poorly drained or moderately well drained
Permeability: Moderate
Landform: Moraines

Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon

Fram loam, 100 feet east and 300 feet north of the southwest corner of sec. 1, T. 147 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; common fine roots; 1 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk—9 to 22 inches; light olive brown (2.5Y 5/4) loam; weak thin platy structure; friable; few fine roots; few black (10YR 2/1) wormcasts in channels; common light gray (10YR 7/1) carbonate coatings on faces of peds; 3 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—22 to 45 inches; light olive brown (2.5Y 5/4) loam; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; friable; 5 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

C2—45 to 63 inches; grayish brown (2.5Y 5/2) loam; common medium prominent brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) redoximorphic concentrations; massive; firm; 3 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C3—63 to 80 inches; grayish brown (2.5Y 5/2) loam; common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; massive; firm; 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 1 to 10 percent gravel

A horizon:
Value—2 or 3
Chroma—1 or 2

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 4
Texture—loam, sandy loam, or fine sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Texture—loam, sandy loam, or fine sandy loam

296—Fram loam

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained or moderately well drained
Dominant parent material: Till
Flooding: None
Water table depth: 1.5 to 5.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Content of organic matter in the surface layer: About 6.5 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

- Hedman and similar soils
- Esmond and similar soils
- Heimdal and similar soils
- Hamre and similar soils
- Strathcona and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Glyndon Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderate; lower part—moderately rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 6 percent
Taxonomic classification: Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon

Glyndon very fine sandy loam, 0 to 2 percent slopes, 2,270 feet north and 180 feet east of the southwest corner of sec. 2, T. 148 N., R. 46 W.

Ap—0 to 8 inches; black (10YR 2/1) very fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; very friable, slightly sticky and nonplastic; few very fine roots; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 15 inches; dark gray (10YR 4/1) very fine sandy loam, light gray or gray (10YR 6/1) dry; weak medium subangular blocky structure; very friable, slightly sticky and nonplastic; few very fine roots; common fine irregular masses of carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—15 to 21 inches; brown (10YR 5/3) very fine sandy loam; weak fine subangular blocky structure; very friable, slightly sticky and nonplastic; common fine irregular masses of carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk3—21 to 30 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; common fine distinct olive yellow (2.5Y 6/6) redoximorphic concentrations; weak medium subangular blocky structure; very friable; few fine irregular masses of carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk4—30 to 35 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; common fine distinct light yellowish brown (2.5Y 6/4) redoximorphic concentrations; weak medium subangular blocky structure; very friable; few fine irregular masses of carbonate; slightly effervescent; slightly alkaline; clear smooth boundary.

C1—35 to 54 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; common medium prominent brownish yellow (10YR 6/6) and distinct light yellowish brown (2.5Y 6/4) redoximorphic concentrations; massive; very friable; very slightly effervescent; slightly alkaline; clear smooth boundary.

C2—54 to 67 inches; pale yellow (2.5Y 7/3) loamy very fine sand; common medium distinct olive yellow (2.5Y 6/6) redoximorphic concentrations; massive; very friable; slightly alkaline; abrupt smooth boundary.

C3—67 to 80 inches; olive gray (5Y 4/2) loam; common fine and medium prominent dark brown (7.5YR 4/4) redoximorphic concentrations; massive; very friable; 3 percent gravel; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Value—2 or 3
Chroma—1 or 2

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 7
Texture—very fine sandy loam, silt loam, loamy very fine sand, loam, or silty clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Chroma—2 to 4
Texture—very fine sandy loam, loamy very fine sand, very fine sand, loam, or silt loam

1304A—Glyndon very fine sandy loam, 0 to 2 percent slopes

Composition

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

Setting

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

Component Description

Texture of the surface layer: Very fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Borup and similar soils
- Wheatville and similar soils
- Bearden and similar soils
- Colvin and similar soils

Major Uses of the Unit

- Cropland

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

- "Agronomy" section

1304B—Glyndon very fine sandy loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Lake plains
Position on the landform: Rises and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Very fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Borup and similar soils
- Bearden and similar soils
- Colvin and similar soils

Major Uses of the Unit

- Cropland

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

- "Agronomy" section

Grimstad Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderately rapid or rapid; lower part—moderate
Landform: Lake plains and moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Sandy over loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon

Grimstad fine sandy loam, 2,300 feet east and 810 feet south of the northwest corner of sec. 34, T. 154 N., R. 47 W.

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

ABk—10 to 16 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; few fine irregularly shaped white (10YR 8/1) masses of carbonates; violently effervescent; moderately alkaline; clear wavy boundary.

Bk—16 to 23 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine subangular blocky structure; very friable; fine disseminated carbonates; violently effervescent; moderately alkaline; clear wavy boundary.

C1—23 to 31 inches; grayish brown (2.5Y 5/2) fine sand; common fine prominent yellowish brown

(10YR 5/8) redoximorphic concentrations; massive; very friable; slightly effervescent; slightly alkaline; abrupt wavy boundary.

2C2—31 to 53 inches; grayish brown (2.5Y 5/2) loam; common fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; massive; friable; 5 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

2C3—53 to 67 inches; light olive brown (2.5Y 5/4) loam; common fine and medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; weak thin platy soil fragments parting to moderate fine subangular blocky; friable; 5 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

2C4—67 to 75 inches; light olive brown (2.5Y 5/4) fine sandy loam; common fine and medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; friable; 3 percent gravel; common fine very dark grayish brown (2.5Y 3/2) manganese stains; strongly effervescent; slightly alkaline; gradual wavy boundary.

2C5—75 to 86 inches; light olive brown (2.5Y 5/4) loam; common fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; friable; 6 percent gravel; common fine dark reddish brown (5YR 3/2) iron stains; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 1 to 10 percent gravel in the underlying till
Thickness of sandy material: 20 to 40 inches

A horizon:
Value—2 or 3
Chroma—1 or 2

Bk horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 to 4
Texture—fine sandy loam, loamy sand, loamy fine sand, loamy very fine sand, very fine sandy loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—fine sand, loamy sand, or loamy fine sand

2C horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Texture—loam, fine sandy loam, clay loam, or silty clay loam

59—Grimstad fine sandy loam

Composition

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

Setting

Landform: Lake plains and moraines
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)
Content of organic matter 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

- Strathcona and similar soils
- Foldahl and similar soils
- Ulen and similar soils
- Hamerly and similar soils
- Huot and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Gunclub Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderately slow; lower part—very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-silty, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon

Gunclub silty clay loam, 1,250 feet west and 1,350 feet north of the southeast corner of sec. 20, T. 150 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—9 to 20 inches; 60 percent gray (10YR 5/1) and 40 percent grayish brown (2.5Y 5/2) silty clay loam; moderate fine and medium subangular blocky structure; friable; common fine roots; common medium irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bk2—20 to 34 inches; light yellowish brown (2.5Y 6/4) silty clay loam; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium subangular blocky structure; friable; few fine roots; few fine irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Cg1—34 to 54 inches; 60 percent light olive brown (2.5Y 5/4) and 40 percent olive gray (5Y 5/2) silty clay loam; common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; moderate medium subangular blocky soil fragments; firm; few very fine roots; few fine irregularly shaped masses of carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.

2Cg2—54 to 68 inches; light olive gray (5Y 6/2) clay; common medium prominent brownish yellow (10YR 6/8) and few fine prominent yellowish red (5YR 5/8) redoximorphic concentrations; massive; moderate thin and medium platy soil fragments; very firm; few fine irregularly shaped masses of carbonate; 5 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

2Cg3—68 to 80 inches; 60 percent light gray (5Y 7/2) and 40 percent pale olive (5Y 6/3) clay; common medium prominent brownish yellow (10YR 6/8) and common fine prominent yellowish red (5YR 5/8) redoximorphic concentrations; massive; moderate medium platy soil fragments; very firm; common fine irregularly shaped masses of carbonate; 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches
Depth to the 2C horizon: 40 to 60 inches

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 7
Texture—silty clay loam or silt loam

Cg horizon:
Value—4 to 7
Texture—silty clay loam or laminated silt loam and silty clay loam

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—2 to 4
Texture—clay or silty clay
Content of rock fragments—0 to 6 percent gravel and cobbles, by volume

1280—Gunclub silty clay loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None

Water table depth: 1.5 to 2.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter 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

- Nielsville and similar soils
- Wheatville and similar soils

Major Uses of the Unit

- Cropland

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

- "Agronomy" section

Halverson Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—rapid; lower part—moderately slow
Landform: Moraines
Parent material: Glacial outwash over till
Slope range: 1 to 15 percent
Taxonomic classification: Loamy, mixed, superactive Arenic Argiborolls

Typical Pedon

Halverson loamy fine sand, 1 to 6 percent slopes (fig. 13), 1,170 feet south and 1,340 feet east of the northwest corner of sec. 7, T. 147 N., R. 43 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; many fine roots; 1 percent gravel; moderately acid; abrupt wavy boundary.

E/A—10 to 15 inches; 65 percent grayish brown (10YR 5/2) and 35 percent very dark grayish brown (10YR 3/2) loamy fine sand; light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; very friable; common fine roots; slightly acid; abrupt wavy boundary.

E—15 to 23 inches; brown (10YR 5/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; common very fine roots; neutral; abrupt smooth boundary.

2Bt1—23 to 29 inches; dark yellowish brown (10YR 4/4) very fine sandy loam; moderate medium subangular blocky structure; firm; few very fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few faint grayish brown (10YR 5/2) skeletans in root channels and pores; 7 percent gravel and 1 percent cobbles; neutral; clear smooth boundary.

2Bt2—29 to 35 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; firm; few very fine roots; common prominent very dark grayish brown (10YR 3/2) clay films on faces of peds and in root channels; 7 percent gravel and 1 percent cobbles; neutral; clear wavy boundary.

2Bk1—35 to 39 inches; pale brown (10YR 6/3) loam; weak medium platy structure; friable; many white (10YR 8/2) carbonate coatings on peds; 6 percent gravel and 2 percent cobbles; violently effervescent; moderately alkaline; clear wavy boundary.

2Bk2—39 to 55 inches; pale brown (10YR 6/3) fine sandy loam; weak medium platy structure; firm; common light gray (10YR 7/2) masses of carbonate; 6 percent gravel and 2 percent cobbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C—55 to 80 inches; pale brown (10YR 6/3) fine sandy loam; massive; firm; few strong brown (7.5YR 5/8) iron stains on faces of soil fragments; few light gray (10YR 7/2) masses of carbonate; 11 percent gravel and 3 percent cobbles; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to the base of the argillic horizon: 26 to 55 inches
Thickness of the mollic epipedon: 10 to 16 inches
Thickness of sandy material: 20 to 40 inches
Other features: Some pedons have an A/E horizon. Also, some pedons have a 2BC horizon, and some pedons do not have a 2Bk horizon.

A horizon:
Value—2 or 3
Chroma—1 to 3
Content of rock fragments—1 to 10 percent gravel

E horizon:
Value—3 to 5
Texture—loamy fine sand, loamy sand, fine sand, or sand
Content of rock fragments—0 to 10 percent gravel

2Bt horizon:
Hue—10YR or 2.5Y
Chroma—3 to 6
Texture—loam, very fine sandy loam, fine sandy loam, sandy clay loam, or sandy loam
Content of rock fragments—2 to 13 percent gravel and 0 to 5 percent cobbles

2Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—fine sandy loam, loam, very fine sandy loam, or sandy loam
Content of rock fragments—1 to 13 percent gravel and 0 to 5 percent cobbles

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 6
Texture—fine sandy loam, loam, or sandy loam
Content of rock fragments—1 to 13 percent gravel and 0 to 5 percent cobbles

735B—Halverson loamy fine sand, 1 to 6 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises
Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Glacial outwash over till
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 7.5 inches (moderate)
Content of organic matter 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

- Kratka and similar soils
- Chapett and similar soils
- Foldahl and similar soils

Major Uses of the Unit

- Forest land
- Cropland
- Pasture
- Hayland

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

- “Forest Land” section
- “Agronomy” section

735C—Halverson loamy fine sand, 6 to 15 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 6 to 15 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Glacial outwash over till
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.5 inches (low)
Content of organic matter 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

- Kratka and similar soils
- Chapett and similar soils
- Foldahl and similar soils
- Esmond and similar soils

Major Uses of the Unit

- Forest land
- Cropland
- Hayland
- Pasture

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

- “Forest Land” section
- “Agronomy” section

Hamar Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid or rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, frigid Typic Endoaquolls

Typical Pedon

Hamar loamy fine sand, 2,500 feet west and 1,000 feet north of the southeast corner of sec. 18, T. 147 N., R. 44 W.

A1—0 to 8 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; common fine roots; neutral; abrupt smooth boundary.

A2—8 to 13 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

C—13 to 53 inches; grayish brown (2.5Y 5/2) fine sand; common medium prominent strong brown (7.5YR 4/6) redoximorphic concentrations; single grain; loose; neutral; clear smooth boundary.

Cg1—53 to 67 inches; light olive gray (5Y 6/2) fine sand; common fine prominent brownish yellow (10YR 6/6) redoximorphic concentrations; single grain; loose; 3 percent gravel; neutral; clear smooth boundary.

Cg2—67 to 81 inches; light brownish gray (2.5Y 6/2) fine sand; common fine and medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; single grain; loose; 1 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 22 to more than 60 inches
Thickness of the mollic epipedon: 10 to 20 inches
Other features: Some pedons have an AC horizon.

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6
Chroma—1 to 4
Texture—fine sand, loamy fine sand, or loamy sand

372—Hamar loamy fine sand

Composition

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

Setting

Landform: Lake plains
Position on the landform: Flats and swales
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 1.0 to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches (low)
Content of organic matter 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

- Ulen and similar soils
- Kratka and similar soils

- Rosewood and similar soils
- Deerwood and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Hamerly Series

Depth class: Very deep
Drainage class: Somewhat poorly drained or moderately well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon

Hamerly loam, 0 to 3 percent slopes, 490 feet south and 400 feet west of the northeast corner of sec. 14, T. 153 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; few very fine roots; 5 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk—9 to 20 inches; dark grayish brown (10YR 4/2) loam; weak fine subangular blocky structure; friable; few very fine roots; 5 percent gravel; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

C1—20 to 30 inches; dark grayish brown (2.5Y 4/2) loam; massive; friable; few fine gypsum crystals; 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—30 to 50 inches; grayish brown (2.5Y 5/2) loam; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; massive; friable; 5 percent gravel; slightly effervescent; moderately alkaline; gradual wavy boundary.

C3—50 to 64 inches; light olive brown (2.5Y 5/4) loam; few fine prominent yellowish red (5YR 5/6) redoximorphic concentrations; subangular blocky soil fragments; friable; 2 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C4—64 to 80 inches; light brownish gray (2.5Y 6/2) loam; few medium prominent dark reddish brown (5Y 3/2), common fine prominent yellowish brown (10YR 5/6), and many fine and medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; platy soil fragments; friable; 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 2 to 8 percent gravel
Other features: Some pedons have an ABk horizon, and some pedons have a Bky or By horizon.

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 7
Chroma—1 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Chroma—1 to 4
Texture—loam or clay loam

184A—Hamerly loam, 0 to 3 percent slopes

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)

Content of organic matter 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

- Vallers and similar soils
- Strathcona and similar soils
- Grimstad and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Hamre Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow or moderate
Landform: Moraines and lake plains
Parent material: Organic material over till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-loamy, mixed, superactive, nonacid, frigid Histic Humaquepts

Typical Pedon

Hamre muck, 1,700 feet east and 110 feet south of the northwest corner of sec. 36, T. 153 N., R. 46 W.

Oa—0 to 10 inches; black (10YR 2/1) muck; about 10 percent fiber, trace rubbed; weak thin platy structure; very friable; neutral; clear smooth boundary.

A—10 to 16 inches; black (10YR 2/1) mucky sandy clay loam; few medium distinct dark gray (10YR 4/1) redoximorphic depletions; weak medium subangular blocky structure; friable; 3 percent rock fragments; few fragments of snail shells; neutral; clear wavy boundary.

Cg1—16 to 30 inches; light olive gray (5Y 6/2) loam; common fine prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; friable; 8 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—30 to 52 inches; gray (5Y 5/1) loam; common fine prominent olive brown (2.5Y 4/4) and few fine prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; massive; friable; 8 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg3—52 to 68 inches; dark gray (5Y 4/1) loam; massive; firm; 10 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg4—68 to 80 inches; olive gray (5Y 4/2) loam; massive; firm; 12 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 25 inches
Thickness of the histic epipedon: 8 to 16 inches
Content of rock fragments: 0 to 15 percent gravel

Oa horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—sandy clay loam, loam, clay loam, or silt loam or the mucky analogs of these textures

Cg horizon:
Hue—2.5Y or 5Y
Chroma—1 to 3
Texture—loam, clay loam, or silt loam

1878—Hamre muck

Composition

Hamre 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

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over till
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface

Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 90 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

- Deerwood and similar soils
- Markey and similar soils
- Hedman and similar soils
- Kratka and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Forest land
- Cropland
- Hayland
- Pasture

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

- "Forest Land" section
- "Agronomy" section

Hangaard Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Rapid
Landform: Beach plains
Parent material: Beach deposits
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, frigid Typic Endoaquolls

Typical Pedon

Hangaard sandy loam, 300 feet north and 1,650 feet west of the southeast corner of sec. 1, T. 152 N., R. 46 W.

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

A—10 to 15 inches; very dark grayish brown (2.5Y 3/2) loamy sand, dark brown (10YR 3/3) dry; few medium prominent dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak fine subangular blocky structure; very friable; few fine roots; neutral; clear wavy boundary.

Cg1—15 to 35 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; few medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose; 20 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2—35 to 48 inches; light brownish gray (2.5Y 6/2) coarse sand; few fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose; 8 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg3—48 to 62 inches; grayish brown (2.5Y 5/2) coarse sand; few fine prominent brownish yellow (10YR 5/8) redoximorphic concentrations; single grain; loose; 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg4—62 to 71 inches; grayish brown (2.5Y 5/2) coarse sand; few medium prominent brownish yellow (10YR 5/8) redoximorphic concentrations; single grain; loose; 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg5—71 to 80 inches; light brownish gray (2.5Y 6/2) coarse sand; few fine prominent brownish yellow (10YR 6/8) redoximorphic concentrations; single grain; loose; 12 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 11 to 24 inches
Thickness of the mollic epipedon: 7 to 20 inches
Depth to the C horizon: 7 to 20 inches
Other features: Some pedons have a thin Bg horizon.

A horizon:
Hue—10YR or 2.5Y
Chroma—1 or 2

Cg horizon:
Hue—2.5Y or 5Y
Chroma—1 or 2
Texture—gravelly coarse sand, coarse sand, gravelly sand, or sand
Content of rock fragments—10 to 35 percent gravel

111—Hangaard sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Beach deposits
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches (low)
Content of organic matter 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

- Radium similar soils
- Markey and similar soils
- Deerwood and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Haploborolls

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Glaciolacustrine deposits
Slope range: 2 to 30 percent
Taxonomic classification: Loamy Haploborolls

Typical Pedon

Haploborolls, in an area of Fluvaquents-Haploborolls complex, 0 to 30 percent slopes, 1,250 feet west and 2,100 feet north of the southeast corner of sec. 33, T. 150 N., R. 46 W.

A—0 to 9 inches; very dark grayish brown (10YR 3/2) clay loam; weak fine subangular blocky structure; friable; common fine roots; 3 percent gravel; slightly alkaline; clear smooth boundary.
Bw—9 to 13 inches; grayish brown (10YR 5/2) clay loam; weak fine subangular blocky structure; friable; few fine roots; 2 percent gravel; slightly alkaline; clear smooth boundary.
C—13 to 60 inches; yellowish brown (10YR 5/4) clay loam; common fine prominent strong brown (7.5YR 5/8) relict redoximorphic concentrations; massive; friable; 5 percent gravel; common fine white (10YR 8/1) carbonate masses; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 12 inches
Depth to carbonates: 0 to 16 inches
Content of gravel: 2 to 8 percent

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 to 3
Texture—loam, clay loam, sandy loam, fine sandy loam, silty clay, or clay

Bw horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay loam, silt loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay loam, silt loam, or sandy loam

Haslie Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderate or moderately rapid; lower part—slow
Landform: Moraines, lake plains, and outwash plains
Parent material: Organic materials and coprogenous earth
Slope range: 0 to 1 percent

Taxonomic classification: Coprogenous, euic Limnic Borosaprists

Typical Pedon

Haslie muck, 1,600 feet north and 2,160 feet west of the southeast corner of sec. 28, T. 147 N., R. 39 W.

Oa1—0 to 12 inches; muck, black (10YR 2/1) broken face and very dark brown (10YR 2/2) rubbed; about 20 percent fiber, 5 percent rubbed; weak medium and fine subangular blocky structure parting to weak fine granular; very friable; many fine roots; mostly herbaceous fiber; few snail shells; neutral; gradual wavy boundary.

Oa2—12 to 30 inches; muck, black (10YR 2/1) broken face and very dark brown (10YR 2/2) rubbed; about 30 percent fiber, 5 percent rubbed; weak fine and medium subangular blocky structure; very friable; common fine roots; mostly herbaceous fiber; few snail shells; neutral; abrupt smooth boundary.

Cg1—30 to 39 inches; mucky silt loam (coprogenous earth), about 70 percent olive gray (5Y 4/2) and 30 percent olive gray (5Y 5/2); common medium distinct very dark gray (5Y 3/1) redoximorphic depletions; traces of fiber; massive; very friable; slightly sticky; about 5 percent snail shells and fragments; slightly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—39 to 51 inches; dark olive gray (5Y 3/2) mucky silt loam (coprogenous earth); common medium faint olive gray (5Y 5/2) redoximorphic depletions; massive; very friable; slightly sticky; about 10 percent snail shells and fragments; slightly effervescent; slightly alkaline; gradual smooth boundary.

Cg3—51 to 80 inches; olive gray (5Y 4/2) mucky silt loam (coprogenous earth); few medium faint olive (5Y 5/3) redoximorphic concentrations; plant detritus in channels; massive; very friable; slightly sticky; about 7 percent snail shells and fragments; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to coprogenous earth: 16 to 50 inches
Content and size of woody fragments: 1/8 inch to 3 inches in diameter and about 0 to 15 percent, by volume, in some pedons

Oa horizon:
Hue—7.5YR, 10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 3
Texture—dominantly sapric material, but the range includes thin layers of hemic material

Cg horizon:
Hue—10YR, 2.5Y, 5Y, 5GY, or neutral
Value—2 to 6
Chroma—0 to 3
Texture—coprogenous earth

746—Haslie muck

Composition

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

Setting

Landform: Moraines and lake plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials and coprogenous earth
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 18.8 inches (high)
Content of organic matter 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

- Cathro and similar soils
- Seelyeville and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- “Wildlife Habitat” section

1113—Haslie, Seelyeville, and Cathro soils, ponded

Composition

Haslie: Variable
Seelyeville: Variable
Cathro: Variable
Inclusions: About 10 percent

Setting

Landform: Lake plains, outwash plains, and moraines
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Haslie

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials and coprogenous earth
Flooding: None
Water table depth: 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 19.6 inches (high)
Content of organic matter in the surface layer: About 75 percent (very high)

Seelyeville

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials
Flooding: None
Water table depth: 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 24.0 inches (high)
Content of organic matter in the surface layer: About 62 percent (very high)

Cathro

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over till or glacial outwash
Flooding: None
Water table depth: 4.0 feet 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 21.3 inches (high)
Content of organic matter in the surface layer: About 72.5 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

- Markey and similar soils
- Berner and similar soils
- Northwood and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- “Wildlife Habitat” section

Hattie Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Lake plains
Parent material: Till
Slope range: 6 to 18 percent
Taxonomic classification: Fine, smectitic, frigid Typic Hapluderts

Typical Pedon

Hattie clay, 6 to 18 percent slopes, eroded, 2,000 feet north and 300 feet east of the southwest corner of sec. 16, T. 150 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong medium subangular blocky structure; friable; common fine roots; 2 percent gravel; common round fine white (10YR 8/2) masses of carbonate; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bkss—8 to 24 inches; olive (5Y 4/3) clay; strong coarse subangular blocky structure parting to strong fine angular blocky; firm; few very fine and fine roots; common distinct black (2.5Y 2.5/1) slickensides on vertical faces of peds; 2 percent

gravel; few irregular fine and medium white (10YR 8/2) masses of carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—24 to 56 inches; olive (5Y 4/3) clay; common fine prominent yellow (2.5Y 7/6) redoximorphic concentrations; massive but with strong fine angular blocky soil fragments; firm; 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—56 to 68 inches; olive gray (5Y 4/2) clay; common fine prominent yellowish red (5YR 4/6) and common fine prominent light yellowish brown (2.5Y 6/4) redoximorphic concentrations; moderate fine and medium angular blocky soil fragments; firm; 3 percent gravel; many fine and medium irregularly shaped white (10YR 8/1) masses of carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—68 to 80 inches; grayish brown (2.5Y 5/2) clay; common fine prominent yellowish red (5YR 4/6) and light yellowish brown (10YR 6/4) redoximorphic concentrations; weak or moderate fine or medium angular blocky soil fragments; firm; 5 percent gravel; many fine and medium irregularly shaped white (10YR 8/1) masses of carbonate; violently effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Content of rock fragments: 2 to 8 percent gravel
Content of clay: 35 to 60 percent
Other features: Some pedons have a Bw or BC horizon.

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3

Bk horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay, silty clay, or clay loam

C horizon:
Chroma—2 to 4
Texture—clay, silty clay, or clay loam

185D2—Hattie clay, 6 to 18 percent slopes, eroded

Composition

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

Setting

Landform: Lake plains
Position on the landform: Side slopes of drainageways
Slope range: 6 to 18 percent

Component Description

Texture of the surface layer: Clay
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter 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

- Clearwater and similar soils
- Zell and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Hedman Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Hedman loam (fig. 14), 300 feet south and 2,600 feet west of the northeast corner of sec. 1, T. 147 N., R. 42 W.

Ap—0 to 8 inches; black (2.5Y 2.5/1) loam, dark gray (2.5Y 4/1) dry; moderate medium subangular blocky structure; friable; many fine roots; 1 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.

A—8 to 11 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; common medium prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; moderate medium subangular blocky structure; friable; common fine roots; 1 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bkg—11 to 20 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common fine prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; moderate medium subangular blocky structure; friable; common very fine roots; many medium irregularly shaped white (10YR 8/1) masses of carbonate; 3 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Cg1—20 to 32 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine prominent strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) redoximorphic concentrations; massive; firm; common fine roots; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 5 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Cg2—32 to 55 inches; light olive brown (2.5Y 5/3) fine sandy loam; common fine distinct dark gray (2.5Y 4/1) redoximorphic depletions; common fine prominent dark yellowish brown (10YR 4/6) and few fine prominent dark reddish brown (5Y 3/4) redoximorphic concentrations; massive; firm; few very fine roots; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 5 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

Cg3—55 to 68 inches; light gray (2.5Y 7/2) fine sandy loam; many fine prominent brownish yellow (10YR 6/6) redoximorphic concentrations; massive; firm; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 4 percent gravel; strongly effervescent; slightly alkaline; clear wavy boundary.

Cg4—68 to 80 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common fine prominent brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) redoximorphic concentrations; massive; firm; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 5 percent gravel; violently effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to free carbonates: Less than 16 inches
Content of rock fragments: 1 to 10 percent gravel
Other features: Some pedons have a Bg horizon.

A horizon:
Hue—10YR, 2.5Y, or neutral
Chroma—0 to 2

Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—loam, fine sandy loam, or sandy loam

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 7
Chroma—0 to 3
Texture—loam, fine sandy loam, or sandy loam

1117—Hedman loam

Composition

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

Setting

Landform: Moraines
Position on the landform: Flats
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Content of organic matter 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

- Fram and similar soils
- Strathcona and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

1121—Hedman loam, depressional

Composition

Hedman 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

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter in the surface layer: About 7 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

- Northwood and similar soils
- Strathcona and similar soils
- Fram and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

1142—Hedman-Fram complex

Composition

Hedman and similar soils: About 50 percent
Fram and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Hedman—flats; Fram—rises
Slope range: Hedman—0 to 2 percent; Fram—0 to 3 percent

Component Description

Hedman

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

Fram

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 1.5 to 5.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 6.5 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

- Esmond and similar soils
- Heimdal and similar soils
- Onstad and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Hegne Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow or very slow
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Fine, smectitic, frigid Typic Calciaquerts

Typical Pedon

Hegne silty clay, in an area of Hegne-Fargo complex, 2,350 feet north and 150 feet west of the southeast corner of sec. 8, T. 152 N., R. 48 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; few fine roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

ABk—9 to 15 inches; 70 percent black (10YR 2/1) and 30 percent light brownish gray (2.5Y 6/2) silty clay; dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; common masses of carbonate; strongly effervescent; moderately alkaline; gradual irregular boundary.

Bkss—15 to 25 inches; 90 percent light brownish gray (2.5Y 6/2) and 10 percent dark gray (10YR 4/1) silty clay; few fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common distinct intersecting slickensides tilted less than 45 degrees from the horizontal; cracks 1/4 inch to 3 inches wide and 2 to 4 feet apart filled with material from the A horizon; many irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

C1—25 to 40 inches; dark grayish brown (2.5Y 4/1) clay; few fine prominent dark brown (7.5YR 3/4) redoximorphic concentrations and few fine distinct dark gray (5Y 4/1) redoximorphic depletions; massive; firm; slightly effervescent; slightly alkaline; clear smooth boundary.

C2—40 to 57 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium distinct olive brown (2.5Y 4/4) and few fine prominent dark brown (7.5YR 3/4) redoximorphic concentrations; massive; firm; few fine nests of gypsum; slightly effervescent; slightly alkaline; clear smooth boundary.

C3—57 to 65 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium prominent yellowish red (5YR 4/6) and few fine prominent yellowish brown (10YR 5/8) redoximorphic concentrations; weak thin platy structure parting to moderate medium subangular blocky; friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—65 to 80 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent yellowish red (5YR 4/6) and few fine prominent yellowish brown (10YR 5/8) redoximorphic concentrations; moderate thick platy structure; friable; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 or 1

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—silty clay or clay

C horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2

935—Hegne-Fargo complex

Composition

Hegne and similar soils: About 50 percent
Fargo and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Hegne—flats; Fargo—swales
Slope range: 0 to 1 percent

Component Description

Hegne

Texture of the surface layer: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.4 inches (moderate)
Content of organic matter in the surface layer: About 5 percent (high)

Fargo

Texture of the surface layer: Silty clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter in the surface layer: About 7 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

- Bearden and similar soils
- Colvin and similar soils
- Perella and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Heimdal Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 20 percent
Taxonomic classification: Coarse-loamy, mixed, superactive Udic Haploborolls

Typical Pedon

Heimdal loam, in an area of Heimdal-Esmond complex, 2 to 6 percent slopes, 1,800 feet east and 1,200 feet north of the southwest corner of sec. 2, T. 147 N., R. 42 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few medium roots; 5 percent gravel; neutral; abrupt smooth boundary.

Bw1—10 to 14 inches; very dark grayish brown (10YR 3/2) loam; weak medium subangular blocky structure; friable; few fine roots; common black (10YR 2/1) coatings of organic matter on faces of peds; few black (10YR 2/1) wormcasts in channels; 5 percent gravel; neutral; gradual wavy boundary.

Bw2—14 to 22 inches; dark brown (10YR 3/4) loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few fine roots; common very dark grayish brown (10YR 3/2) streaks on ped exteriors; 8 percent gravel; neutral; clear wavy boundary.

Bk—22 to 33 inches; pale brown (10YR 6/3) fine sandy loam; weak medium platy structure; friable; common fine irregularly shaped light gray (10YR 7/2) threads of carbonate; 10 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—33 to 54 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; friable; common fine irregularly shaped light gray (10YR 7/2) threads of carbonate; 10 percent gravel; slightly effervescent; moderately alkaline; clear smooth boundary.

C2—54 to 68 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; firm; 5 percent gravel; common fine black (2.5Y 2.5/1) manganese stains; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—68 to 81 inches; light olive brown (2.5Y 5/4) fine sandy loam; common medium prominent

yellowish brown (10YR 5/6) relict redoximorphic concentrations; massive; firm; 5 percent gravel; common fine black (2.5Y 2.5/1) manganese stains; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 26 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 2 to 10 percent gravel

A horizon:
Value—2 or 3

Bw horizon:
Hue—10YR or 2.5Y
Value—2 to 5
Texture—loam, sandy loam, or fine sandy loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, sandy loam, or fine sandy loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, sandy loam, or fine sandy loam

827B—Heimdal-Esmond complex, 2 to 6 percent slopes

Composition

Heimdal and similar soils: About 60 percent
Esmond and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Heimdal—backslopes; Esmond—summits and shoulder slopes
Slope range: 2 to 6 percent

Component Description

Heimdal

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

Esmond

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)
Content of organic matter 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

- Hedman and similar soils
- Onstad and similar soils
- Fram and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

827C2—Heimdal-Esmond complex, 6 to 12 percent slopes, eroded

Composition

Heimdal and similar soils: About 50 percent
Esmond and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Heimdal—backslopes; Esmond—summits and shoulder slopes
Slope range: 6 to 12 percent

Component Description

Heimdal

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

Esmond

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter 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

- Hedman and similar soils
- Onstad and similar soils
- Fram and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Hilaire Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Sandy over clayey, mixed over smectitic Aquic Haploborolls

Typical Pedon

Hilaire loamy fine sand, 2,560 feet south and 2,310 feet east of the northwest corner of sec. 10, T. 147 N., R. 45 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; moderate medium granular structure; very friable; few very fine roots; 2 percent gravel; slightly alkaline; abrupt smooth boundary.

Bw1—10 to 16 inches; very dark grayish brown (10YR 3/2) loamy fine sand; weak medium subangular blocky structure; very friable; few very fine roots; 1 percent gravel; slightly alkaline; clear smooth boundary.

Bw2—16 to 25 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; 2 percent gravel; slightly alkaline; abrupt wavy boundary.

2Bk—25 to 58 inches; grayish brown (2.5Y 5/2) clay; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak fine subangular blocky structure; firm; 2 percent gravel; few fine light gray (2.5Y 7/2) rounded masses of carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

2Cg1—58 to 70 inches; olive gray (5Y 4/2) clay; few fine prominent yellowish red (5YR 4/6) redoximorphic concentrations; weak fine and medium angular blocky soil fragments; firm; 3 percent gravel; few fine light gray (2.5Y 7/2) rounded masses of carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

2Cg2—70 to 83 inches; olive gray (5Y 4/2) clay; common fine prominent brown (10YR 5/3) redoximorphic concentrations; weak fine and medium angular blocky soil fragments; firm; 2 percent gravel; few fine light gray (2.5Y 7/2) rounded masses of carbonate; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 6 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Thickness of sandy material: 20 to 40 inches

Ap horizon:
Value—2 or 3
Chroma—1 or 2
Content of rock fragments—0 to 15 percent gravel

Bw horizon:
Hue—10YR or 2.5Y

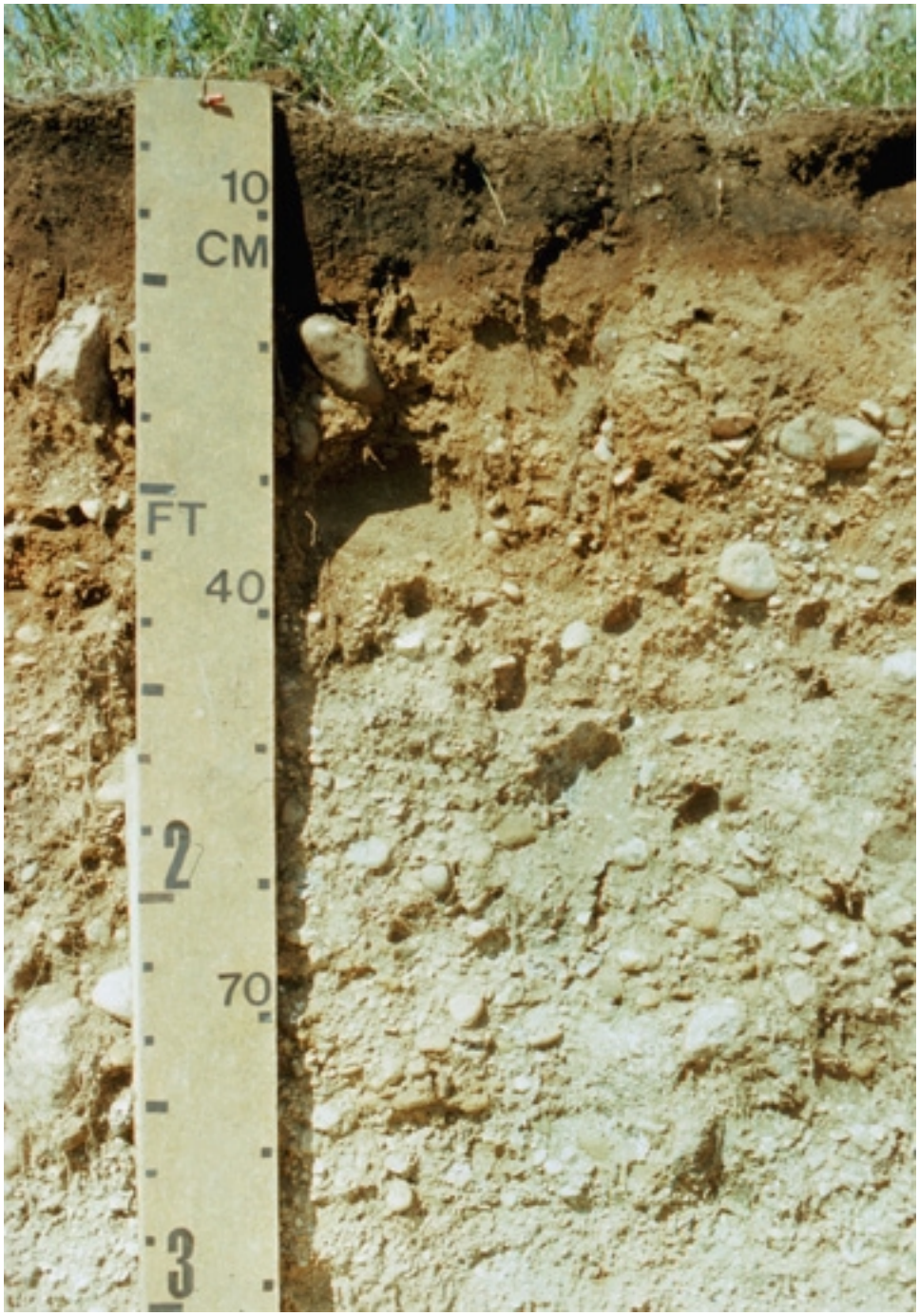

Figure 11.—A representative profile of Chapett fine sandy loam. The argillic horizon is between the depths of 27 and 40 centimeters.

Figure 12.—A representative profile of Fargo silty clay. The high content of clay and the shrink-swell potential of this soil cause cracking during dry periods. The cracking results in tonguing of the darker material from the surface layer into the subsoil. The tongues in this profile extend from a depth of 40 to 60 centimeters.

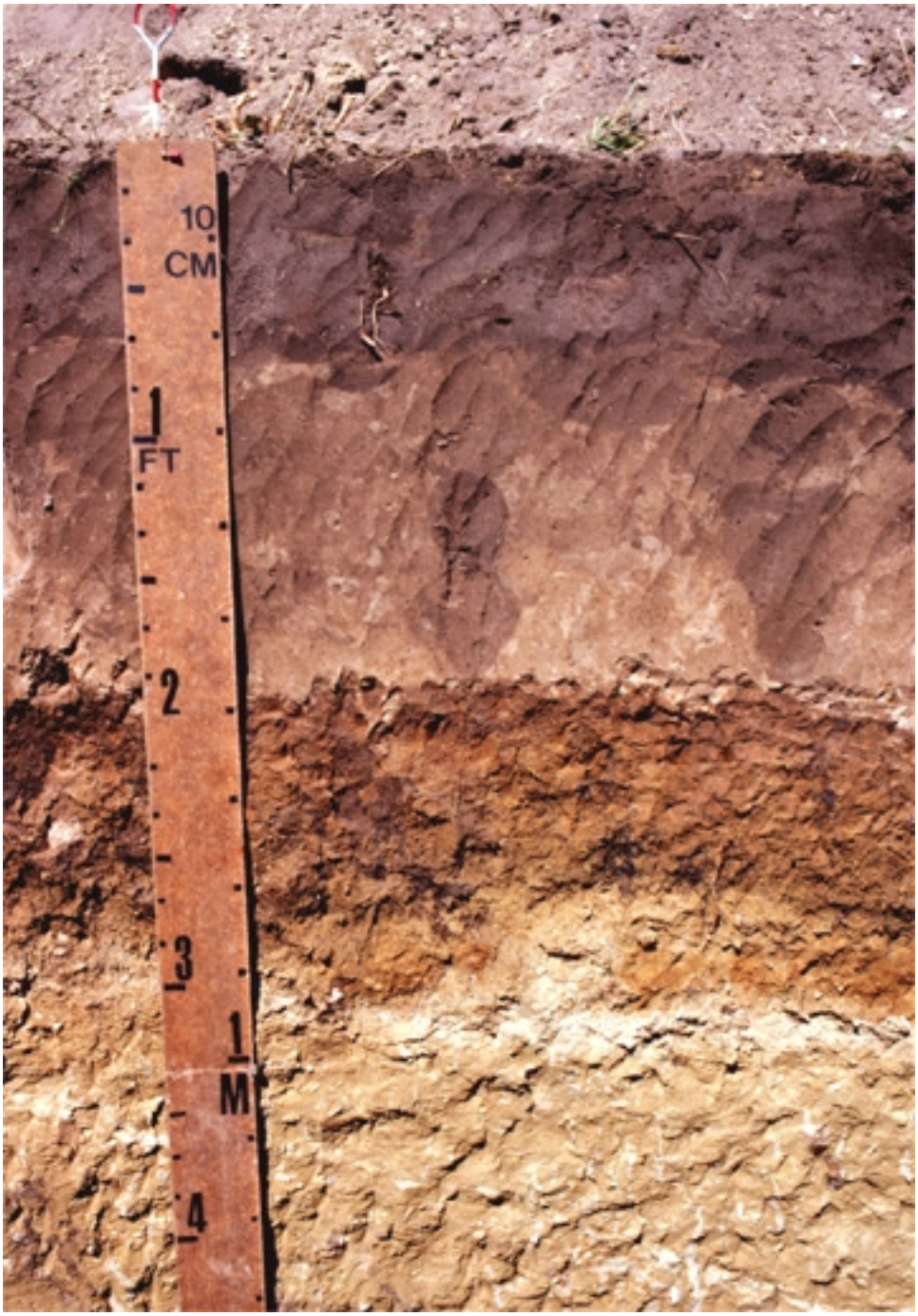

Figure 13.—A representative profile of Halverson loamy fine sand, 1 to 6 percent slopes. This well drained soil has about 24 inches of sandy material over loamy glacial till. The argillic horizon in this profile occurs at a depth of 23 to 35 inches. Several animal burrows are in the upper sandy sediments.

Figure 14.—A representative profile of Hedman loam. An accumulation of calcium carbonates is at a depth of 8 to 20 inches.

Figure 15.—A representative profile of Knute fine sandy loam. The argillic horizon occurs between the depths of 60 and 90 centimeters.

Figure 16.—A representative profile of Lindaas silty clay loam. The dark surface layer is typically more than 16 inches thick, and the underlying argillic horizon ranges from 10 to 23 inches in thickness.

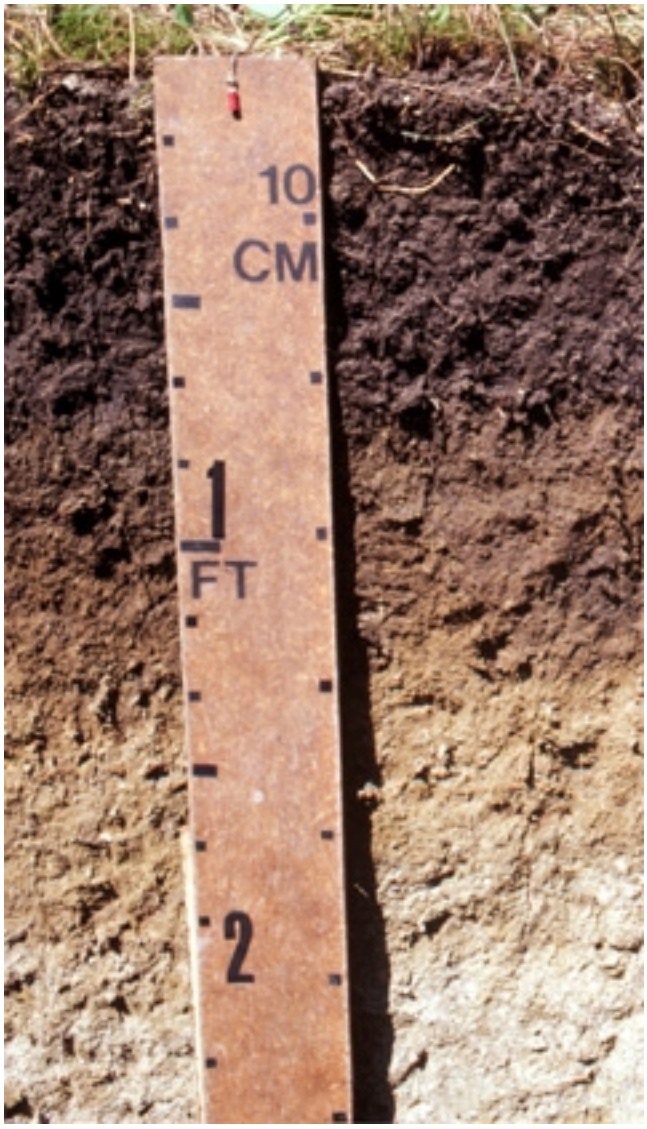

Figure 17.—A representative profile of Onstad loam. A zone of carbonate accumulation is at a depth of 60 centimeters.

Figure 18.—A representative profile of Sandberg loamy sand. This soil formed in beach deposits from glacial Lake Agassiz. Note the layers in the subsoil and substratum.

Figure 19.—A representative profile of Thiefriver fine sandy loam. This soil has about 30 inches of sandy material over clay. An accumulation of calcium carbonate is between the depths of about 12 and 23 inches.

Value—3 to 6
Chroma—2 to 4
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 15 percent gravel

2Bk horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—clay, silty clay, or silty clay loam

2Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—clay, silty clay, or silty clay loam

647—Hilaire loamy fine sand

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.6 inches (moderate)
Content of organic matter 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

- Espelie and similar soils
- Flaming and similar soils
- Clearwater and similar soils
- Huot and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Huot Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Sandy over clayey, mixed over smectitic Aquic Calciborolls

Typical Pedon

Huot fine sandy loam, 1,500 feet west and 2,600 feet north of the southeast corner of sec. 32, T. 151 N., R. 46 W.

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

Ak—10 to 14 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; very friable; few very fine roots; few fine irregularly shaped white (10YR 8/1) masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Bk—14 to 26 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine subangular structure; very friable; few fine irregularly shaped white (10YR 8/1) masses of carbonate; 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

C1—26 to 34 inches; light olive brown (2.5Y 5/4) fine sand; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; single grain; loose; 2 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2C2—34 to 58 inches; olive gray (5Y 4/2) clay; common fine distinct very dark grayish brown (2.5Y 3/2) redoximorphic depletions; moderate medium prismatic soil fragments parting to moderate fine angular; firm; 1 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2C3—58 to 80 inches; olive gray (5Y 4/2) clay; few fine distinct light olive brown (2.5Y 5/3) redoximorphic concentrations; moderate medium prismatic soil fragments; firm; 1 percent gravel; few fine irregularly shaped white (10YR 8/1) masses of carbonate; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Thickness of sandy material: 20 to 40 inches

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Content of rock fragments—0 to 15 percent gravel

Bk horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 to 3
Texture—loamy fine sand, loamy sand, fine sand, fine sandy loam, or sandy loam
Content of rock fragments—0 to 15 percent gravel

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—fine sand, loamy fine sand, sand, or loamy sand
Content of rock fragments—0 to 15 percent gravel

2C horizon:
Hue—2.5Y or 5Y
Value—3 to 6
Chroma—1 to 4
Texture—clay, silty clay, or silty clay loam
Content of rock fragments—0 to 10 percent gravel

643—Huot fine sandy loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 80 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.7 inches (moderate)
Content of organic matter 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

- Thiefriver and similar soils
- Ulen and similar soils
- Clearwater and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Knute Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, superactive Aquic Argiborolls

Typical Pedon

Knute fine sandy loam (fig. 15), 170 feet east and 490

feet north of the southwest corner of sec. 6, T. 148 N., R. 43 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure parting to weak fine granular; friable; common fine roots; few sand grains coating faces of peds; 3 percent gravel; neutral; abrupt smooth boundary.

Bt1—7 to 14 inches; dark brown (10YR 4/3) sandy clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many faint very dark grayish brown (10YR 3/2) clay films on faces of peds; 5 percent gravel; neutral; clear wavy boundary.

Bt2—14 to 18 inches; olive brown (2.5Y 4/4) sandy clay loam; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; 5 percent gravel; slightly alkaline; clear wavy boundary.

Bk—18 to 36 inches; grayish brown (2.5Y 5/2) fine sandy loam; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak medium platy structure; friable; many fine light gray (10YR 7/2) carbonate filaments and masses in internal planes; 5 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

C1—36 to 47 inches; grayish brown (2.5Y 5/2) fine sandy loam; common medium distinct light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium platy soil fragments; friable; common fine light gray (10YR 7/2) carbonate filaments and masses in internal planes; 5 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C2—47 to 65 inches; grayish brown (2.5Y 5/2) fine sandy loam; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak thin platy soil fragments; friable; common fine white (10YR 8/1) irregularly shaped masses of carbonate; 5 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C3—65 to 80 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine and medium faint light olive brown (2.5Y 5/4) redoximorphic concentrations; weak thin platy soil fragments; friable; common fine white (10YR 8/1) irregularly shaped masses of carbonate; 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 24 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 2 to 10 percent

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

Bt horizon:
Value—3 to 5
Chroma—2 to 4
Texture—sandy clay loam, fine sandy loam, loam, or sandy loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—fine sandy loam, loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—fine sandy loam, loam, or sandy loam

670—Knute fine sandy loam

Composition

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

Setting

Landform: Moraines
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Water table depth: 2.5 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)
Content of organic matter 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

- Brandsvold and similar soils
- Hedman and similar soils
- Chapett and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Kratka Series

Depth class: Very deep
Drainage class: Poorly drained or very poorly drained
Permeability: Upper part—rapid; lower part—moderate or moderately slow
Landform: Lake plains and moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Sandy over loamy, mixed, superactive, frigid Typic Endoaquolls

Typical Pedon

Kratka fine sandy loam, 800 feet west and 2,500 feet south of the northeast corner of sec. 17, T. 153 N., R. 46 W.

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

Bw—10 to 15 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations and common fine faint grayish brown (10YR 5/2) redoximorphic depletions; weak fine and medium subangular blocky structure parting to weak fine granular; friable; common fine and medium roots; neutral; clear smooth boundary.

Bg—15 to 25 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; few fine prominent yellowish brown (10YR 5/6 and 5/4) redoximorphic concentrations; weak fine subangular blocky structure parting to weak fine granular; friable; common fine roots; neutral; abrupt smooth boundary.

2Cg1—25 to 36 inches; grayish brown (2.5Y 5/2) loam; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium subangular blocky structure; firm; common very fine roots; common fine white (10YR 8/1) irregularly shaped masses of carbonate; 5 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

2Cg2—36 to 52 inches; grayish brown (2.5Y 5/2) loam; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) redoximorphic concentrations; massive; firm; common fine white (10YR 8/1) irregularly shaped masses of carbonate; 4 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

2Cg3—52 to 66 inches; grayish brown (2.5Y 5/2) loam; many fine prominent yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 5/8) redoximorphic concentrations; massive; firm; common fine white (10YR 8/1) irregularly shaped masses of carbonate; 3 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

2Cg4—66 to 82 inches; grayish brown (2.5Y 5/2) loam; many fine prominent yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 5/8) redoximorphic concentrations; massive; very firm; common fine white (10YR 8/1) irregularly shaped masses of carbonate; 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 45 inches
Thickness of the mollic epipedon: 10 to 18 inches
Thickness of sandy material: 20 to 40 inches

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Content of rock fragments—0 to 5 percent gravel

Bw or Bg horizon:
Value—3 to 6

Chroma—1 or 2 in the upper part; 1 to 4 in the lower part
Texture—loamy fine sand, fine sand, loamy sand, or sand
Content of rock fragments—0 to 5 percent gravel

2Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—fine sandy loam, loam, or sandy loam
Content of rock fragments—0 to 8 percent

481—Kratka fine sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)
Content of organic matter 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

- Grimstad and similar soils
- Northwood and similar soils
- Strathcona and similar soils
- Smiley and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

LaDelle Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow or moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 3 percent
Taxonomic classification: Fine-silty, mixed, superactive Cumulic Udic Haploborolls

Typical Pedon

LaDelle silt loam, 0 to 3 percent slopes, occasionally flooded, 300 feet west and 250 feet north of the southeast corner of sec. 15, T. 148 N., R. 49 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common fine and very fine roots; very slightly effervescent; slightly alkaline; clear smooth boundary.

A—11 to 20 inches; very dark gray (10YR 3/1) silt loam; weak fine and medium granular structure; friable; common fine and very fine roots; slightly alkaline; clear smooth boundary.

Bk—20 to 29 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak fine and medium subangular blocky structure; friable; common very fine roots; common fine white (10YR 8/1) irregularly shaped masses of carbonate; slightly effervescent; slightly alkaline; clear smooth boundary.

Akb—29 to 38 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure; friable; common very fine roots; many fine white (10YR 8/1) irregularly shaped masses of carbonate and common fine white (10YR 8/1) irregularly shaped carbonate threads; slightly effervescent; slightly alkaline; clear smooth boundary.

B´k1—38 to 55 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate medium subangular blocky structure; friable; many fine white (10YR 8/1) irregularly shaped masses of carbonate and common fine white (10YR 8/1) irregularly shaped carbonate threads; slightly effervescent; slightly alkaline; clear smooth boundary.

B´k2—55 to 69 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate medium

subangular blocky structure; firm; many fine white (10YR 8/1) irregularly shaped masses of carbonate; strongly effervescent; slightly alkaline; clear smooth boundary.

C—69 to 82 inches; dark brown (10YR 4/3) silty clay; massive; firm; many fine white (10YR 8/1) irregularly shaped masses of carbonate and common fine white (10YR 8/1) irregularly shaped carbonate threads; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 17 to 50 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1

Bk horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 to 5
Chroma—0 to 3
Texture—silty clay loam, silt loam, or loam

C horizon:
Hue—10YR or 2.5Y
Value—2 to 5
Chroma—1 to 4
Texture—silty clay, silty clay loam, loam, or silt loam with thin strata of sand, silt, clay loam, or clay

1323B—LaDelle silt loam, 0 to 3 percent slopes, occasionally flooded

Composition

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

Setting

Landform: Flood plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Silt loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Alluvium
Flooding: Occasional
Water table depth: 3.5 to 5.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 12.3 inches (high)
Content of organic matter 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

- Fairdale and similar soils
- Rauville and similar soils
- Zell and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Langhei Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 20 percent
Taxonomic classification: Fine-loamy, mixed, superactive, frigid Typic Eutrochrepts

Typical Pedon

Langhei loam, in an area of Langhei-Waukon complex, 12 to 20 percent slopes, eroded, 1,300 feet west and 2,550 feet south of the northeast corner of sec. 23, T. 147 N., R. 40 W.

Ap—0 to 7 inches; 60 percent very dark grayish brown (10YR 3/2) and 40 percent yellowish brown (10YR 5/4) loam; 60 percent grayish brown (10YR 5/2) and 40 percent light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; friable; many fine and medium roots; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 3 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk—7 to 19 inches; olive brown (2.5Y 4/3) loam; weak fine and medium subangular blocky structure; friable; many fine and medium roots; common fine and medium irregularly shaped white (2.5Y 8/2) masses of carbonate; 2 percent

gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

BCk—19 to 36 inches; light olive brown (2.5Y 5/3) loam; weak and moderate medium subangular blocky structure; friable; common fine and very fine roots; common fine irregularly shaped white (2.5Y 8/2) masses of carbonate; 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—36 to 57 inches; light olive brown (2.5Y 5/3) loam; massive but with moderate fine or medium subangular blocky soil fragments; friable; common fine and medium irregularly shaped white (2.5Y 8/2) masses of carbonate and common fine and medium rounded dark brown (10YR 4/3) clay bodies; 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—57 to 68 inches; light olive brown (2.5Y 5/3) loam; massive but with moderate fine subangular blocky soil fragments; firm; common fine irregularly shaped white (2.5Y 8/2) masses of carbonate; 3 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—68 to 80 inches; light olive brown (2.5Y 5/3) loam; massive; firm; few fine irregularly shaped white (2.5Y 8/2) masses of carbonate; 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Content of rock fragments: 2 to 10 percent gravel

A horizon:
Hue—10YR or 2.5Y
Chroma—1 or 2

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4

C horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—2 to 4
Texture—loam or clay loam

979D2—Langhei-Waukon complex, 12 to 20 percent slopes, eroded

Composition

Langhei and similar soils: About 55 percent
Waukon and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Langhei—summits and shoulder slopes; Waukon—summits and backslopes
Slope range: 12 to 20 percent

Component Description

Langhei

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 1.75 percent (moderately low)

Waukon

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter 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

- Smiley and similar soils
- Reiner and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Lindaas Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic classification: Fine, smectitic, frigid Typic Argiaquolls

Typical Pedon

Lindaas silty clay loam (fig. 16), 1,800 feet west and 100 feet north of the southeast corner of sec. 36, T. 149 N., R. 49 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

Bt1—9 to 17 inches; very dark gray (10YR 3/1) silty clay; weak medium prismatic structure parting to moderate fine angular blocky; friable; few faint very dark grayish brown (10YR 3/2) clay films on faces of peds; neutral; clear wavy boundary.

Bt2—17 to 24 inches; very dark gray (10YR 3/1) clay; moderate medium prismatic structure parting to strong fine angular blocky; firm; few faint dark gray (10YR 4/1) clay films on faces of peds; neutral; gradual wavy boundary.

Bt3—24 to 29 inches; very dark grayish brown (2.5Y 3/2) silty clay; few fine faint grayish brown (2.5Y 5/2) redoximorphic depletions; moderate medium prismatic structure parting to strong fine angular blocky; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; neutral; gradual wavy boundary.

Bk—29 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; weak medium subangular blocky structure; friable; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg1—40 to 62 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent dark brown (7.5YR 4/4) redoximorphic concentrations; weak medium platy soil fragments; friable; slightly effervescent; moderately alkaline; gradual wavy boundary.

Cg2—62 to 80 inches; light olive gray (5Y 6/2) silty clay loam; massive; friable; few fine irregularly shaped white (10YR 8/1) masses of carbonate; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 35 inches
Thickness of the mollic epipedon: 16 to 36 inches

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

Bt horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5

Bk horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—silty clay loam or silt loam

Cg horizon:
Value—5 to 7
Chroma—1 to 4
Texture—silty clay loam or silt loam

1916—Lindaas silty clay loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Flats and swales
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 1.0 foot above to 1.5 feet 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)
Content of organic matter 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

- Bearden and similar soils
- Bygland and similar soils
- Overly and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Linveldt Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—rapid; lower part—moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 3 percent
Taxonomic classification: Coarse-loamy, mixed, superactive Aquic Argiborolls

Typical Pedon

Linveldt fine sandy loam, 2,390 feet north and 200 feet west of the southeast corner of sec. 16, T. 151 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable; common very fine roots; 3 percent gravel; slightly alkaline; abrupt smooth boundary.

Bt—9 to 16 inches; dark brown (10YR 4/3) sandy loam; moderate medium subangular blocky structure; firm; few very fine roots; very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; 6 percent gravel; slightly alkaline; clear smooth boundary.

2Bw1—16 to 24 inches; grayish brown (10YR 5/2) gravelly loamy sand; weak medium subangular blocky structure; friable; few very fine roots; 18 percent gravel and 3 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bw2—24 to 29 inches; light yellowish brown (2.5Y 6/4) sand; common medium distinct light brownish gray (2.5Y 6/2) redoximorphic depletions and few medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; few fine cylindrical strong brown (7.5YR 5/6) masses of iron-manganese; 13 percent gravel; slightly effervescent; moderately alkaline; abrupt wavy boundary.

3Bk—29 to 45 inches; grayish brown (2.5Y 5/2) loam; common medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; friable; common fine discontinuous prominent dark brown (7.5YR 3/2) iron-manganese stains on vertical faces of peds; 5 percent gravel and 2 percent cobbles; common fine and medium irregular light gray (2.5Y 7/2) masses of carbonate; slightly effervescent; moderately alkaline; clear wavy boundary.

3Cg1—45 to 58 inches; olive gray (5Y 5/2) loam; many medium prominent dark yellowish brown (10YR 4/6) and few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; firm; common discontinuous prominent dark olive gray (5Y 3/2) iron-manganese stains on vertical faces of peds; 6 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

3Cg2—58 to 71 inches; olive gray (5Y 5/2) loam; common fine and medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; massive; firm; common discontinuous distinct black (5Y 2.5/1) iron-manganese stains on vertical faces of peds; 6 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

3Cg3—71 to 82 inches; olive gray (5Y 5/2) loam; common fine and medium prominent light olive brown (2.5Y 5/4) and few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; massive; firm; common discontinuous distinct black (5Y 2.5/1) iron-manganese stains on vertical faces of peds; 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 14 inches
Thickness of sandy material: 20 to 40 inches

A horizon:
Value—2 or 3
Chroma—1 or 2
Content of rock fragments—2 to 15 percent gravel

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—3 or 4
Texture—sandy loam, fine sandy loam, or loam
Content of rock fragments—2 to 15 percent gravel

2Bw horizon:
Texture—loamy sand, sand, fine sand, or loamy fine sand
Content of rock fragments—2 to 25 percent gravel and cobbles

3Bk horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam, clay loam, or fine sandy loam
Content of rock fragments—2 to 10 percent gravel and cobbles

3C horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam, clay loam, or fine sandy loam
Content of rock fragments—2 to 10 percent gravel and cobbles

713—Linveldt fine sandy loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)
Content of organic matter 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

- Kratka and similar soils
- Foldahl and similar soils
- Reiner and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Lizzie Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glaciolacustrine deposits
Slope range: 1 to 3 percent
Taxonomic classification: Fine-silty, mixed, superactive Boralfic Udic Argiborolls

Typical Pedon

Lizzie silt loam, 1 to 3 percent slopes, 1,225 feet west and 2,060 feet north of the southeast corner of sec. 29, T. 147 N., R. 43 W.

Ap—0 to 14 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak very fine and fine granular structure; very friable; few fine and common very fine roots between peds; neutral; abrupt smooth boundary.

Bt—14 to 24 inches; dark brown (10YR 4/3) silt loam; moderate fine subangular blocky structure; friable; few very fine roots; patchy faint light brownish gray (10YR 6/2) clean sand grains on vertical faces of peds; continuous faint dark brown (10YR 3/3) clay films on faces of peds; neutral; clear wavy boundary.

Bk—24 to 36 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; few fine irregularly shaped light gray (10YR 7/2) carbonate threads and masses;

strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—36 to 58 inches; yellowish brown (10YR 5/4) very fine sandy loam; massive; very friable; few fine irregularly shaped light gray (10YR 7/2) carbonate threads and masses; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C2—58 to 67 inches; stratified 80 percent yellowish brown (10YR 5/4) very fine sandy loam and 20 percent light yellowish brown (10YR 6/4) loamy very fine sand; massive; very friable; 1 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

C3—67 to 72 inches; light yellowish brown (10YR 6/4) silt loam; moderate thin platy soil fragments parting to weak fine angular blocky; friable; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—72 to 80 inches; brownish yellow (10YR 6/6) silt loam; common fine distinct brownish yellow (10YR 6/8) redoximorphic concentrations; moderate thin platy soil fragments parting to weak fine subangular blocky; friable; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 17 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 0 to 2 percent gravel

A horizon:
Value—2 or 3

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—silt loam or loam with 18 to 35 percent clay

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 or 4
Texture—silt loam, loam, fine sandy loam, or very fine sandy loam

C horizon:
Hue—10YR or 2.5Y
Chroma—3 to 6
Texture—stratified silt loam, very fine sandy loam, loamy very fine sand, or fine sand

707A—Lizzie silt loam, 1 to 3 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Flats and slight rises
Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: 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: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.8 inches (high)
Content of organic matter 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

- Brandsvold and similar soils
- Chapett and similar soils
- Maddock and similar soils
- Esmond and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Maddock Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid
Landform: Lake plains and outwash plains
Parent material: Glaciolacustrine deposits
Slope range: 1 to 30 percent

Taxonomic classification: Sandy, mixed Udorthentic Haploborolls

Typical Pedon

Maddock loamy fine sand, 1 to 6 percent slopes, 300 feet east and 110 feet north of the southwest corner of sec. 19, T. 147 N., R. 44 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.

Bw—10 to 15 inches; very dark grayish brown (10YR 3/2) fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose; neutral; clear wavy boundary.

C1—15 to 45 inches; dark brown (10YR 4/3) fine sand; single grain; loose; neutral; clear wavy boundary.

C2—45 to 64 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; neutral; clear wavy boundary.

C3—64 to 80 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 10 to 60 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Value—2 or 3
Chroma—1 or 2

Bw horizon:
Value—2 to 5
Chroma—2 to 4
Texture—fine sand, loamy fine sand, or loamy sand

C horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 4
Texture—fine sand, loamy fine sand, or loamy sand

45B—Maddock loamy fine sand, 1 to 6 percent slopes

Composition

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

Setting

Landform: Lake plains and outwash plains
Position on the landform: Rises and backslopes
Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.4 inches (low)
Content of organic matter 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

- Hamar and similar soils
- Sandberg and similar soils
- Flaming and similar soils
- Halverson and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

45C—Maddock loamy fine sand, 6 to 12 percent slopes

Composition

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

Setting

Landform: Lake plains and outwash plains
Position on the landform: Rises, summits, and backslopes
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.4 inches (low)
Content of organic matter 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

- Hamar and similar soils
- Sandberg and similar soils
- Flaming and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- "Agronomy" section

45E—Maddock loamy fine sand, 12 to 30 percent slopes

Composition

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

Setting

Landform: Lake plains and outwash plains
Position on the landform: Summits and backslopes
Slope range: 12 to 30 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.4 inches (low)
Content of organic matter 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

- Sandberg and similar soils
- Serden and similar soils

Major Uses of the Unit

- Hayland
- Pasture
- Wildlife habitat

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

- "Agronomy" section
- "Wildlife Habitat" section

Mahkonce Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Moraines
Parent material: Till
Slope range: 1 to 3 percent
Taxonomic classification: Fine, smectitic Aquic Eutroboralfs

Typical Pedon

Mahkonce loam, 2,600 feet south and 250 feet east of the northwest corner of sec. 4, T. 147 N., R. 36 W. (Clearwater County):

A—0 to 4 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; 2 percent gravel; moderately acid; clear smooth boundary.

E—4 to 9 inches; grayish brown (2.5Y 5/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak thin platy structure; very friable; many fine roots; 2 percent gravel; moderately acid; clear smooth boundary.

Bt1—9 to 18 inches; olive brown (2.5Y 4/4) clay; few fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; strong medium angular blocky structure; very firm; common medium roots; many distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; 2 percent gravel; slightly acid; clear wavy boundary.

Bt2—18 to 26 inches; olive brown (2.5Y 4/4) clay;

common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions and common medium distinct olive yellow (2.5Y 6/6) redoximorphic concentrations; strong medium angular blocky structure; very firm; few medium roots; many distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; 2 percent gravel; slightly acid; clear wavy boundary.

BC—26 to 34 inches; light olive brown (2.5Y 5/4) clay loam; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions and common medium distinct olive yellow (2.5Y 6/8) redoximorphic concentrations; moderate medium subangular blocky structure; firm; few medium roots; common distinct very dark grayish brown (2.5Y 3/2) clay films in old root channels; 6 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions and common medium distinct olive yellow (2.5Y 6/8) redoximorphic concentrations; massive; firm; 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Content of rock fragments: 1 to 8 percent gravel

A horizon:
Value—2 or 3
Chroma—1 or 2

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 3
Texture—fine sandy loam or loam

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay, silty clay, silty clay loam, or clay loam

BC horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay loam, silty clay loam, or loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, clay loam, or silty clay loam

737—Mahkonce loam

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises
Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Auganaush and similar soils
- Naytahwaush and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Markey Series

Depth class: Very deep
Drainage class: Very poorly drained

Permeability: Upper part—moderately slow to moderately rapid; lower part—rapid
Landform: Outwash plains, lake plains, and moraines
Parent material: Organic material over glaciolacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Markey muck, 950 feet west and 160 feet north of the southeast corner of sec. 15, T. 151 N., R. 39 W.

Oa—0 to 12 inches; black (10YR 2/1) muck; about 20 percent fiber, 5 percent rubbed; weak medium subangular blocky structure; nonsticky; neutral; clear wavy boundary.
Oe—12 to 17 inches; black (10YR 2/1) mucky peat; about 60 percent fiber, 25 percent rubbed; weak thick platy structure; nonsticky; neutral; clear smooth boundary.
O´a—17 to 32 inches; black (10YR 2/1) muck; about 5 percent fiber, trace rubbed; weak thin platy structure; nonsticky; neutral; abrupt smooth boundary.
Cg1—32 to 41 inches; grayish brown (2.5Y 5/2) fine sand; few medium distinct olive brown (2.5Y 4/4) redoximorphic concentrations; massive; loose; 4 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
Cg2—41 to 52 inches; light brownish gray (2.5Y 6/2) fine sand; massive; loose; 3 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
Cg3—52 to 63 inches; grayish brown (2.5Y 5/2) fine sand; few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; single grain; loose; 1 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
Cg4—63 to 72 inches; grayish brown (2.5Y 5/2) fine sand; few fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 1 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.
Cg5—72 to 80 inches; grayish brown (2.5Y 5/2) fine sand; many fine and medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; single grain; loose; 4 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Content of woody fragments: 0 to 15 percent, by volume
Fiber content: 10 to 65 percent unrubbed, 0 to 15 percent rubbed (up to 30 percent rubbed in hemic layers)

Oa and Oe horizons:
Hue—10YR, 7.5YR, 5YR, 2.5YR, or neutral
Value—2 to 4
Chroma—0 to 3

C horizon:
Hue—7.5YR, 10YR, 2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 4
Texture—sand, fine sand, or loamy sand containing up to 15 percent gravel

543—Markey muck

Composition

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

Setting

Landform: Lake plains, outwash plains, and moraines
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glacial outwash or glaciolacustrine deposits
Flooding: None
Water table depth: 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 14.3 inches (high)
Content of organic matter in the surface layer: About 70 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

- Berner and similar soils
- Deerwood and similar soils
- Seelyeville and similar soils
- Hamar and similar soils

- Syrene and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- “Wildlife Habitat” section

Marquette Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Upper part—moderately rapid; lower part—very rapid
Landform: Beach ridges
Parent material: Beach deposits
Slope range: 1 to 30 percent
Taxonomic classification: Loamy-skeletal, mixed, superactive Ochreptic Eutroboralfs

Typical Pedon

Marquette loamy sand, 1 to 8 percent slopes, 2,000 feet east and 1,900 feet north of the southwest corner of sec. 25, T. 150 N., R. 40 W.

Ap—0 to 8 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine and very fine granular structure; very friable; common very fine and fine roots; 10 percent gravel; slightly acid; clear wavy boundary.

Bt—8 to 18 inches; dark yellowish brown (10YR 3/4) very gravelly sandy loam; weak fine subangular blocky structure; very friable; common discontinuous distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; common very fine and fine roots; 25 percent gravel and 15 percent cobbles; neutral; abrupt wavy boundary.

C1—18 to 30 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; single grain; loose; few fine roots around cobbles; 25 percent gravel and 10 percent cobbles; common prominent light gray (10YR 7/2) carbonate coatings on the lower surfaces of cobbles; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C2—30 to 53 inches; light yellowish brown (10YR 6/4) very gravelly coarse sand; single grain; loose; 30 percent gravel and 15 percent cobbles; common prominent light gray (10YR 7/2) carbonate coatings on the lower surfaces of cobbles; slightly effervescent; moderately alkaline; clear wavy boundary.

C3—53 to 65 inches; light brownish gray (10YR 6/2) gravelly coarse sand; single grain; loose; 30 percent gravel and 15 percent cobbles; slightly effervescent; moderately alkaline; clear wavy boundary.

C4—65 to 80 inches; pale brown (10YR 6/3) gravelly coarse sand; single grain; loose; 25 percent gravel and 15 percent cobbles; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 8 to 30 inches
Other features: Some pedons have a thin E horizon.

A horizon:
Value—2 to 4
Chroma—1 to 3
Content of rock fragments—0 to 30 percent gravel and cobbles

Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 or 4
Texture—sandy loam or fine sandy loam or the very gravelly or extremely gravelly analogs of these textures
Content of rock fragments—35 to 65 percent gravel and cobbles

C horizon:
Chroma—2 to 5
Texture—gravelly, very gravelly, or extremely gravelly coarse sand or sand
Content of rock fragments—10 to 75 percent gravel and cobbles

242B—Marquette loamy sand, 1 to 8 percent slopes

Composition

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

Setting

Landform: Beach ridges
Position on the landform: Rises and backslopes
Slope range: 1 to 8 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: More than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.5 inches (low)
Content of organic matter 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

- Hangaard and similar soils
- Sandberg and similar soils
- Maddock and similar soils
- Chapett and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- "Agronomy" section
- "Forest Land" section

242D—Marquette loamy sand, 8 to 30 percent slopes

Composition

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

Setting

Landform: Beach ridges
Position on the landform: Summits and backslopes
Slope range: 8 to 30 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches (low)
Content of organic matter 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

- Sandberg and similar soils
- Maddock and similar soils
- Chapett and similar soils

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

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

- "Agronomy" section
- "Forest Land" section

Mavie Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—rapid; lower part—moderate or moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Sandy-skeletal over loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Mavie fine sandy loam, 200 feet south and 720 feet west of the northeast corner of sec. 34, T. 154 N., R. 46 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; 1 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ak—8 to 16 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; 1 percent gravel; few fine light gray (10YR 7/2) irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

2Cg1—16 to 24 inches; light brownish gray (2.5Y 6/2) very gravelly sand; few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; single

grain; loose; 45 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg2—24 to 30 inches; light brownish gray (2.5Y 6/2) very gravelly coarse sand; few fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; single grain; loose; 50 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

3Cg3—30 to 48 inches; light brownish gray (2.5Y 6/2) loam; common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; massive; friable; 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

3Cg4—48 to 61 inches; grayish brown (2.5Y 5/2) loam; few medium prominent yellowish red (5YR 5/6) and common fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; firm; 5 percent gravel; few fine black (10YR 2/1) manganese stains; slightly effervescent; slightly alkaline; clear smooth boundary.

3Cg5—61 to 72 inches; olive gray (5Y 5/2) loam; common fine and medium prominent strong brown (7.5YR 5/6) and common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; firm; 4 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

3Cg6—72 to 81 inches; grayish brown (2.5Y 5/2) loam; common fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; firm; 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Thickness of sandy material: 20 to 40 inches
Other features: Some pedons have a Bk horizon, which has properties similar to those of the Ak horizon.

Ap horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Content of rock fragments—0 to 15 percent gravel

Ak horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—fine sandy loam, sandy loam, loam, or sandy clay loam
Content of rock fragments—0 to 15 percent gravel

2Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—very gravelly or extremely gravelly sand, coarse sand, or loamy sand
Content of rock fragments—35 to 75 percent gravel

3Cg horizon:
Value—4 to 6
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—0 to 15 percent gravel

412—Mavie fine sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.3 inches (moderate)
Content of organic matter 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

- Foxhome and similar soils

- Hamre and similar soils
- Northwood and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Naytahwaush Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Moraines
Parent material: Till
Slope range: 2 to 30 percent
Taxonomic classification: Fine, smectitic Mollic Eutroboralfs

Typical Pedon

Naytahwaush loam, 2 to 8 percent slopes, 1,500 feet south and 800 feet west of the northeast corner of sec. 25, T. 147 N., R. 40 W.

A—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; common fine roots; 5 percent gravel; neutral; abrupt smooth boundary.

Bt1—7 to 17 inches; olive brown (2.5Y 4/4) clay; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many prominent very dark grayish brown (10YR 3/2) continuous clay films on faces of peds and in pores; 5 percent gravel; neutral; clear wavy boundary.

Bt2—17 to 22 inches; olive brown (2.5Y 4/4) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; many prominent very dark grayish brown (10YR 3/2) continuous clay films on faces of peds and in pores; 5 percent gravel; neutral; clear wavy boundary.

Btk—22 to 31 inches; light olive brown (2.5Y 5/4) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; many prominent very dark grayish brown (10YR 3/2) continuous clay films on faces of peds and in pores; 5 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bk1—31 to 54 inches; light olive brown (2.5Y 5/4) clay loam; few fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; massive; friable; 5 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bk2—54 to 67 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 5/8) relict redoximorphic concentrations; massive; firm; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 4 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk3—67 to 80 inches; brown (10YR 5/3) clay loam; common fine and medium distinct light yellowish brown (10YR 6/4) and few fine prominent yellowish red (5YR 5/8) relict redoximorphic concentrations; massive; firm; common fine irregularly shaped white (10YR 8/1) masses of carbonate; 4 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 21 to 40 inches
Content of rock fragments: 1 to 8 percent gravel and cobbles
Other features: Some pedons have a thin E horizon.

A horizon:
Value—2 or 3
Chroma—1 or 2

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—3 or 4
Texture—clay, silty clay, silty clay loam, or clay loam

Btk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 or 4
Texture—clay, silty clay, silty clay loam, or clay loam

Bk horizon:
Value—4 to 6
Chroma—3 to 5
Texture—clay loam or silty clay loam

C horizon (if it occurs):
Hue—2.5Y or 10YR
Value—4 to 6
Chroma—3 to 5
Texture—clay loam or silty clay loam

718B—Naytahwaush loam, 2 to 8 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises and backslopes
Slope range: 2 to 8 percent

Component Description

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)
Content of organic matter 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

- Auganaush and similar soils
- Langhei and similar soils
- Mahkonce and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

718C—Naytahwaush loam, 8 to 15 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 8 to 15 percent

Component Description

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)
Content of organic matter 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

- Auganaush and similar soils
- Langhei and similar soils
- Mahkonce and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

718E—Naytahwaush loam, 15 to 30 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 15 to 30 percent

Component Description

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)
Content of organic matter 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

- Auganaush and similar soils
- Langhei and similar soils
- Mahkonce and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- "Agronomy" section
- "Forest Land" section

Nielsville Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately slow; lower part—very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Nielsville silty clay loam, 800 feet east and 450 feet south of the northwest corner of sec. 27, T. 147 N., R. 48 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; friable; few very fine roots; few fine irregularly shaped masses of carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bkg1—9 to 17 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/8) redoximorphic concentrations; moderate medium subangular blocky structure; friable; few very fine roots; common fine irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—17 to 28 inches; light olive gray (5Y 6/2) silty clay loam; many fine and medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; moderate medium subangular blocky structure; friable; few very fine roots; common fine irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Cg1—28 to 45 inches; light olive gray (5Y 6/2) silty clay loam; common fine and medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; platy soil fragments; firm; few fine irregularly shaped masses of carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.

2Cg2—45 to 63 inches; light brownish gray (2.5Y 6/2) clay; common fine prominent reddish yellow (7.5YR 6/8) redoximorphic concentrations; massive; angular blocky soil fragments; very firm; few fine threads and masses of carbonate; 5 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

2Cg3—63 to 80 inches; olive gray (5Y 4/2) clay; common fine and medium prominent reddish yellow (7.5YR 6/8) redoximorphic concentrations; massive; angular blocky soil fragments; very firm; common medium irregularly shaped masses of carbonate; 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches
Depth to the 2C horizon: 40 to 60 inches

Ap horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1

Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 6
Chroma—0 to 2

Texture—silty clay loam or silt loam

Cg horizon:
Hue—2.5Y or 5Y
Value—3 to 6
Chroma—1 to 4
Texture—silty clay loam or laminated silty clay loam and silt loam

2Cg horizon:
Value—3 to 6
Chroma—1 to 3
Texture—clay or silty clay with a noncarbonate clay content ranging from 40 to 70 percent
Content of rock fragments—0 to 8 percent gravel

1119—Nielsville silty clay loam

Composition

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

Setting

Landform: Flats and slight rises on lake plains
Position on the landform: Flats
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Perella and similar soils
- Gunclub and similar soils
- Clearwater and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

1122—Nielsville-Perella complex

Composition

Nielsville and similar soils: About 50 percent
Perella and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Nielsville—flats; Perella—swales
Slope range: 0 to 1 percent

Component Description

Nielsville

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 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)
Content of organic matter in the surface layer: About 5.5 percent (high)

Perella

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Gunclub and similar soils
- Clearwater and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Northwood Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderately rapid; middle part—rapid; lower part—moderate
Landform: Lake plains
Parent material: Organic material and glaciolacustrine deposits over till
Slope range: 0 to 1 percent
Taxonomic classification: Sandy over loamy, mixed, superactive, nonacid, frigid Histic Humaquepts

Typical Pedon

Northwood muck, 370 feet north and 290 feet west of the southeast corner of sec. 16, T. 151 N., R. 39 W.

Oa—0 to 9 inches; black (10YR 2/1) muck; moderate very fine granular structure; many very fine roots; slightly acid; abrupt smooth boundary.
A—9 to 16 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak medium subangular blocky structure; friable; few very fine roots; slightly alkaline; clear smooth boundary.
Bg—16 to 31 inches; grayish brown (2.5Y 5/2) loamy fine sand; many medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; single grain; very friable; slightly alkaline; abrupt wavy boundary.
2Cg1—31 to 55 inches; grayish brown (2.5Y 5/2) clay loam; many medium prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; massive; friable; 3 percent gravel; few fine irregularly shaped white (10YR 8/1) masses of carbonate; slightly effervescent; slightly alkaline; clear smooth boundary.
2Cg2—55 to 67 inches; grayish brown (2.5Y 5/2) loam; common fine and medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; friable; 3 percent gravel; few distinct very dark grayish brown (2.5Y 3/2) discontinuous manganese stains on faces of peds and in pores; strongly effervescent; moderately alkaline; clear smooth boundary.
2Cg3—67 to 81 inches; olive gray (5Y 5/2) loam; many medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; massive; friable; 4 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the organic material: 8 to 16 inches
Depth to carbonates: 20 to 60 inches
Depth to the 2C horizon: 20 to 40 inches

Oa horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 or 3
Chroma—1 or 2
Content of woody fragments—0 to 15 percent

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loamy fine sand, loamy coarse sand, loamy sand, sandy loam, or fine sandy loam
Content of rock fragments—0 to 15 percent gravel

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—loamy fine sand, coarse sand, sand, fine sand, loamy coarse sand, or loamy sand
Content of rock fragments—0 to 15 percent gravel

2Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—4 to 7
Chroma—1 or 2
Texture—clay loam, loam, fine sandy loam, or silty clay loam
Content of rock fragments—0 to 8 percent gravel

563—Northwood muck

Composition

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

Setting

Landform: Lake plains

Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: 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
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 67.5 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

- Kratka and similar soils
- Mavie and similar soils
- Strathcona and similar soils
- Berner and similar soils

Major Uses of the Unit

- Wildlife habitat
- Cropland
- Hayland
- Pasture

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

- “Wildlife Habitat” section
- “Agronomy” section

1422—Northwood muck, marl subsoil

Composition

Northwood 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

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over till or glacial outwash
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 67.5 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

- Berner and similar soils
- Seelyeville and similar soils
- Northwood and similar soils

Major Uses of the Unit

- Wildlife habitat
- Cropland
- Hayland
- Pasture

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

- “Wildlife Habitat” section
- “Agronomy” section

Onstad Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Coarse-loamy, mixed, superactive Aquic Haploborolls

Typical Pedon

Onstad loam (fig. 17), 1,060 feet west and 240 feet north of the southeast corner of sec. 1, T. 147 N., R. 42 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; common very fine roots; 2 percent gravel and 1 percent cobbles; neutral; abrupt smooth boundary.

Bw—10 to 17 inches; olive brown (2.5Y 4/4) fine sandy loam; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; common very fine roots; 2 percent gravel and 1 percent cobbles; neutral; clear wavy boundary.

Bk1—17 to 31 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; weak thin platy structure; friable; common very fine roots; common fine irregularly shaped very pale brown (10YR 7/3) masses of carbonate; 5 percent gravel and 1 percent cobbles; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk2—31 to 47 inches; light olive brown (2.5Y 5/4) very fine sandy loam; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; moderate thin platy structure parting to weak fine subangular blocky; friable; common very fine roots; common fine irregularly shaped very pale brown (10YR 7/3) masses of carbonates; 2 percent gravel and 1 percent cobbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk3—47 to 66 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; few medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; moderate medium platy structure parting to weak medium subangular blocky; friable; common fine irregularly shaped very pale brown (10YR 7/3) masses of carbonate; few fine rounded yellowish brown (10YR 5/6) redoximorphic concentrations in peds; 3 percent gravel and 1 percent cobbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—66 to 80 inches; light olive brown (2.5Y 5/4) fine sandy loam; few coarse distinct grayish brown (2.5Y 5/2) redoximorphic depletions; moderate thick platy soil fragments; firm; common fine irregularly shaped very pale brown (10YR 7/3) masses of carbonate; 3 percent gravel and 1 percent cobbles; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 30 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 1 to 10 percent gravel

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—fine sandy loam, loam, very fine sandy loam, or sandy loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—very fine sandy loam, fine sandy loam, loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—very fine sandy loam, fine sandy loam, loam, or sandy loam

671—Onstad loam

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter 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

- Hedman and similar soils
- Esmond and similar soils
- Heimdal and similar soils
- Fram and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Overly Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Lacustrine sediments
Slope range: 0 to 3 percent
Taxonomic classification: Fine-silty, mixed, superactive Pachic Udic Haploborolls

Typical Pedon

Overly silty clay loam, 860 feet west and 2,200 feet north of the southeast corner of sec. 14, T. 148 N., R. 49 W.

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

A—10 to 18 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; neutral; gradual wavy boundary.

Bw—18 to 24 inches; dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; clear wavy boundary.

Bk1—24 to 32 inches; light olive brown (2.5Y 5/4) silty clay loam; common fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; weak thin platy structure; friable; common light gray (10YR 7/2) threads and masses of carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2—32 to 46 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak thin platy structure; friable; common light gray (10YR 7/2) threads of carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

C1—46 to 67 inches; grayish brown (2.5Y 5/2), stratified silty clay loam and silt loam; common medium prominent dark brown (7.5YR 3/4) redoximorphic concentrations; weak medium platy soil fragments; friable; slightly effervescent; slightly alkaline; gradual smooth boundary.

C2—67 to 80 inches; grayish brown (2.5Y 5/2), stratified silty clay and silt loam; common fine prominent light gray (10YR 7/2) and many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate thick platy soil fragments; firm; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches
Thickness of the mollic epipedon: 16 to 30 inches
Clay content: 27 to 35 percent

Bw horizon:
Hue—10YR or 2.5Y
Value—2 to 4
Chroma—1 to 4
Texture—silty clay loam or silt loam

Bk horizon:
Hue—2.5Y or 10YR
Value—3 to 6
Chroma—1 to 4
Texture—silty clay loam or silt loam

C horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 4
Texture—stratified silty clay loam, silt loam, silty clay, or clay loam

506—Overly silty clay loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine sediments
Flooding: None
Water table depth: 3 to 5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)
Content of organic matter 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

- Lindaas and similar soils
- Bygland and similar soils
- Bearden and similar soils
- Colvin and similar soils
- Perella and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Perella Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, mixed, superactive, frigid Typic Endoaquolls

Typical Pedon

Perella silty clay loam, in an area of Colvin-Perella complex, 200 feet west and 1,400 feet south of the northeast corner of sec. 1, T. 153 N., R. 50 W.

Ap—0 to 10 inches; black (2.5Y 2.5/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; slightly alkaline; abrupt smooth boundary.

A—10 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; few fine distinct grayish brown (10YR 5/2) redoximorphic depletions; weak coarse subangular blocky structure; friable; slightly alkaline; gradual wavy boundary.

Bg—16 to 23 inches; very dark gray (5Y 3/1) silty clay; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak coarse prismatic structure parting to moderate very fine angular blocky; firm; many black (10YR 2/1) organic coatings on faces of peds; neutral; clear wavy boundary.

Bkg1—23 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; weak thin platy soil fragments; friable; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkg2—31 to 53 inches; grayish brown (2.5Y 5/2) silt loam; common fine prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; weak thin platy soil fragments; friable; slightly effervescent; slightly alkaline; clear wavy boundary.

Bkg3—53 to 62 inches; dark grayish brown (2.5Y 4/2) silt loam; many fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations and few fine distinct dark reddish brown (5YR 3/2) redoximorphic depletions; weak thin platy soil fragments parting to moderate fine and medium subangular blocky; friable; common medium irregularly shaped pale yellow (2.5Y 7/4) masses of carbonate; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg1—62 to 74 inches; olive brown (2.5Y 4/4) silty clay loam; many fine and medium prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; massive; friable; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—74 to 80 inches; olive brown (2.5Y 4/4) silty clay loam; many fine and medium prominent dark reddish brown (5YR 3/2) redoximorphic depletions; massive; friable; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1

Bg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 4
Chroma—0 to 3
Texture—silty clay loam, silty clay, or silt loam

Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 5
Texture—silty clay loam or silt loam with an average clay content of 18 to 35 percent

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 4
Texture—stratified silty clay loam, silt loam, or silt

1030—Pits, gravel-Udipsamments complex

Composition

Pits, gravel: About 70 percent
Udipsamments: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and lake plains
Slope range: 1 to 50 percent

Component Description

Pits, gravel

Dominant parent material: Beach deposits

Udipsamments

Texture of the surface layer: Sand
Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glaciofluvial deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)

A taxonomic unit description of Udipsamments with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Marquette and similar soils
- Sandberg and similar soils
- Maddock and similar soils

Radium Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Beach ridges
Parent material: Beach deposits
Slope range: 0 to 3 percent
Taxonomic classification: Sandy, mixed Aquic Haploborolls

Typical Pedon

Radium loamy sand, 1,590 feet south and 100 feet east of the northwest corner of sec. 9, T. 147 N., R. 45 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; common fine roots; 5 percent gravel; neutral; abrupt smooth boundary.

A—10 to 14 inches; very dark grayish brown (10YR 3/2) loamy sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; common fine roots; 5 percent gravel; neutral; clear wavy boundary.

Bw—14 to 32 inches; brown (10YR 4/3) gravelly sand; single grain; loose; few fine roots between peds; 25 percent gravel; few distinct white (10YR 8/2) patchy carbonate coatings on gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

C1—32 to 46 inches; pale brown (10YR 6/3) sand; common fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; single grain; loose; few fine roots matted around stones; 8 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

C2—46 to 58 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; few medium distinct olive brown (2.5Y 4/4) redoximorphic concentrations; single grain; loose; 18 percent gravel; very few distinct white (10YR 8/2) patchy carbonate coatings on gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

C3—58 to 71 inches; light gray (2.5Y 7/2) gravelly coarse sand; single grain; loose; 20 percent gravel; common distinct white (10YR 8/2) patchy carbonate coatings on gravel; slightly

effervescent; slightly alkaline; clear wavy boundary.

C4—71 to 80 inches; light yellowish brown (2.5Y 6/3) gravelly coarse sand; single grain; loose; 23 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 10 to 24 inches
Thickness of the mollic epipedon: 10 to 17 inches
Content of rock fragments: Averages 10 to 35 percent gravel in the 10- to 40-inch particle-size control section
Other features: Some pedons have an AC horizon, and some pedons have a Bk horizon.

Bw horizon:
Value—2 to 4
Chroma—1 to 3
Texture—loamy sand, sand, loamy fine sand, gravelly sand, or gravelly loamy coarse sand

C horizon:
Value—4 to 7
Chroma—2 to 4
Texture—gravelly coarse sand, sand, coarse sand, fine sand, or loamy coarse sand

1874—Radium loamy sand

Composition

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

Setting

Landform: Beach ridges
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Beach deposits
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 3.6 inches (low)
Content of organic matter 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

- Syrene and similar soils
- Sandberg and similar soils
- Hangaard and similar soils
- Strathcona and similar soils
- Marquette and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Rauville Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls

Typical Pedon

Rauville silty clay loam, 600 feet east and 1,300 feet south of the northwest corner of sec. 27, T. 150 N., R. 47 W.

A1—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; common fine and medium roots; slightly effervescent; slightly alkaline; clear smooth boundary.

A2—10 to 22 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure parting to weak fine and medium subangular blocky; friable; common fine and medium roots; strongly effervescent; slightly alkaline; clear smooth boundary.

A3—22 to 36 inches; very dark gray (10YR 3/1) silty clay loam; few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; weak fine and medium subangular blocky structure; friable; common fine and medium roots; strongly

effervescent; moderately alkaline; abrupt smooth boundary.

Cg1—36 to 52 inches; dark grayish brown (2.5Y 4/2) silty clay loam; many medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; friable; few fine roots; few fine shell fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg2—52 to 65 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent strong brown (7.5YR 5/6 and 5/8) redoximorphic concentrations; massive; firm; few fine shell fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg3—65 to 75 inches; very dark grayish brown (2.5Y 3/2) silty clay; common fine and medium prominent strong brown (7.5YR 5/6 and 5/8) redoximorphic concentrations; massive; firm; few fine shell fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg4—75 to 82 inches; olive gray (5Y 4/2) silty clay; common fine and medium prominent reddish yellow (7.5YR 6/8) redoximorphic concentrations; massive; firm; 1 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 60 inches
Other features: Some pedons have an Ak horizon and a Bkg horizon.

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Chroma—0 to 2

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 6
Chroma—0 to 2
Texture—silty clay loam or silt loam; silty clay, clay loam, or loam below a depth of 40 inches in some pedons

450—Rauville silty clay loam

Composition

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

Setting

Landform: Flood plains
Position on the landform: Oxbows
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Water table depth: At the surface to 0.5 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.8 inches (high)
Content of organic matter 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

- Fairdale and similar soils
- LaDelle and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- “Wildlife Habitat” section

Reiner Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, superactive Abruptic Udic Argiborolls

Typical Pedon

Reiner fine sandy loam, 210 feet west and 1,930 feet north of the southeast corner of sec. 2, T. 150 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; few roots; 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 13 inches; olive brown (2.5Y 4/3) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; many distinct dark brown (10YR 3/3) clay films on faces of peds; 5 percent gravel; neutral; clear wavy boundary.

Bt2—13 to 20 inches; olive brown (2.5Y 4/4) clay loam; few medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 5 percent gravel; neutral; gradual wavy boundary.

Bk—20 to 32 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light grayish brown (2.5Y 6/2) redoximorphic depletions; massive; firm; 8 percent gravel; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—32 to 47 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct light olive brown (2.5Y 5/4) and common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium platy soil fragments; firm; 8 percent gravel; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

C2—47 to 63 inches; light olive brown (2.5Y 5/3) loam; common medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; massive; firm; 6 percent gravel; few fine dark grayish brown (10YR 4/2) manganese stains; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—63 to 71 inches; light olive brown (2.5Y 5/3) loam; many fine and medium prominent yellowish brown (10YR 5/8) and few fine yellowish red (5YR 5/8) redoximorphic concentrations; massive; firm; 5 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—71 to 83 inches; light olive brown (2.5Y 5/3) loam; common medium prominent yellowish brown (10YR 5/8) and common medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; firm; 4 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 13 to 22 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 0 to 15 percent gravel

A horizon:
Value—2 or 3
Chroma—1 or 2

Bt horizon:
Hue—2.5Y or 10YR
Value—3 to 5
Chroma—2 to 4
Texture—clay loam, loam, or sandy clay loam

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

C horizon:
Chroma—2 to 4
Texture—loam or clay loam

650—Reiner fine sandy loam

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)
Content of organic matter 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

- Smiley and similar soils

- Kratka and similar soils
- Foldahl and similar soils
- Linveldt and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Reis Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine, smectitic, frigid Typic Calciaquerts

Typical Pedon

Reis clay, in an area of Reis-Clearwater complex, 1,270 feet west and 190 feet north of the southeast corner of sec. 1, T. 147 N., R. 48 W.

Ap—0 to 9 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; few fine prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; weak fine and medium subangular blocky structure parting to weak fine granular; friable; many fine roots; common fine rounded light gray (10YR 7/2) masses of carbonate; 2 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A/Bk—9 to 17 inches; about 60 percent very dark gray (10YR 3/1) clay occurring as tongues (A) and 40 percent grayish brown (2.5Y 5/2) clay (Bk); 60 percent dark gray (10YR 4/1) (A) and 40 percent white (2.5Y 8/2) (Bk) dry; common fine and medium faint dark grayish brown (2.5Y 4/2) redoximorphic depletions; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; many fine roots; 2 percent gravel; common fine irregularly shaped light gray (2.5Y 7/2) masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Bkss1—17 to 24 inches; grayish brown (2.5Y 5/2) clay, light brownish gray (2.5Y 6/2) dry; common fine faint light brownish gray (2.5Y 6/2) redoximorphic depletions and many fine and medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak and moderate medium subangular blocky structure parting to weak very fine subangular blocky; friable; common fine roots; few distinct intersecting slickensides tilting less than 45 degrees from the horizontal; cracks 1/4 inch to 3 inches wide and 2 to 4 feet apart filled with material from the A horizon; few prominent very dark gray (10YR 3/1) patchy organic coatings on vertical and horizontal faces of peds; 2 percent gravel; common fine irregularly shaped light gray (2.5Y 7/2) threads of carbonates; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkss2—24 to 33 inches; 60 percent olive gray (5Y 4/2) and 40 percent olive gray (5Y 5/2) clay; light olive gray (5Y 6/2) dry; common fine prominent brown (7.5YR 5/4) redoximorphic concentrations; weak and moderate medium subangular blocky structure parting to weak very fine subangular blocky; friable; few fine roots between peds; few distinct intersecting slickensides tilting less than 60 degrees from the horizontal; cracks 1/4 inch to 2 inches wide and 2 to 4 feet apart filled with material from the A horizon; very few prominent dark brown (7.5YR 3/2) patchy manganese or iron-manganese stains on vertical faces of peds; common fine irregularly shaped light gray (2.5Y 7/2) threads of carbonate; 5 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg—33 to 42 inches; 60 percent olive gray (5Y 4/2) and 40 percent olive brown (2.5Y 4/3) clay; common fine prominent brown (7.5YR 4/4) redoximorphic concentrations; strong medium angular blocky structure parting to moderate very fine subangular blocky; firm; very few prominent yellowish red (5YR 4/6) patchy manganese or iron-manganese stains on vertical faces of peds; few fine irregularly shaped light gray (2.5Y 7/2) threads of carbonate; 3 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg1—42 to 60 inches; 60 percent olive gray (5Y 4/2) and 40 percent light olive brown (2.5Y 5/4) clay; common fine prominent brown (7.5YR 4/4) redoximorphic concentrations; strong medium prismatic soil fragments parting to moderate fine angular blocky; firm; very few prominent reddish brown (5YR 5/4) and dark reddish brown (5YR 3/2) patchy iron-manganese stains on vertical faces of soil fragments; common fine irregularly

shaped light gray (2.5Y 7/2) threads of carbonate; 2 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cg2—60 to 72 inches; olive (5Y 4/3) clay; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations and faint olive gray (5Y 4/2) redoximorphic depletions; strong medium prismatic soil fragments parting to moderate fine angular blocky; firm; very few prominent dark reddish brown (5YR 2/2) discontinuous iron-manganese stains on vertical and horizontal faces of soil fragments; few medium cylindrical nests of gypsum; common fine irregularly shaped light gray (2.5Y 7/2) threads of carbonate; 4 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—72 to 82 inches; olive brown (2.5Y 4/4) clay; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations and common fine distinct gray (5Y 5/1) redoximorphic depletions; strong coarse prismatic soil fragments parting to moderate fine and medium angular blocky; firm; dark reddish brown (5YR 2/2) manganese or iron-manganese stains on faces of soil fragments; very few light gray (2.5Y 7/2) discontinuous carbonate coatings on vertical and horizontal faces of soil fragments; 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 18 inches
Content of rock fragments: 1 to 10 percent gravel throughout

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Bkss horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay or silty clay

Bkg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay or silty clay

Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—4 to 6
Texture—clay or silty clay

1283—Reis-Clearwater complex

Composition

Reis and similar soils: About 50 percent
Clearwater and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Reis—flats; Clearwater—swales
Slope range: 0 to 2 percent

Component Description

Reis

Texture of the surface layer: Clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

Clearwater

Texture of the surface layer: Clay
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)
Content of organic matter 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

- Colvin and similar soils
- Hegne and similar soils
- Thiefriver and similar soils

Major Uses of the Unit

- Cropland

- Hayland
- Pasture

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

- “Agronomy” section

Roliss Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Moderately slow or moderate
Landform: Lake plains
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, superactive, calcareous, frigid Typic Endoaquolls

Typical Pedon

Roliss loam, 2,350 feet west and 560 feet north of the southeast corner of sec. 15, T. 151 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; few fine distinct dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak medium subangular blocky structure parting to weak fine granular; friable; few very fine roots; 4 percent gravel; very slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—9 to 14 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak medium prismatic structure parting to weak medium subangular blocky; friable; few very fine roots; 5 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Bg—14 to 20 inches; grayish brown (2.5Y 5/2) clay loam; common fine prominent strong brown (7.5YR 4/6) redoximorphic concentrations; weak medium subangular blocky structure; friable; few very fine roots; 5 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

Cg1—20 to 45 inches; grayish brown (2.5Y 5/2) loam; common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; massive; friable; few very fine roots; 5 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—45 to 59 inches; grayish brown (2.5Y 5/2) loam; common medium prominent yellowish brown (10YR 5/6) and few fine strong brown (7.5YR 5/6) redoximorphic concentrations; massive; firm; few very fine irregularly shaped white (10YR 8/1) masses of carbonate; 4 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg3—59 to 70 inches; dark grayish brown (2.5Y 4/2) loam; common and many fine and medium prominent yellowish brown (10YR 5/6) and few fine yellowish red (5YR 5/8) redoximorphic concentrations; massive; firm; few fine irregularly shaped white (10YR 8/1) masses of carbonate; 4 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg4—70 to 82 inches; grayish brown (2.5Y 5/2) loam; many medium prominent yellowish brown (10YR 5/6) and few fine yellowish red (5YR 5/8) redoximorphic concentrations; massive; firm; few discontinuous distinct black (2.5Y 2.5/1) manganese stains on faces of peds and in pores; 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 19 inches
Content of rock fragments: 2 to 15 percent gravel

A horizon:
Hue—10YR or neutral
Chroma—0 or 1

Bg horizon:
Hue—2.5Y or 5Y
Value—3 to 5
Chroma—1 or 2
Texture—clay loam, loam, silt loam, or fine sandy loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam

387—Roliss loam, depressional

Composition

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

Setting

Landform: Lake plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 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 10.7 inches (high)
Content of organic matter 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

- Hamre and similar soils
- Strathcona and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

582—Roliss loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Hamre and similar soils
- Reiner and similar soils
- Smiley and similar soils
- Kratka and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Rosewood Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, frigid Typic Calciaquolls

Typical Pedon

Rosewood fine sandy loam, 110 feet east and 1,370 feet north of the southwest corner of sec. 10, T. 150 N., R. 46 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; few fine roots; 1 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.
Bk—10 to 17 inches; dark gray (10YR 4/1) fine sandy

loam; few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations in the lower 3 inches; weak medium subangular blocky structure; very friable; few fine roots; 2 percent gravel; few fine white (10YR 8/1) irregularly shaped masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Cg1—17 to 30 inches; grayish brown (2.5Y 5/2) fine sand; many medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose; few fine roots; 2 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg2—30 to 58 inches; light brownish gray (2.5Y 6/2) sand; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose; 4 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg3—58 to 68 inches; light gray (2.5Y 7/2) sand; few fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; single grain; loose; slightly effervescent; slightly alkaline; clear wavy boundary.

Cg4—68 to 80 inches; light gray (5Y 7/2) sand; few fine prominent brownish yellow (10YR 6/8) redoximorphic concentrations; single grain; loose; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 0 to 10 percent gravel

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—fine sandy loam, sandy loam, loamy fine sand, or loamy sand

Cg horizon:
Value—4 to 7
Chroma—1 or 2

712—Rosewood fine sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches (low)
Content of organic matter 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

- Strathcona and similar soils
- Hamar and similar soils
- Ulen and similar soils
- Syrene and similar soils
- Deerwood and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

1278—Rosewood-Venlo complex

Composition

Rosewood and similar soils: About 50 percent
Venlo and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Rosewood—flats; Venlo—depressions
Slope range: Rosewood—0 to 2 percent; Venlo—0 to 1 percent

Component Description

Rosewood

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches (low)
Content of organic matter in the surface layer: About 5.5 percent (high)

Venlo

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 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 6.2 inches (moderate)
Content of organic matter 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

- Strathcona and similar soils
- Deerwood and similar soils
- Kratka and similar soils
- Ulen and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

1882—Rosewood, Strathcona, and Berner soils, seepy

Composition

Rosewood: Variable
Strathcona: Variable
Berner: Variable
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Seeps on side slopes
Slope range: Rosewood—0 to 2 percent; Strathcona—0 to 2 percent; Berner—0 to 1 percent

Component Description

Rosewood

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 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 5.4 inches (low)
Content of organic matter in the surface layer: About 5.5 percent (high)

Strathcona

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: At the surface to 0.5 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.7 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Berner

Texture of the surface layer: 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
Water table depth: At the surface to 0.5 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 13.8 inches (high)
Content of organic matter in the surface layer: About 87.5 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

- Vallers and similar soils
- Deerwood and similar soils
- Radium and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- “Wildlife Habitat” section

Sandberg Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Upper part—rapid; lower part—very rapid
Landform: Beach ridges
Parent material: Beach deposits
Slope range: 1 to 30 percent
Taxonomic classification: Sandy, mixed Udorthentic Haploborolls

Typical Pedon

Sandberg loamy sand (fig. 18), 1 to 6 percent slopes, 150 feet south and 75 feet west of the northeast corner of sec. 32, T. 148 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; many fine roots; 5 percent gravel; slightly acid; clear wavy boundary.

AB—10 to 14 inches; 70 percent very dark brown (10YR 2/2) and 30 percent dark brown (10YR 3/3) loamy sand; dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; common fine roots; 5 percent gravel; slightly acid; gradual wavy boundary.

Bw—14 to 19 inches; dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loamy sand; weak medium and fine subangular blocky structure; very friable; common fine roots; 10 percent gravel; neutral; abrupt wavy boundary.

C1—19 to 25 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) gravelly sand; single grain; loose; few fine roots; 20 percent gravel; strongly effervescent; slightly alkaline; abrupt wavy boundary.

C2—25 to 38 inches; pale brown (10YR 6/3) and very pale brown (10YR 7/3) sand; single grain; loose; few fine roots; 10 percent gravel; slightly effervescent; slightly alkaline; abrupt wavy boundary.

C3—38 to 51 inches; pale brown (10YR 6/3) and very pale brown (10YR 7/3) gravelly sand; single grain; loose; 25 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

C4—51 to 65 inches; light brownish gray (10YR 6/2) gravelly sand; single grain; loose; 20 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

C5—65 to 80 inches; light brownish gray (10YR 6/2) sand; single grain; loose; 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 5 to 35 percent gravel
Other features: Some pedons have a Bk horizon.

A horizon:
Value—2 or 3
Chroma—1 to 3

Bw horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 or 4
Texture—loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs of these textures

C horizon:
Hue—7.5YR, 10YR, or 2.5Y
Value—4 to 7
Chroma—2 to 6
Texture—sand or coarse sand or the gravelly analogs of these textures

258B—Sandberg loamy sand, 1 to 6 percent slopes

Composition

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

Setting

Landform: Beach ridges
Position on the landform: Rises and backslopes
Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches (low)
Content of organic matter 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

- Hangaard and similar soils
- Halverson and similar soils
- Radium and similar soils
- Marquette and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

258C—Sandberg loamy sand, 6 to 12 percent slopes

Composition

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

Setting

Landform: Beach ridges
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)
Content of organic matter 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

- Halverson and similar soils
- Radium and similar soils
- Marquette and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

258E—Sandberg loamy sand, 12 to 30 percent slopes

Composition

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

Setting

Landform: Beach ridges
Position on the landform: Summits and backslopes
Slope range: 12 to 30 percent

Component Description

Texture of the surface layer: Loamy sand

Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.2 inches (low)
Content of organic matter 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

- Halverson and similar soils
- Radium and similar soils
- Marquette 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

Seelyeville Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Landform: Lake plains and moraines
Parent material: Organic material
Slope range: 0 to 1 percent
Taxonomic classification: Euic Typic Borosaprists

Typical Pedon

Seelyeville muck, 2,100 feet west and 2,000 feet south of the northeast corner of sec. 7, T. 148 N., R. 42 W.

Oa1—0 to 20 inches; black (10YR 2/1) muck; about 5 percent fiber, trace rubbed; weak thin platy structure parting to weak medium subangular blocky; very friable; slightly acid; clear wavy boundary.
Oa2—20 to 36 inches; black (10YR 2/1) muck; about 20 percent fiber, 3 percent rubbed; weak thin platy structure parting to weak medium subangular blocky; very friable; slightly acid; clear wavy boundary.
Oa3—36 to 51 inches; black (10YR 2/1) muck; about 2 percent fiber, trace rubbed; weak thin platy structure; very friable; slightly acid; clear wavy boundary.
Oa4—51 to 65 inches; black (10YR 2/1) muck; about 2 percent fiber, trace rubbed; weak thin platy structure; very friable; slightly acid; clear wavy boundary.
Cg—65 to 80 inches; very dark gray (10YR 3/1) silt loam; massive; very friable; 2 percent gravel; slightly acid.

Range in Characteristics

Thickness of the organic material: 51 to more than 100 inches

Oa horizon:
Hue—10YR, 7.5YR, or neutral
Value—2 or 3
Chroma—0 to 2 (broken face or rubbed)
Fiber content—less than 25 percent unrubbed and less than 10 percent rubbed

Cg horizon:
Hue—5YR, 7.5YR, 10YR, 2.5Y, 5Y, 5GY, or 5BG
Value—3 to 6
Chroma—1 to 3

540—Seelyeville muck

Composition

Seelyeville 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

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)
Content of organic matter in the surface layer: About 62 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

- Cathro and similar soils
- Markey and similar soils
- Haslie and similar soils

Major Uses of the Unit

- Wildlife habitat

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

- “Wildlife Habitat” section

1879—Seelyeville muck, calcareous, 0 to 3 percent slopes

Composition

Seelyeville 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 3 percent

Component Description

Texture of the surface layer: Muck
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)
Content of organic matter in the surface layer: About 62 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

- Berner and similar soils
- Haslie and similar soils

Major Uses of the Unit

- Forest land
- Wildlife habitat

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

- “Forest Land” section
- “Wildlife Habitat” section

Serden Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Lake plains
Parent material: Eolian deposits
Slope range: 6 to 30 percent
Taxonomic classification: Mixed, frigid Typic Udipsamments

Typical Pedon

Serden fine sand, 6 to 30 percent slopes, 700 feet east and 750 feet north of the southwest corner of sec. 32, T. 147 N., R. 44 W.

A—0 to 3 inches; very dark gray (10YR 3/1) fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; loose; many fine roots; neutral; clear wavy boundary.
C1—3 to 36 inches; dark brown (10YR 4/3) fine sand; single grain; loose; common fine roots; neutral; clear wavy boundary.
C2—36 to 62 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; neutral; clear wavy boundary.
C3—62 to 80 inches; brown (10YR 5/3) fine sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 36 to 60 inches

A horizon:
Value—2 to 4
Chroma—1 or 2

C horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 4
Texture—fine sand; layers of sand in some pedons

573D—Serden fine sand, 6 to 30 percent slopes

Composition

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

Setting

Landform: Lake plains
Position on the landform: Summits and backslopes
Slope range: 6 to 30 percent

Component Description

Texture of the surface layer: Fine sand
Depth to bedrock: More than 60 inches
Drainage class: Excessively drained
Dominant parent material: Eolian deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches (low)
Content of organic matter in the surface layer: About 0.75 percent (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

- Maddock and similar soils
- Hamar and similar soils

Major Uses of the Unit

- Pasture
- Wildlife habitat

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

- “Agronomy” section
- “Wildlife Habitat” section

Smiley Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Lake plains and moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, superactive, frigid Typic Argiaquolls

Typical Pedon

Smiley loam, 2,400 feet west and 1,300 feet north of the southeast corner of sec. 5, T. 151 N., R. 39 W.

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

Btg—10 to 18 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (2.5Y 5/2) dry; few fine distinct light olive yellow (2.5Y 5/6) redoximorphic concentrations; weak fine and medium subangular blocky structure; friable; many fine and medium roots; common distinct black (5Y 2.5/1) clay films on faces of peds and in pores; 2 percent gravel; neutral; abrupt smooth boundary.

Bkg1—18 to 27 inches; olive gray (5Y 5/2) clay loam; common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; moderate medium subangular blocky structure; friable; many very fine roots; many fine white (10YR 8/1) irregularly shaped masses of carbonate; 2 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—27 to 36 inches; olive gray (5Y 5/2) clay loam; common fine prominent dark yellowish brown (10YR 4/6) and common fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium subangular blocky structure; friable; many fine white (10YR 8/1) irregularly shaped masses of carbonate; 3 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg3—36 to 50 inches; grayish brown (2.5Y 5/2) clay loam; common fine and medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium subangular blocky structure; many fine white (10YR 8/1) irregularly shaped masses of carbonate and few fine black (10YR 2/1) rounded iron-manganese concretions; 3 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg4—50 to 61 inches; grayish brown (2.5Y 5/2) loam; common fine and medium prominent yellowish brown (10YR 4/6 and 5/6) redoximorphic concentrations; moderate medium subangular blocky structure; few fine black (10YR 2/1) rounded iron-manganese concretions; 4 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg1—61 to 73 inches; grayish brown (2.5Y 5/2) loam; common fine and medium prominent yellowish brown (10YR 5/6) and yellowish red (5YR 5/6) redoximorphic concentrations; massive; few fine black (10YR 2/1) rounded iron-manganese concretions; 5 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg2—73 to 85 inches; grayish brown (2.5Y 5/2) loam; common fine prominent yellowish red (5YR 4/6) and strong brown (7.5YR 4/6) redoximorphic concentrations; massive; few fine black (10YR 2/1) rounded iron-manganese concretions; 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 10 to 26 inches
Thickness of the mollic epipedon: 7 to 14 inches
Content of rock fragments: 2 to 10 percent gravel

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3
Chroma—0 to 2

Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5
Chroma—1 to 3
Texture—clay loam, silty clay loam, or loam

Bkg horizon:
Value—4 to 7
Chroma—1 to 4

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6

765—Smiley loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 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)
Content of organic matter 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

- Reiner and similar soils
- Vallers and similar soils
- Roliss and similar soils
- Hamre and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Strathcona Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Upper part—moderately rapid or rapid; lower part—moderate or moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Sandy over loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Strathcona fine sandy loam, 1,100 feet west and 200 feet south of the northeast corner of sec. 9, T. 147 N., R. 45 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; few very fine roots; 5 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bkg—10 to 17 inches; dark gray (5Y 4/1) fine sandy loam; weak medium subangular blocky structure; very friable; few very fine roots; 3 percent gravel; disseminated carbonates; violently effervescent; moderately alkaline; gradual wavy boundary.

Cg1—17 to 30 inches; olive gray (5Y 5/2) fine sand; few fine distinct olive (5Y 4/4) redoximorphic concentrations; weak fine subangular blocky structure parting to single grain; very friable; 6 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.

2Cg2—30 to 51 inches; light olive gray (5Y 6/2) fine sandy loam; common medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; friable; 5 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg3—51 to 66 inches; light olive gray (5Y 6/2) fine sandy loam; common medium distinct brownish yellow (10YR 6/6) redoximorphic concentrations; massive; firm; few fine irregularly shaped white (10YR 8/1) carbonate coatings; 4 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2Cg4—66 to 80 inches; grayish brown (2.5Y 5/2) fine sandy loam; common medium prominent brownish yellow (10YR 6/8) redoximorphic concentrations; massive; firm; few fine irregularly shaped white (10YR 8/1) carbonate coatings and few fine black (10YR 2/1) manganese stains; 4 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 14 inches
Thickness of sandy material: 20 to 40 inches
Content of rock fragments: 0 to 10 percent gravel

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 4
Chroma—0 or 1

Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 7
Chroma—0 to 2
Texture—fine sandy loam or sandy loam in the upper part; grades to loamy fine sand or loamy sand in the lower part

Cg horizon:
Hue—2.5Y or 5Y
Value—5 to 7
Chroma—1 or 2
Texture—fine sand, sand, loamy fine sand, or loamy sand

2Cg horizon:
Value—5 to 7
Chroma—1 or 2
Texture—fine sandy loam, loam, or clay loam

439—Strathcona fine sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.3 inches (moderate)
Content of organic matter 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

- Grimstad and similar soils
- Rosewood and similar soils
- Hedman and similar soils
- Mavie and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

1144—Strathcona and Kratka soils, depressional

Composition

Strathcona: Variable
Kratka: Variable
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Depressions
Slope range: 0 to 1 percent

Component Description

Strathcona

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 15 percent (very high)

Kratka

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 7.8 inches (moderate)
Content of organic matter in the surface layer: About 15 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

- Berner and similar soils
- Northwood and similar soils
- Vallers and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Wildlife habitat

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

- “Agronomy” section
- “Wildlife Habitat” section

Sugarbush Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid
Landform: Outwash plains and moraines
Parent material: Glacial outwash deposits
Slope range: 1 to 30 percent
Taxonomic classification: Coarse-loamy, mixed, superactive Typic Eutroboralfs

Typical Pedon

Sugarbush loamy sand, 1 to 8 percent slopes, 1,450 feet east and 1,250 feet north of the southwest corner of sec. 36, T. 147 N., R. 39 W.

A—0 to 4 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; many fine and medium roots; 2 percent gravel; moderately acid; abrupt smooth boundary.

E—4 to 10 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; many fine and very fine roots; 3 percent gravel; neutral; clear smooth boundary.

Bt1—10 to 15 inches; dark yellowish brown (10YR 3/4) sandy loam; weak and moderate fine subangular blocky structure; friable; many fine and very fine roots; common prominent dark brown (7.5YR 3/2) clay bridges between sand grains; 3 percent gravel; neutral; clear smooth boundary.

Bt2—15 to 20 inches; dark yellowish brown (10YR

3/4) coarse sandy loam; moderate medium subangular blocky structure; firm; common prominent dark brown (7.5YR 3/2) clay bridges between sand grains; common fine and very fine roots; 8 percent gravel; neutral; clear smooth boundary.

2Bw—20 to 25 inches; dark brown (7.5YR 4/2) loamy coarse sand; weak and moderate fine and medium subangular blocky structure; friable; common fine and very fine roots; 12 percent gravel; neutral; abrupt smooth boundary.

2C1—25 to 42 inches; yellowish brown (10YR 5/4) gravelly coarse sand; massive; loose; 25 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

2C2—42 to 58 inches; brown (10YR 5/3) gravelly sand; massive; loose; 25 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2C3—58 to 80 inches; yellowish brown (10YR 5/4) gravelly sand; massive; loose; 30 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches

A horizon:
Value—2 or 3
Chroma—1 or 2
Content of rock fragments—0 to 10 percent gravel

E horizon:
Value—4 to 6
Chroma—3 or 4
Texture—loamy sand or loamy coarse sand
Content of rock fragments—0 to 10 percent gravel

Bt horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 to 6
Texture—sandy loam or coarse sandy loam
Content of rock fragments—0 to 10 percent gravel

2Bw horizon:
Hue—7.5YR or 10YR
Value—4 or 5
Chroma—2 to 4
Texture—loamy coarse sand, loamy sand, sand, or coarse sand or the gravelly analogs of these textures
Content of rock fragments—15 to 35 percent gravel

2C horizon:
Hue—10YR or 7.5YR
Value—5 or 6
Chroma—3 to 6
Texture—gravelly sand or gravelly coarse sand
Content of rock fragments—15 to 35 percent gravel

1152B—Sugarbush loamy sand, 1 to 8 percent slopes

Composition

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

Setting

Landform: Outwash plains and moraines
Position on the landform: Rises and backslopes
Slope range: 1 to 8 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Outwash deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)
Content of organic matter in the surface layer: About 0.75 percent (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

- Deerwood and similar soils
- Marquette and similar soils
- Naytahwaush and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

1152C—Sugarbush loamy sand, 8 to 15 percent slopes

Composition

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

Setting

Landform: Outwash plains and moraines
Position on the landform: Summits and backslopes
Slope range: 8 to 15 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Outwash deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)
Content of organic matter in the surface layer: About 0.75 percent (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

- Deerwood and similar soils
- Marquette and similar soils
- Naytahwaush and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

1152E—Sugarbush loamy sand, 15 to 30 percent slopes

Composition

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

Setting

Landform: Outwash plains and moraines
Position on the landform: Summits and backslopes
Slope range: 15 to 30 percent

Component Description

Texture of the surface layer: Loamy sand
Depth to bedrock: More than 60 inches
Drainage class: Well drained
Dominant parent material: Outwash deposits
Flooding: None
Depth to the water table: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches (low)
Content of organic matter in the surface layer: About 0.75 percent (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

- Marquette and similar soils
- Naytahwaush and similar soils
- Deerwood 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

Syrene Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Beach plains
Parent material: Beach deposits
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, frigid Typic Calciaquolls

Typical Pedon

Syrene sandy loam, 1,700 feet east and 2,000 feet south of the northwest corner of sec. 30, T. 149 N., R. 44 W.

Ap—0 to 11 inches; black (2.5Y 2.5/1) sandy loam, very dark gray (2.5Y 3/1) dry; moderate medium subangular blocky structure parting to moderate fine granular; very friable; common fine roots; 1 percent gravel; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bkg1—11 to 18 inches; dark grayish brown (2.5Y 4/2) sandy loam, light brownish gray (2.5Y 6/2) dry; common fine faint very dark grayish brown (2.5Y 3/2) and common fine prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations; moderate medium subangular blocky structure; very friable; common fine roots; 2 percent gravel; common round fine light gray (10YR 7/1) masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

2Bkg2—18 to 28 inches; light brownish gray (2.5Y 6/2) gravelly sand; common medium prominent yellowish brown (10YR 5/6) and few fine distinct very dark grayish brown (2.5Y 3/2) redoximorphic depletions; single grain; loose; few fine roots matted at top of horizon; 30 percent gravel; common round fine white (10YR 8/2) masses of carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Cg1—28 to 37 inches; olive gray (5Y 5/2) sand; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 10 percent gravel; common irregular medium white (10YR 8/2) masses of carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Cg2—37 to 57 inches; light brownish gray (2.5Y 6/2) gravelly sand; common medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 18 percent gravel; common irregular fine light gray (10YR 7/1) masses of carbonate on pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

2Cg3—57 to 71 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; common fine prominent yellow (10YR 7/6) redoximorphic concentrations; single grain; loose; 28 percent gravel; few prominent light gray (10YR 7/2) carbonate coatings in channels and pores; strongly effervescent; moderately alkaline; clear smooth boundary.

2Cg4—71 to 83 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; common fine prominent yellow (10YR 7/6) redoximorphic concentrations; single grain; loose; 20 percent gravel; few prominent light gray (10YR 7/2) carbonate coatings in channels and pores; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 16 inches
Thickness of the loamy mantle: 12 to 24 inches

A horizon:
- Hue—10YR, 2.5Y, 5Y, or neutral
- Value—2 or 3
- Chroma—0 or 1
- Content of rock fragments—0 to 10 percent gravel

Bkg horizon:
- Hue—2.5Y, 5Y, or neutral
- Value—4 to 6
- Chroma—0 to 2
- Texture—sandy loam, fine sandy loam, or very fine sandy loam
- Content of rock fragments—0 to 10 percent gravel

2Bkg horizon:
- Hue—2.5Y or 5Y
- Value—4 to 6
- Chroma—1 or 2
- Texture—sand, coarse sand, loamy sand, or loamy coarse sand or the gravelly analogs of these textures
- Content of rock fragments—10 to 35 percent gravel

2Cg horizon:
- Chroma—2 to 4
- Texture—sand or coarse sand or the gravelly analogs of these textures
- Content of rock fragments—10 to 35 percent gravel

435—Syrene sandy loam

Composition

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

Setting

Landform: Beach plains
Position on the landform: Flats
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam
Depth to bedrock: More than 60 inches

Drainage class: Poorly drained
Dominant parent material: Beach deposits
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 4.2 inches (low)
Content of organic matter 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

- Rosewood and similar soils
- Hangaard and similar soils
- Wyrene and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- "Agronomy" section

Thiefriver Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Sandy over clayey, mixed over smectitic, frigid Typic Calciaquolls

Typical Pedon

Thiefriver fine sandy loam (fig. 19), 1,500 feet west and 1,700 feet south of the northeast corner of sec. 15, T. 149 N., R. 45 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; 2 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—8 to 12 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium platy structure; very friable; 1 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bkg1—12 to 14 inches; dark gray (10YR 4/1) loamy fine sand; few fine faint dark grayish brown (10YR 4/2) redoximorphic depletions; weak medium subangular blocky structure; very friable; 4 percent gravel; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkg2—14 to 19 inches; light brownish gray (2.5Y 6/2) loamy fine sand; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium subangular blocky structure; very friable; 1 percent gravel; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkg3—19 to 23 inches; light brownish gray (2.5Y 6/2) loamy fine sand; few fine prominent brownish yellow (10YR 6/6) and few fine distinct light yellowish brown (10YR 6/4) redoximorphic concentrations; weak medium subangular blocky structure; very friable; 1 percent gravel; few fine irregularly shaped light gray (10YR 7/2) threads of carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Cg1—23 to 32 inches; grayish brown (10YR 5/2) fine sand; common fine distinct light yellowish brown (10YR 6/4) redoximorphic concentrations; single grain; loose; 1 percent gravel; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2Cg2—32 to 54 inches; dark gray (5Y 4/1) clay; common fine and medium prominent yellowish brown (10YR 5/8) and brown (7.5YR 4/4) redoximorphic concentrations; moderate very fine and fine angular blocky soil fragments; firm; 4 percent gravel; few fine irregularly shaped white (10YR 8/1) threads of carbonate; strongly effervescent; slightly alkaline; clear wavy boundary.

2Cg3—54 to 68 inches; dark olive gray (5Y 3/2) clay; common medium prominent light yellowish brown (2.5Y 6/3) redoximorphic concentrations; massive; firm; 3 percent gravel; few fine irregularly shaped white (10YR 8/1) threads of carbonate; strongly effervescent; slightly alkaline; clear wavy boundary.

2Cg4—68 to 80 inches; dark olive gray (5Y 3/2) clay; common fine prominent light yellowish brown (2.5Y 6/4) redoximorphic concentrations;

massive; firm; 4 percent gravel; many fine irregularly shaped white (10YR 8/1) threads of carbonate; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 16 inches
Thickness of sandy material: 20 to 40 inches

A horizon:
Value—2 or 3
Chroma—1 or 2
Content of rock fragments—0 to 15 percent gravel

Bk horizon:
Value—4 to 7
Texture—loamy fine sand, loamy sand, fine sandy loam, or sandy loam
Content of rock fragments—0 to 15 percent gravel

Cg horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—1 or 2
Texture—loamy fine sand, fine sand, loamy sand, or sand
Content of rock fragments—0 to 15 percent gravel

2Cg horizon:
Hue—2.5Y or 5Y
Value—3 to 5
Chroma—1 or 2
Texture—clay, silty clay, silty clay loam, or clay loam
Content of rock fragments—0 to 5 percent gravel

651—Thiefriver fine sandy loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.0 inches (moderate)
Content of organic matter 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

- Espelie and similar soils
- Huot and similar soils
- Clearwater and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Udipsamments

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and lake plains
Parent material: Glaciofluvial deposits
Slope range: 1 to 50 percent
Taxonomic classification: Udipsamments

Typical Pedon

Udipsamments, in an area of Pits, gravel-Udipsamments complex, 1,700 feet east and 1,050 feet north of the southwest corner of sec. 34, T. 150 N., R. 45 W.

A—0 to 4 inches; dark gray (10YR 4/1) sand; single grain; loose; 10 percent rock fragments; slightly effervescent; slightly alkaline; abrupt smooth boundary.
C1—4 to 30 inches; brown (10YR 5/3) coarse sand; single grain; loose; 15 percent rock fragments; slightly effervescent; slightly alkaline; clear smooth boundary.
C2—30 to 60 inches; yellowish brown (10YR 5/4) sand; common medium faint yellowish brown

(10YR 5/6) redoximorphic concentrations; single grain; loose; 10 percent rock fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Content of rock fragments: 5 to 35 percent

C horizon:
Hue—2.5Y or 10YR
Value—3 to 7
Chroma—1 to 6

Ulen Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 3 percent
Taxonomic classification: Sandy, mixed, frigid Aeric Calciaquolls

Typical Pedon

Ulen loamy fine sand, 2,500 feet east and 200 feet south of the northwest corner of sec. 16, T. 150 N., R. 46 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk—10 to 20 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine subangular blocky structure; very friable; few fine irregularly shaped light gray (10YR 7/2) carbonate threads; violently effervescent; moderately alkaline; clear wavy boundary.

C1—20 to 36 inches; light yellowish brown (2.5Y 6/4) fine sand; few fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; single grain; loose; slightly effervescent; slightly alkaline; gradual wavy boundary.

C2—36 to 59 inches; light brownish gray (2.5Y 6/2), stratified fine sand and very fine sand; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose, nonsticky; slightly effervescent; slightly alkaline; clear smooth boundary.

C3—59 to 68 inches; light yellowish brown (2.5Y 6/3), stratified fine sand and very fine sand; few medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; single grain; loose; slightly effervescent; moderately alkaline; clear smooth boundary.

C4—68 to 80 inches; light brownish gray (2.5Y 6/2), stratified fine sand and very fine sand; few fine prominent brownish yellow (10YR 6/6) and few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; single grain; loose; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Content of rock fragments: 0 to 5 percent gravel

A horizon:
Value—2 or 3
Chroma—1 or 2

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 4
Texture—loamy fine sand, loamy sand, fine sand, or sandy loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—2 to 6
Texture—dominantly fine sand or loamy fine sand; layers of sand, coarse sand, or very fine sand included in the range

1264—Ulen loamy fine sand

Composition

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

Setting

Landform: Lake plains
Position on the landform: Slight rises
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.2 inches (moderate)
Content of organic matter 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

- Rosewood and similar soils
- Grimstad and similar soils
- Flaming and similar soils
- Huot and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Vallers Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon

Vallers loam, 1,000 feet east and 500 feet north of the southwest corner of sec. 36, T. 149 N., R. 41 W.

Ap—0 to 14 inches; black (10YR 2/1) loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; firm; few fine roots; common medium light gray (10YR 7/1) irregularly shaped masses of carbonate; strongly effervescent; slightly alkaline; abrupt wavy boundary.

Bkg1—14 to 22 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; moderate medium subangular blocky structure; firm; few fine irregularly shaped light gray (5YR 7/1) masses of carbonate; 2 percent gravel; violently effervescent; slightly alkaline; abrupt wavy boundary.

Bkg2—22 to 35 inches; gray (10YR 5/1) clay loam; common medium prominent strong brown (7.5YR 5/8) redoximorphic concentrations; moderate medium subangular blocky structure; firm; few fine irregularly shaped light gray (5YR 7/1) masses of carbonate; violently effervescent; slightly alkaline; clear smooth boundary.

Cg1—35 to 67 inches; dark grayish brown (2.5Y 4/2) clay loam; common fine prominent strong brown (7.5YR 5/8) and yellowish brown (10YR 5/8) redoximorphic concentrations; moderate medium subangular blocky soil fragments; firm; common fine irregularly shaped light gray (5YR 7/1) masses of carbonate; few fine very dark gray (2.5YR 3/0) rounded iron-manganese concretions; 5 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Cg2—67 to 86 inches; dark grayish brown (2.5Y 4/2) clay loam; many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium subangular blocky soil fragments; firm; few medium irregularly shaped light gray (5YR 7/1) masses of carbonate; 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Content of rock fragments: 2 to 8 percent gravel

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1

Bkg horizon:
Hue—2.5Y, 10YR, 5Y, or neutral
Value—3 to 6
Chroma—0 to 2
Texture—loam or clay loam

C horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 to 3
Texture—loam or clay loam

236—Vallers loam

Composition

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

Setting

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

Component Description

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)
Content of organic matter in the surface layer: About 6.5 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

- Hamre and similar soils
- Kratka and similar soils
- Strathcona and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- "Agronomy" section

1279—Vallers-Hamerly complex

Composition

Vallers and similar soils: About 50 percent
Hamerly and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Vallers—flats; Hamerly—slight rises
Slope range: 0 to 2 percent

Component Description

Vallers

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Content of organic matter in the surface layer: About 6.5 percent (high)

Hamerly

Texture of the surface layer: Loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Water table depth: 1.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter 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

- Roliss and similar soils
- Kratka and similar soils
- Strathcona and similar soils
- Hamre and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- "Agronomy" section

Venlo Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Sandy, mixed, frigid Typic Endoaquolls

Typical Pedon

Venlo fine sandy loam, in an area of Rosewood-Venlo complex, 1,345 feet east and 700 feet north of the southwest corner of sec. 22, T. 148 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine roots; neutral; abrupt smooth boundary.

Cg1—10 to 15 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; few fine distinct grayish brown (10YR 5/2) redoximorphic depletions; weak fine subangular blocky structure; very friable; few fine roots; slightly alkaline; clear wavy boundary.

Cg2—15 to 26 inches; grayish brown (2.5Y 5/2) fine sand; few medium distinct olive brown (2.5YR 4/4) redoximorphic concentrations; single grain; loose; slightly alkaline; clear wavy boundary.

Cg3—26 to 46 inches; grayish brown (2.5Y 5/2) fine sand; few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; single grain; loose; slightly alkaline; clear wavy boundary.

Cg4—46 to 58 inches; grayish brown (2.5Y 5/2) fine sand; common medium prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; single grain; loose; neutral; clear wavy boundary.

Cg5—58 to 69 inches; light olive gray (5Y 6/2) fine sand; few fine prominent brownish yellow (10YR 6/6) redoximorphic concentrations; single grain; loose; neutral; clear wavy boundary.

Cg6—69 to 80 inches; light brownish gray (2.5Y 6/2) fine sand; common fine and medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; single grain; loose; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1

Cg horizon:
Hue—2.5Y, 5Y, 5GY, or neutral
Value—4 to 6
Chroma—0 to 2
Texture—loamy fine sand, fine sand, loamy sand, or sand

W—Water

Component Description

- Naturally occurring basins of surface water

1356—Water, miscellaneous

Component Description

- Small manmade areas that are used for industrial, sanitary, or mining applications and that contain water most of the year

Waukon Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 20 percent
Taxonomic classification: Fine-loamy, mixed, superactive Mollic Eutroboralfs

Typical Pedon

Waukon loam, 2 to 6 percent slopes, 100 feet east and 1,700 feet north of the southwest corner of sec. 14, T. 148 N., R. 39 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; common fine and very fine roots; 2 percent gravel; neutral; abrupt smooth boundary.

E—6 to 8 inches; dark brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; common fine and very fine roots; 2 percent gravel; neutral; clear wavy boundary.

B/E—8 to 14 inches; 90 percent dark brown (10YR 4/3) (B) and 10 percent dark grayish brown (10YR 4/2) (E) fine sandy loam; moderate fine and medium subangular blocky structure; friable; many fine and very fine roots; 2 percent gravel; neutral; clear smooth boundary.

Bt1—14 to 23 inches; dark brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; firm; common fine and medium roots; very few faint black (10YR 2/1) organic coatings in root channels and pores and few distinct black (10YR 2/1) clay films on vertical and horizontal faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Bt2—23 to 29 inches; dark brown (10YR 4/3) clay loam; few fine prominent strong brown (7.5YR 5/6) relict redoximorphic concentrations; moderate medium subangular blocky structure; firm; common fine and medium roots; very few distinct black (10YR 2/1) organic coatings in root channels and pores and very few distinct black (10YR 2/1) clay films on vertical and horizontal

faces of peds; slightly effervescent; 2 percent gravel; slightly alkaline; clear smooth boundary.

Bk1—29 to 38 inches; brown (10YR 5/3) loam; moderate fine and medium subangular blocky structure; firm; common fine and very fine roots; very few distinct black (10YR 2/1) organic coatings in root channels and pores; many fine white (10YR 8/1) irregularly shaped masses of carbonate; violently effervescent; 2 percent gravel; slightly alkaline; clear smooth boundary.

Bk2—38 to 48 inches; yellowish brown (10YR 5/4) loam; common fine distinct yellowish brown (10YR 5/6) relict redoximorphic concentrations; moderate fine and medium subangular blocky structure; firm; many fine white (10YR 8/1) irregularly shaped masses of carbonate; violently effervescent; 2 percent gravel; slightly alkaline; clear smooth boundary.

C1—48 to 64 inches; light olive brown (2.5Y 5/4) loam; common fine prominent yellowish brown (10YR 5/8) and yellowish red (5YR 5/8) relict redoximorphic concentrations; massive; firm; many fine white (10YR 8/1) irregularly shaped masses of carbonate; 3 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

C2—64 to 80 inches; light olive brown (2.5Y 5/4) loam; few fine prominent brownish yellow (10YR 6/6) and yellowish red (5YR 5/6) relict redoximorphic concentrations; massive; firm; many fine white (10YR 8/1) irregularly shaped masses of carbonate; 3 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Content of rock fragments: 2 to 8 percent gravel
Other features: Some pedons have a BC horizon.

A horizon:
Value—2 or 3
Chroma—1 or 2

E horizon:
Value—3 to 5
Chroma—2 or 3
Texture—fine sandy loam, loam, or sandy loam

B/E horizon:
Value—3 to 5
Chroma—1 to 6
Texture—fine sandy loam, loam, or sandy loam

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—clay loam or loam

Bk horizon:
Hue—2.5Y or 10YR
Value—4 or 5
Chroma—3 to 6
Texture—loam or clay loam

C horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Chroma—3 or 4
Texture—loam or clay loam

38B—Waukon loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter 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

- Smiley and similar soils
- Reiner and similar soils
- Roliss and similar soils
- Langhei and similar soils
- Halverson and similar soils

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

38C2—Waukon loam, 6 to 12 percent slopes, eroded

Composition

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

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter 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

- Smiley and similar soils
- Reiner and similar soils
- Roliss and similar soils
- Langhei and similar soils
- Halverson and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

38D2—Waukon loam, 12 to 20 percent slopes, eroded

Composition

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

Setting

Landform: Moraines
Position on the landform: Rises and backslopes
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter 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

- Smiley and similar soils
- Langhei and similar soils
- Reiner and similar soils
- Halverson and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

967B—Waukon-Langhei complex, 2 to 6 percent slopes

Composition

Waukon and similar soils: About 65 percent
Langhei and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Waukon—rises and backslopes; Langhei—shoulder slopes
Slope range: 2 to 6 percent

Component Description

Waukon

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

Langhei

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 1.75 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

- Smiley and similar soils
- Reiner and similar soils
- Hamerly and similar soils
- Hamre and similar soils
- Halverson and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

967C2—Waukon-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Waukon and similar soils: About 60 percent
Langhei and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Waukon—summits and backslopes; Langhei—shoulder slopes
Slope range: 6 to 12 percent

Component Description

Waukon

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

Langhei

Texture of the surface layer: 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 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)

Content of organic matter in the surface layer: About 1.75 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

- Smiley and similar soils
- Reiner and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

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

- “Agronomy” section
- “Forest Land” section

Wheatville Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-silty over clayey, mixed over smectitic, superactive, frigid Aeric Calciaquolls

Typical Pedon

Wheatville very fine sandy loam, 0 to 2 percent slopes, 2,090 feet east and 570 feet north of the southwest corner of sec. 13, T. 150 N., R. 47 W.

Ap—0 to 9 inches; black (10YR 2/1) very fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; few fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—9 to 20 inches; dark grayish brown (10YR 4/2) very fine sandy loam; weak medium subangular blocky structure; very friable; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—20 to 31 inches; light olive brown (2.5Y 5/4) very fine sandy loam; few medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; weak medium platy structure parting to weak fine subangular blocky; very friable; few fine irregularly shaped white (10YR 8/1) masses of carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Cg1—31 to 43 inches; grayish brown (2.5Y 5/2) silty clay; few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; moderate medium platy soil fragments; friable; slightly effervescent; slightly alkaline; clear wavy boundary.

2Cg2—43 to 58 inches; grayish brown (2.5Y 5/2) silty clay; common fine prominent dark brown (7.5YR 4/4) redoximorphic concentrations; moderate medium platy soil fragments; firm; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg3—58 to 72 inches; light brownish gray (2.5Y 6/2) silty clay; few fine prominent strong brown (7.5YR 5/6) and brownish yellow (10YR 6/8) redoximorphic concentrations; moderate medium platy soil fragments parting to weak fine and medium subangular blocky; firm; slightly effervescent; slightly alkaline; clear smooth boundary.

2Cg4—72 to 80 inches; light brownish gray (2.5Y 6/2) silty clay; few fine prominent strong brown (7.5YR 4/6) and brownish yellow (10YR 6/8) redoximorphic concentrations; moderate thin platy soil fragments parting to moderate medium subangular blocky; firm; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the silty material: 20 to 40 inches
Thickness of the mollic epipedon: 7 to 14 inches
Content of rock fragments: None in the upper silty material; 0 to 5 percent gravel below a depth of 40 inches

A horizon:
Value—2 or 3
Chroma—1 or 2

Bk horizon:
Value—4 to 6
Chroma—1 to 4
Texture—very fine sandy loam, loam, or silt loam with less than 18 percent noncarbonate clay

2C horizon:
Hue—2.5Y or 5Y
Value—4 to 6

Chroma—1 to 3
Texture—silty clay or clay

1315A—Wheatville very fine sandy loam, 0 to 2 percent slopes

Composition

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

Setting

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

Component Description

Texture of the surface layer: Very fine sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Water table depth: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter 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

- Augsburg and similar soils
- Clearwater and similar soils
- Glyndon and similar soils

Major Uses of the Unit

- Cropland

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

- “Agronomy” section

Winterfield Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Rapid
Landform: Flood plains
Parent material: Alluvium
Slope range: 1 to 3 percent
Taxonomic classification: Mixed, frigid Aquic Udipsamments

Typical Pedon

Winterfield loamy fine sand, occasionally flooded, 2,200 feet east and 150 feet south of the northwest corner of sec. 14, T. 147 N., R. 44 W.

A—0 to 6 inches; black (10YR 2/1) loamy fine sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fine roots; slightly alkaline; clear wavy boundary.

C1—6 to 18 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine subangular blocky soil fragments; very friable; common fine roots; slightly alkaline; clear wavy boundary.

C2—18 to 30 inches; olive brown (2.5Y 4/3) fine sand; few fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations and few fine distinct dark gray (2.5Y 4/1) redoximorphic depletions; single grain; loose; few fine roots; slightly alkaline; clear wavy boundary.

C3—30 to 47 inches; grayish brown (2.5Y 5/2) fine sand; few fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; single grain; loose; slightly alkaline; abrupt wavy boundary.

C4—47 to 60 inches; brown (10YR 5/3), stratified fine sand and sand; weak fine subangular blocky soil fragments; very friable; slightly effervescent; slightly alkaline; abrupt wavy boundary.

C5—60 to 72 inches; grayish brown (2.5Y 5/2) loamy fine sand; common fine prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; weak medium subangular blocky soil fragments; very friable; common fine and medium strong brown (7.5YR 5/8) cylindrical masses of iron-manganese; few white (10YR 8/1) broken shells; 3 percent gravel; slightly effervescent; moderately alkaline; clear wavy boundary.

C6—72 to 80 inches; grayish brown (2.5Y 5/2) loamy fine sand; common fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations and common medium distinct dark gray (10YR 4/1) redoximorphic depletions; weak medium subangular blocky soil fragments; very friable; common fine and medium strong brown (7.5YR 5/8) cylindrical masses of iron-manganese; few white (10YR 8/1) broken shells; slightly effervescent; moderately alkaline.

Range in Characteristics

A horizon:
Hue—10YR or 7.5YR
Value—2 to 4
Chroma—1 to 3

C horizon:
Hue—5YR, 7.5YR, 10YR, or 2.5Y
Value—2 to 6
Chroma—2 to 6
Texture—loamy fine sand, fine sand, sand, loamy sand, or coarse sand; gravelly sand or gravelly loamy sand below a depth of 40 inches in some pedons

791—Winterfield loamy fine sand, occasionally flooded

Composition

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

Setting

Landform: Flood plains
Position on the landform: Flats and slight rises
Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Alluvium
Flooding: Occasional
Water table depth: 0.5 foot to 3.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches (low)
Content of organic matter 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

- Deerwood and similar soils
- Hedman and similar soils
- Fram and similar soils
- Hamar and similar soils
- Hangaard and similar soils

Major Uses of the Unit

- Forest land
- Wildlife habitat

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

- “Forest Land” section
- “Wildlife Habitat” section

Wyrene Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Beach plains
Parent material: Beach deposits
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, frigid Aeric Calciaquolls

Typical Pedon

Wyrene sandy loam, 10 feet west and 1,700 feet north of the southeast corner of sec. 18, T. 149 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable; common fine roots; 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 11 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; common fine and very fine roots; 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk1—11 to 21 inches; dark gray (10YR 4/1) sandy loam; common fine distinct dark brown (10YR 4/3) redoximorphic concentrations; weak very fine subangular blocky structure; very friable; few fine roots; 5 percent gravel; common fine distinct light gray (10YR 7/2) carbonate coatings; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Bk2—21 to 25 inches; dark grayish brown (10YR 4/2) gravelly loamy sand; common fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; few fine roots; 20 percent gravel; common fine prominent white (10YR 8/1) carbonate coatings; violently effervescent; moderately alkaline; gradual wavy boundary.

2C1—25 to 30 inches; brown (10YR 5/3) gravelly sand; few fine distinct dark grayish brown (2.5Y 4/2) redoximorphic depletions; single grain; loose; 28 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C2—30 to 48 inches; yellowish brown (10YR 5/4) gravelly coarse sand; common medium and fine prominent grayish brown (2.5Y 5/2) redoximorphic depletions; single grain; loose; 25 percent gravel; common fine distinct white (10YR 8/1) carbonate coatings; strongly effervescent; moderately alkaline; abrupt wavy boundary.

2C3—48 to 62 inches; brownish yellow (10YR 6/6) gravelly coarse sand; few fine prominent grayish brown (2.5Y 5/2) redoximorphic depletions; single grain; loose; 33 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

2C4—62 to 80 inches; light brownish gray (10YR 6/2) gravelly coarse sand; few fine prominent yellow (10YR 7/6) redoximorphic concentrations; single grain; loose; few faint light gray (10YR 7/2) carbonate coatings on rock fragments; 25 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to sandy material: 20 to 32 inches

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Content of rock fragments—0 to 10 percent gravel

Bk horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 or 2
Texture—sandy loam, coarse sandy loam, or loam with less than 18 percent clay
Content of rock fragments—0 to 10 percent gravel

2C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6
Chroma—1 to 6
Texture—stratified gravelly coarse sand, gravelly sand, sand, and coarse sand
Content of rock fragments—5 to 35 percent gravel

704—Wyrene sandy loam

Composition

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

Setting

Landform: Beach plains
Position on the landform: Slight rises
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam
Depth to bedrock: More than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Beach deposits
Flooding: None
Water table depth: 1.5 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 5.1 inches (low)
Content of organic matter 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

- Syrene and similar soils
- Hangaard and similar soils
- Ulen and similar soils
- Sandberg and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

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

- “Agronomy” section

Zell Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 6 to 20 percent
Taxonomic classification: Coarse-silty, mixed, superactive Udic Calciborolls

Typical Pedon

Zell silt loam, 6 to 20 percent slopes, eroded, 2,600

feet west and 1,000 feet south of the northeast corner of sec. 15, T. 149 N., R. 49 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak fine granular; friable; few very fine roots; violently effervescent; slightly alkaline; abrupt wavy boundary.

Bk1—7 to 14 inches; brown (10YR 5/3) silt loam; weak medium subangular blocky structure; friable; few very fine roots; few fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; slightly alkaline; abrupt smooth boundary.

Bk2—14 to 31 inches; grayish brown (2.5Y 5/2) silt loam; few fine prominent strong brown (7.5YR 5/6) relict redoximorphic concentrations; weak medium subangular blocky structure; friable; common fine irregularly shaped light gray (10YR 7/2) masses of carbonate; violently effervescent; slightly alkaline; gradual smooth boundary.

C1—31 to 54 inches; grayish brown (2.5Y 5/2) silt loam; few fine faint dark grayish brown (10YR 4/2) relict redoximorphic depletions and few prominent yellowish red (5YR 4/6) stains on ped interiors; weak thin platy soil fragments; friable; few fine white (10YR 8/1) irregularly shaped masses of carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—54 to 67 inches; dark grayish brown (2.5Y 4/2) silt loam; common medium prominent brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) relict redoximorphic concentrations; moderate thin platy soil fragments; firm; few fine white (10YR 8/1) carbonate coatings; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—67 to 81 inches; dark grayish brown (2.5Y 4/2) silt loam; common medium prominent brownish yellow (10YR 6/8) relict redoximorphic concentrations; moderate thin platy soil fragments; firm; few fine white (10YR 8/1) carbonate coatings; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Value—2 or 3

Bk horizon:
Value—3 to 6
Chroma—2 to 4
Texture—silt loam or very fine sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—silt loam, very fine sandy loam, or loam with thin lenses of finer or coarser textures

694D2—Zell silt loam, 6 to 20 percent slopes, eroded

Composition

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

Setting

Landform: Lake plains
Position on the landform: Backslopes
Slope range: 6 to 20 percent

Component Description

Texture of the surface layer: 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: More than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches (high)
Content of organic matter 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

- Fairdale and similar soils
- Hattie and similar soils
- Glyndon and similar soils

Major Uses of the Unit

- Cropland
- Wildlife habitat

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

- “Agronomy” section
- “Wildlife Habitat” 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.

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

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

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

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.

Beach deposits. Material, such as sand and gravel, that is generally laid down parallel to an active or relict shoreline of a postglacial or glacial lake.

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.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

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.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clayey. In this survey, clayey textures include clay, silty clay, and sandy clay.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

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 has 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 has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has 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.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

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 effects of 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. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which

classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

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.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Depth, soil. Generally, 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.

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 wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Eolian deposits. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

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. Synonym: scarp.

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.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Footslope. The position that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

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 has 15 to 35 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 the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is

an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Head slope. A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-chroma zones. In a soil profile, zones having chroma of 3 or more. Typical 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 15 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. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

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 potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

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

Interfluve. An elevated area between two drainageways that sheds water to those drainageways.

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.

Irrigation. Application of water to soils to assist in production of crops.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Kame moraine. An end moraine that contains numerous kames. A group of kames along the front of a stagnant glacier, commonly comprising the slumped remnants of a formerly continuous outwash plain built up over the foot of rapidly wasting or stagnant ice.

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.

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.

Loamy. In this survey, loamy textures include loam, sandy loam, sandy clay loam, clay loam, and silt loam that contains more than 20 percent sand.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-chroma zones. In a soil profile, zones having chroma of 2 or less. Typical 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.

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 earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, and recessional.

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 of 6.6 to 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.

Nose slope. A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent.

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. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The 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 or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as “permeability.” Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 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 flooding.

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.

Pitted outwash plain. An outwash plain marked by many irregular depressions, such as kettles, shallow pits, and potholes, which formed by melting of incorporated ice masses. Common in Wisconsin and Minnesota.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

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.

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.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

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:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
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 generally is 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.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

Sandy. In this survey, sandy soils include coarse sand, sand, fine sand, very fine sand, loamy coarse sand, loamy sand, loamy fine sand, and loamy very fine sand and the gravelly analogs of these textures.

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.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. 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 position that forms the uppermost inclined surface near the top of a hillslope. It is a transition 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.

Side slope. A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel.

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.

Silty. In this survey, silty textures include silt, silty clay loam, silt loam (containing 20 percent or less sand), and very fine sandy loam.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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. In this survey, the slope classes are as follows:

Level	0 to 1 percent
Nearly level	0 to 2 percent
	0 to 3 percent
	1 to 3 percent
Gently sloping	1 to 4 percent
	1 to 6 percent
	2 to 6 percent
Undulating	1 to 8 percent
	2 to 8 percent
Sloping	6 to 12 percent
	6 to 15 percent
Rolling	8 to 15 percent
Moderately steep	6 to 18 percent
	6 to 20 percent
	12 to 20 percent
Hilly	6 to 30 percent
Steep	12 to 30 percent
	15 to 30 percent
	20 to 40 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

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.

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 material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stagnation moraine. A body of drift released by the melting of a glacier that ceased flowing. Commonly (but not always) occurs near ice margins; composed of till, ice-contact stratified drift, and small areas of glacial lake sediment. Typical landforms are knob-and-kettle topography, locally including ice-walled lake plains.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded 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 erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsidence. The potential decrease in surface elevation as a result of the drainage of wet soils that have organic layers or semifluid mineral layers. Subsidence as a result of drainage is attributed to (1) shrinkage from drying, (2) consolidation because of the loss of ground-water buoyancy, (3) compaction from tillage or manipulation, (4) wind erosion, (5) burning, and (6) biochemical oxidation.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

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 caused by uneven glacial deposition.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is 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 that is 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 soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer 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 ovendry 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.

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Polk County, Minnesota

Part II

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**, 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 units 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** 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**. 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 **Contents** 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 **Contents** in Part II shows which table has data on a specific land use for each detailed soil map unit. Also, see the **Contents** in Part I and Part II for other 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 1994. Soil names and descriptions were approved in 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1994. This survey was made cooperatively by the Natural Resources Conservation Service, the Minnesota Agricultural Experiment Station, Polk County, the East Polk Soil and Water Conservation District, and the West Polk Soil and Water Conservation District. The survey is part of the technical assistance furnished to the East Polk Soil and Water Conservation District and the West Polk Soil and Water Conservation District. It was partially funded by the Legislative Commission for Minnesota Resources and by Polk 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: Windbreaks and shelterbelts in an area of the Hedman-Fram-Heimdal association. The trees help to control soil blowing, protect farmsteads and livestock, provide wildlife habitat, and beautify the landscape.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov.

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Soil Survey of
Polk County, Minnesota—Part II

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Interpretive ratings help engineers, planners, and others understand how soil properties influence important nonagricultural uses, such as building site development and construction materials. The ratings indicate the most restrictive soil features affecting the suitability of the soils for these uses.

Soils are rated in their natural state. No unusual modification of the soil site or material is made other than that which is considered normal practice for the rated use. Even though soils may have limitations, it is important to remember that engineers and others can modify soil features or can design or adjust the plans for a structure to compensate for most of the limitations. Most of these practices, however, are costly. The final decision in selecting a site for a particular use generally involves weighing the costs of site preparation and maintenance.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where wetness or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The classification and extent of the soils in this survey area are shown in the tables “Classification of the Soils” and “Acreage and Proportionate Extent of the Soils,” which are at the end of this section.

Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
20B	Chapett fine sandy loam, 2 to 6 percent slopes	50,805	4.0
20C2	Chapett fine sandy loam, 6 to 12 percent slopes, eroded	12,366	1.0
20D2	Chapett fine sandy loam, 12 to 20 percent slopes, eroded	5,474	0.4
20E	Chapett fine sandy loam, 20 to 40 percent slopes	447	*
38B	Waukon loam, 2 to 6 percent slopes	4,778	0.4
38C2	Waukon loam, 6 to 12 percent slopes, eroded	2,726	0.2
38D2	Waukon loam, 12 to 20 percent slopes, eroded	964	*
45B	Maddock loamy fine sand, 1 to 6 percent slopes	10,240	0.8
45C	Maddock loamy fine sand, 6 to 12 percent slopes	2,358	0.2
45E	Maddock loamy fine sand, 12 to 30 percent slopes	2,098	0.2
47	Colvin silty clay loam	52,015	4.1
57A	Fargo silty clay, 0 to 1 percent slopes	1,390	0.1
59	Grimstad fine sandy loam	50,994	4.0
65	Foxhome sandy loam	1,527	0.1
66	Flaming loamy fine sand	15,280	1.2
67A	Bearden silt loam, 0 to 2 percent slopes	20,213	1.6
67B	Bearden silt loam, 2 to 6 percent slopes	6,304	0.5
93A	Bearden silty clay loam, 0 to 2 percent slopes	8,444	0.7
111	Hangaard sandy loam	1,031	*
184A	Hamerly loam, 0 to 3 percent slopes	3,583	0.3
185D2	Hattie clay, 6 to 18 percent slopes, eroded	1,496	0.1
236	Vallers loam	8,083	0.6
242B	Marquette loamy sand, 1 to 8 percent slopes	612	*
242D	Marquette loamy sand, 8 to 30 percent slopes	471	*
258B	Sandberg loamy sand, 1 to 6 percent slopes	21,539	1.7
258C	Sandberg loamy sand, 6 to 12 percent slopes	2,273	0.2
258E	Sandberg loamy sand, 12 to 30 percent slopes	1,706	0.1
296	Fram loam	26,446	2.1
341B	Arvilla sandy loam, 1 to 4 percent slopes	3,014	0.2
348	Borup loam, depressional	397	*
372	Hamar loamy fine sand	2,866	0.2
387	Roliss loam, depressional	1,504	0.1
412	Mavie fine sandy loam	3,521	0.3
422A	Bygland silty clay loam, 0 to 2 percent slopes	8,763	0.7
422B	Bygland silty clay loam, 2 to 6 percent slopes	2,391	0.2
422C2	Bygland silty clay loam, 6 to 12 percent slopes, eroded	510	*
426	Foldahl loamy fine sand	10,110	0.8
435	Syrene sandy loam	2,786	0.2
439	Strathcona fine sandy loam	28,328	2.2
450	Rauville silty clay loam	2,305	0.2
481	Kratka fine sandy loam	5,774	0.5
494B	Darnen loam, 2 to 6 percent slopes	16	*
506	Overly silty clay loam	1,889	0.1
540	Seelyeville muck	12,292	1.0
543	Markey muck	4,567	0.4
544	Cathro muck	13,950	1.1
547	Deerwood muck	2,639	0.2
563	Northwood muck	6,398	0.5
565	Eckvoll loamy fine sand	438	*
573D	Serden fine sand, 6 to 30 percent slopes	1,131	*
582	Roliss loam	6,631	0.5
641	Clearwater clay	13,928	1.1
642	Clearwater loam	22,246	1.7
643	Huot fine sandy loam	16,573	1.3
645	Espelie fine sandy loam	724	*
647	Hilaire loamy fine sand	4,425	0.3
650	Reiner fine sandy loam	3,758	0.3
651	Thiefriver fine sandy loam	2,097	0.2
667B	Fairdale silt loam, 1 to 6 percent slopes, occasionally flooded	11,511	0.9
667C2	Fairdale silt loam, 6 to 15 percent slopes, eroded, occasionally flooded	1,144	*
670	Knute fine sandy loam	11,662	0.9

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
671	Onstad loam	9,152	0.7
681	Brandsvold loam	4,996	0.4
694D2	Zell silt loam, 6 to 20 percent slopes, eroded	3,955	0.3
704	Wyrene sandy loam	5,254	0.4
707A	Lizzie silt loam, 1 to 3 percent slopes	1,903	0.1
712	Rosewood fine sandy loam	24,154	1.9
713	Linveldt fine sandy loam	759	*
718B	Naytahwaush loam, 2 to 8 percent slopes	3,973	0.3
718C	Naytahwaush loam, 8 to 15 percent slopes	8,931	0.7
718E	Naytahwaush loam, 15 to 30 percent slopes	4,369	0.3
733	Berner muck	1,448	0.1
735B	Halverson loamy fine sand, 1 to 6 percent slopes	5,021	0.4
735C	Halverson loamy fine sand, 6 to 15 percent slopes	1,494	0.1
737	Mahkonce loam	792	*
746	Haslie muck	2,352	0.2
749	Colvin silt loam, occasionally flooded	421	*
765	Smiley loam	3,765	0.3
767	Auganaush loam	543	*
791	Winterfield loamy fine sand, occasionally flooded	1,393	0.1
827B	Heimdal-Esmond complex, 2 to 6 percent slopes	16,226	1.3
827C2	Heimdal-Esmond complex, 6 to 12 percent slopes, eroded	3,925	0.3
908	Bearden-Fargo complex	18,215	1.4
935	Hegne-Fargo complex	4,865	0.4
967B	Waukon-Langhei complex, 2 to 6 percent slopes	46	*
967C2	Waukon-Langhei complex, 6 to 12 percent slopes, eroded	1,631	0.1
979D2	Langhei-Waukon complex, 12 to 20 percent slopes, eroded	730	*
1006	Fluvaquents-Haploborolls complex, 0 to 30 percent slopes	3,721	0.3
1030	Pits, gravel-Udipsamments complex	3,191	0.2
1113	Haslie, Seelyeville, and Cathro soils, ponded	5,797	0.5
1117	Hedman loam	21,657	1.7
1119	Nielsville silty clay loam	15,495	1.2
1121	Hedman loam, depressional	2,357	0.2
1122	Nielsville-Perella complex	4,854	0.4
1142	Hedman-Fram complex	41,794	3.3
1144	Strathcona and Kratka soils, depressional	3,085	0.2
1152B	Sugarbush loamy sand, 1 to 8 percent slopes	665	*
1152C	Sugarbush loamy sand, 8 to 15 percent slopes	838	*
1152E	Sugarbush loamy sand, 15 to 30 percent slopes	370	*
1233D	Esmond-Heimdal complex, 12 to 20 percent slopes, eroded	3,474	0.3
1264	Ulen loamy fine sand	42,544	3.3
1278	Rosewood-Venlo complex	3,798	0.3
1279	Vallers-Hamerly complex	10,697	0.8
1280	Gunclub silty clay loam	2,753	0.2
1283	Reis-Clearwater complex	15,090	1.2
1297	Augsburg very fine sandy loam	4,759	0.4
1299	Borup very fine sandy loam	6,121	0.5
1304A	Glyndon very fine sandy loam, 0 to 2 percent slopes	26,838	2.1
1304B	Glyndon very fine sandy loam, 2 to 6 percent slopes	405	*
1315A	Wheatville very fine sandy loam, 0 to 2 percent slopes	18,892	1.5
1323B	LaDelle silt loam, 0 to 3 percent slopes, occasionally flooded	502	*
1325	Bowstring-Fluvaquents complex, frequently flooded	5,559	0.4
1356	Water, miscellaneous	1,320	0.1
1422	Northwood muck, marl subsoil	3,265	0.3
1866	Colvin-Perella complex	100,294	7.9
1871	Fargo silty clay, swales	1,054	*
1874	Radium loamy sand	14,031	1.1
1878	Hamre muck	6,287	0.5
1879	Seelyeville muck, calcareous, 0 to 3 percent slopes	4,040	0.3
1882	Rosewood, Strathcona, and Berner soils, seepy	679	*

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
1916	Lindaas silty clay loam	2,895	0.2
1963	Bearden-Colvin complex	194,254	15.3
1964	Colvin-Fargo complex	28,443	2.2
W	Water	20,620	1.6
	Total	1,278,702	100.0

* Less than 0.1 percent.

Classification of the Soils

Soil name	Family or higher taxonomic class
Arvilla	Sandy, mixed Udic Haploborolls
Auganaush	Fine, smectitic, frigid Mollic Albaqualfs
Augsburg	Coarse-silty over clayey, mixed over smectitic, superactive, frigid Typic Calciaquolls
Bearden	Fine-silty, mixed, superactive, frigid Aeric Calciaquolls
Berner	Loamy, mixed, euic Terric Borosaprists
Borup	Coarse-silty, mixed, superactive, frigid Typic Calciaquolls
Bowstring	Euic Fluvaquentic Borosaprists
Brandsvold	Fine-loamy, mixed, superactive, frigid Typic Argiaquolls
Bygland	Fine, smectitic Aquertic Argiborolls
Cathro	Loamy, mixed, euic Terric Borosaprists
Chapett	Fine-loamy, mixed, superactive Boralfic Udic Argiborolls
Clearwater	Fine, smectitic, frigid Typic Epiaquerts
Colvin	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Darnen	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Deerwood	Sandy, mixed, frigid Histic Humaquepts
Eckvoll	Loamy, mixed, superactive Aquic Arenic Eutroboralfs
Esmond	Coarse-loamy, mixed, superactive Udic Calciborolls
Espelie	Sandy over clayey, mixed over smectitic, frigid Typic Epiaquolls
Fairdale	Fine-loamy, mixed, superactive, calcareous, frigid Mollic Udifluvents
Fargo	Fine, smectitic, frigid Typic Epiaquerts
Flaming	Sandy, mixed Aquic Haploborolls
Fluvaquents	Loamy Fluvaquents
Foldahl	Sandy over loamy, mixed, superactive Aquic Haploborolls
Foxhome	Sandy-skeletal over loamy, mixed, superactive Aquic Haploborolls
Fram	Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls
Glyndon	Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls
Grimstad	Sandy over loamy, mixed, superactive, frigid Aeric Calciaquolls
Gunclub	Fine-silty, mixed, superactive, frigid Aeric Calciaquolls
Halverson	Loamy, mixed, superactive Arenic Argiborolls
Hamar	Sandy, mixed, frigid Typic Endoaquolls
Hamerly	Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls
Hamre	Fine-loamy, mixed, superactive, nonacid, frigid Histic Humaquepts
Hangaard	Sandy, mixed, frigid Typic Endoaquolls
Haploborolls	Loamy Haploborolls
Haslie	Coprogenous, euic Limnic Borosaprists
Hattie	Fine, smectitic, frigid Typic Hapluderts
Hedman	Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls
Hegne	Fine, smectitic, frigid Typic Calciaquerts
Heimdal	Coarse-loamy, mixed, superactive Udic Haploborolls
Hilaire	Sandy over clayey, mixed over smectitic Aquic Haploborolls
Huot	Sandy over clayey, mixed over smectitic Aquic Calciborolls
Knute	Fine-loamy, mixed, superactive Aquic Argiborolls
Kratka	Sandy over loamy, mixed, superactive, frigid Typic Endoaquolls
LaDelle	Fine-silty, mixed, superactive Cumulic Udic Haploborolls
Langhei	Fine-loamy, mixed, superactive, frigid Typic Eutrochrepts
Lindaas	Fine, smectitic, frigid Typic Argiaquolls
Linveldt	Coarse-loamy, mixed, superactive Aquic Argiborolls
Lizzie	Fine-silty, mixed, superactive Boralfic Udic Argiborolls
Maddock	Sandy, mixed Udorthentic Haploborolls
Mahkonce	Fine, smectitic Aquic Eutroboralfs
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Marquette	Loamy-skeletal, mixed, superactive Ochreptic Eutroboralfs
Mavie	Sandy-skeletal over loamy, mixed, superactive, frigid Typic Calciaquolls
Naytahwaush	Fine, smectitic Mollic Eutroboralfs
Nielsville	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Northwood	Sandy over loamy, mixed, superactive, nonacid, frigid Histic Humaquepts
Onstad	Coarse-loamy, mixed, superactive Aquic Haploborolls
Overly	Fine-silty, mixed, superactive Pachic Udic Haploborolls
Perella	Fine-silty, mixed, superactive, frigid Typic Endoaquolls
Radium	Sandy, mixed Aquic Haploborolls
Rauville	Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Reiner	Fine-loamy, mixed, superactive Abruptic Udic Argiborolls
Reis	Fine, smectitic, frigid Typic Calciaquerts
Roliss	Fine-loamy, mixed, superactive, calcareous, frigid Typic Endoaquolls
Rosewood	Sandy, mixed, frigid Typic Calciaquolls
Sandberg	Sandy, mixed Udorthentic Haploborolls
Seelyeville	Euic Typic Borosaprists
Serden	Mixed, frigid Typic Udipsamments
Smiley	Fine-loamy, mixed, superactive, frigid Typic Argiaquolls
Strathcona	Sandy over loamy, mixed, superactive, frigid Typic Calciaquolls
Sugarbush	Coarse-loamy, mixed, superactive Typic Eutroboralfs
Syrene	Sandy, mixed, frigid Typic Calciaquolls
Thiefriver	Sandy over clayey, mixed over smectitic, frigid Typic Calciaquolls
Udipsamments	Udipsamments
Ulen	Sandy, mixed, frigid Aeric Calciaquolls
Vallers	Fine-loamy, mixed, superactive, frigid Typic Calciaquolls
Venlo	Sandy, mixed, frigid Typic Endoaquolls
Waukon	Fine-loamy, mixed, superactive Mollic Eutroboralfs
Wheatville	Coarse-silty over clayey, mixed over smectitic, superactive, frigid Aeric Calciaquolls
Winterfield	Mixed, frigid Aquic Udipsamments
Wyrene	Sandy, mixed, frigid Aeric Calciaquolls
Zell	Coarse-silty, mixed, superactive Udic Calciborolls

Agronomy

General management needed for crops and for hay and pasture is suggested in this section. The system of land capability classification used by the Natural Resources Conservation Service is explained, the estimated yields of the main crops and hay and pasture plants are listed for each soil, and prime farmland is described.

Polk County is mainly a small grain farming area, although some farmers raise soybeans, edible beans, potatoes, beef cattle, or hogs or manage dairy operations. Wheat, barley, sugar beets, corn, potatoes, soybeans, and alfalfa hay are the main crops. Approximately 83 percent of the land area in the county is used for crops, about 3 percent is used for pasture, about 7 percent is forest land, and about 7 percent is used for other purposes.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Cropland Management Considerations

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in the table "Cropland Management Considerations." The main concerns in managing nonirrigated cropland are conserving moisture, controlling wind erosion and water erosion, and maintaining soil fertility.

Conserving moisture consists primarily of reducing the evaporation and runoff rates and increasing the water infiltration rate. Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, and leaving crop residue on the surface conserve moisture (fig. 20).

Generally, a combination of several practices is needed to control *wind erosion* and *water erosion*. Conservation tillage, stripcropping, field windbreaks, contour farming, conservation cropping systems, crop residue management, terraces, diversions, and grassed waterways help to prevent excessive soil loss.

Measures that are effective in maintaining *soil fertility* include applying fertilizer, both organic and inorganic, including manure; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Controlling erosion helps to prevent the loss of organic matter and plant nutrients and thus helps to maintain productivity, although the level of fertility can be reduced even in areas where erosion is controlled. All soils used for nonirrigated crops respond well to applications of fertilizer.

Some of the considerations shown in the table cannot be easily overcome. These are *channels, flooding, gullies,* and *ponding*.

Additional considerations are as follows:

Lime content, limited available water capacity, potential poor tilth and compaction, and *restricted permeability*.—These limitations can be minimized by incorporating green manure crops, manure, or crop residue into the soil; applying a system of conservation tillage; and using conservation cropping systems. Also, crops may respond well to additions of phosphate fertilizer in soils that have a high content of lime.

Potential for ground-water contamination.—The proper use of nutrients and pesticides can reduce the risk of ground-water contamination.

Potential for surface-water contamination.—The risk of surface-water contamination can be reduced by the proper use of nutrients and pesticides and by conservation farming practices that reduce the runoff rate.

Surface crusting.—This limitation retards seedling development after periods of heavy rainfall.

Surface rock fragments.—This limitation causes rapid wear of tillage equipment. It cannot be easily overcome.

Surface stones.—Stones or boulders on or near the surface can hinder normal tillage unless they are removed.

Figure 20.—Using minimum tillage practices and returning crop residue to the soil conserve moisture, improve the content of organic matter, and reduce the hazard of erosion in an area of Chapett fine sandy loam, 2 to 6 percent slopes.

Salt content.—In areas where this is a limitation, only salt-tolerant crops should be grown.

Explanation of Criteria

Acid soil.—The pH is less than 6.1.

Channeled.—The word “channeled” is included in the map unit name.

Dense layer.—The bulk density is greater than 1.80 g/cc within the soil profile.

Depth to rock.—The depth to bedrock is less than 40 inches.

Previously eroded.—The word “eroded” is included in the map unit name.

Excessive permeability.—Permeability is 6 inches per hour or more within the soil profile.

Flooding.—Flooding is occasional or frequent.

Gullied.—The word “gullied” is included in the map unit name.

High content of organic matter.—The surface layer has more than 20 percent organic matter.

Lime content.—The pH is 7.4 or more in the surface layer, or the wind erodibility group is 4L.

Limited available water capacity.—The available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 6 inches or less.

Limited content of organic matter.—The content of organic matter is less than 2 percent in the surface layer.

Ponding.—Ponding duration is assigned to the map unit component. The water table is above the surface.

Potential poor tilth and compaction.—The content of clay is 27 percent or more in the surface layer.

Potential for ground-water contamination (by nutrients or pesticides).—Depth to the water table is 4 feet or less, the permeability of any layer is more than

6.0 inches per hour, or the depth to bedrock is less than 60 inches.

Potential for surface-water contamination (by nutrients or pesticides).—The map unit component is occasionally flooded or frequently flooded, is subject to ponding, is assigned to hydrologic group C or D and has a slope of more than 2 percent, is assigned to hydrologic group A and has a slope of more than 6 percent, or is assigned to hydrologic group B, has a slope of 3 percent or more, and has a K factor of more than 0.17.

Restricted permeability.—Permeability is less than 0.06 inch per hour within the soil profile.

Salt content.—The electrical conductivity is 4 or more in the surface layer or 8 or more within a depth of 30 inches.

Slope (equipment limitation).—The slope is more than 15 percent.

Surface crusting.—The content of clay is 27 percent or more and the content of organic matter is 2 percent or less in the surface layer.

Surface rock fragments (equipment limitation).—The terms describing the texture of the surface layer include any rock fragment modifier, except for gravelly, channery, stony, very stony, extremely stony, bouldery, very bouldery, and extremely bouldery.

Surface stones (equipment limitation).—The word “stony” or “bouldery” is included in the map unit name or in the description of the surface layer.

Water erosion.—Either the slope is 6 percent or more, or the slope is more than 3 percent and less than 6 percent and the surface layer is not sandy.

Water table.—A water table is within 2.5 feet of the surface.

Wind erosion.—The wind erodibility group is 1, 2, 3, 4, or 4L.

Crop Yield Estimates

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

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

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

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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

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

Pasture and Hayland Interpretations

Under good management, proper grazing is essential for the production of high-quality forage, stand survival, and erosion control (fig. 21). Proper grazing helps plants to maintain sufficient and generally vigorous top growth during the growing season. Brush control is essential in many areas, and weed control generally is needed. Rotation grazing and renovation also are important management practices.

Yield estimates are often provided in animal unit months (AUM), or the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about forage yields other than those shown in the table “Land Capability and Yields per Acre of Crops and Pasture.”

Figure 21.—A continuous cover of vegetation is needed to protect this area of Serden fine sand, 6 to 30 percent slopes, from wind erosion and water erosion.

Land Capability Classification

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

In the capability system, soils generally are grouped at three levels—capability class, subclass, and unit (USDA, 1961). These categories indicate the degree and kinds of limitations affecting mechanized farming systems that produce the more commonly grown field crops, such as corn, small grain, cotton, hay, and field-grown vegetables. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are

designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use.

If properly managed, soils in classes 1, 2, 3, and 4 are suitable for the mechanized production of commonly grown field crops and for pasture and woodland. The degree of the soil limitations affecting the production of cultivated crops increases progressively from class 1 to class 4. The limitations can affect levels of production and the risk of permanent soil deterioration caused by erosion and other factors.

Soils in classes 5, 6, and 7 are generally not suited to the mechanized production of commonly grown field crops without special management, but they are suitable for plants that provide a permanent cover, such as grasses and trees. The severity of the soil limitations affecting crops increases progressively from class 5 to class 7.

Areas in class 8 are generally not suitable for crops, pasture, or woodland without a level of management that is impractical. These areas may have potential for other uses, such as recreational facilities and wildlife habitat.

Capability subclasses identify the dominant kind of limitation in the class. They are designated by adding a small letter, *e, w, s,* or *c*, to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

There are no subclasses in class 1 because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the table “Land Capability and Yields per Acre of Crops and Pasture” at the end of this section.

Prime Farmland

Prime farmland is of major importance in meeting the Nation’s short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, State, and Federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation’s prime farmland.

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

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They either are used for food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming in National forests, National parks, military reservations, and State parks.

Prime farmland soils commonly receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable, and the level of acidity or alkalinity and the content of salts and sodium are acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods, and they are not frequently flooded during the growing season or are protected from flooding. Slopes range mainly from 0 to 6 percent.

Soils that have a high water table or are subject to flooding may qualify as prime farmland where these limitations are overcome by drainage measures or flood control. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information about the criteria for prime farmland can be obtained at the local office of the Natural Resources Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 959,297 acres, or nearly 74 percent of the survey area, meets the requirements for prime farmland.

The map units in the survey area that meet the requirements for prime farmland are listed in the table "Prime Farmland." This list does not constitute a recommendation for a particular land use. On some soils included in the table, measures that overcome limitations are needed. The need for these measures is indicated in parentheses after the map unit name. The location of each map unit is shown on the detailed soil maps. The soil qualities that affect use and management are described in the section "Soil Series and Detailed Soil Map Units" in Part I of this publication.

Erosion Factors

Soil erodibility (K) and soil-loss tolerance (T) factors are used in an equation that predicts the amount of soil lost through water erosion in areas of cropland. The procedure for predicting soil loss is useful in guiding the selection of soil and water conservation practices. The erosion factors for the soils in the survey area are listed in the table "Physical Properties of the Soils."

Soil Erodibility (K) Factor

The soil erodibility (K) factor indicates the susceptibility of a soil to sheet and rill erosion by water. The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the water storage capacity of the soil and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability.

Fragment-Free Soil Erodibility (Kf) Factor

This is one of the factors used in the Revised Universal Soil Loss Equation (RUSLE). It shows the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-Loss Tolerance (T) Factor

The soil-loss tolerance (T) factor is an estimate of the maximum annual rate of soil erosion that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss per acre per year. Ratings of 1 to 5 are used, depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

Wind Erodibility Groups

Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index (I) factor is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles. Soils are assigned to wind erodibility groups (WEG) having similar percentages of dry soil aggregates larger than 0.84 millimeter. The wind erodibility group and wind erodibility index of the soils in the survey area are given in the table "Physical Properties of the Soils."

Additional information about wind erodibility groups and K, Kf, T, and I factors can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow (fig. 22). They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Windbreaks are often planted on land that did not originally support trees. Knowledge of how well trees grow and survive on such land can be gained only by observing and recording the performance of trees that

Figure 22.—Windbreaks, along with crop residue management, are effective in reducing the hazard of wind erosion in many cultivated areas in Polk County.

have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil. Each tree or shrub has definable potential heights in a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

The table "Windbreaks and Environmental Plantings" shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in this table are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a nursery.

Windbreak Suitability Groups

Windbreak suitability groups consist of soils in which the kinds and degrees of the hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are about the same.

The soils in Polk County are assigned to specific windbreak suitability groups. These groups are

in the “Windbreak Suitability Groups” table and described in the following paragraphs. In areas where water erosion is a severe hazard, site preparation should be limited to spot treatment extending 2 feet from where the plant is established. Specific information also can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Group 1 consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and do not have free carbonates in the upper 20 inches.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on the soils in this windbreak suitability group. Cultivation or applications of herbicide can help to remove competing vegetation.

Group 1K consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and have free carbonates within 20 inches of the surface. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8). Trees and shrubs grown as windbreaks and environmental plantings on soils in this group should be those that are tolerant of a high content of lime. The free carbonates in the soil tie up plant nutrients and limit their availability. Cultivation or applications of herbicide can help to remove competing vegetation.

Group 2 consists of poorly drained soils that have been artificially drained and do not have free carbonates in the upper 20 inches. Permeability varies.

Trees and shrubs grown as windbreaks and environmental plantings on the soils in this group should be those that are tolerant of wetness and a high content of lime. Cultivation or applications of herbicide can help to remove competing vegetation.

Group 2K consists of poorly drained or very poorly drained soils that have been artificially drained and have free carbonates within 20 inches of the surface. Permeability varies. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

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

Group 2W consists of very poorly drained soils that are subject to ponding and have been artificially drained. It includes soils that have an organic surface layer up to 16 inches thick. Permeability varies.

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

Group 3 consists of soils that are well drained or moderately well drained and are loamy or silty throughout. Permeability is moderate or moderately slow. These soils do not have free carbonates in the upper 20 inches.

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

Group 4 consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a silty or loamy surface layer and a clayey subsoil. Permeability is slow or very slow.

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

Group 4C consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a clayey surface layer and subsoil. Permeability is slow or very slow.

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

Group 5 consists of soils that are excessively drained to moderately well drained and have a moderate available water capacity. These soils are dominantly fine sandy loam or sandy loam, but some are sandy in the upper part and loamy in the lower part.

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

Group 6G consists of excessively drained to moderately well drained soils that are loamy in the upper part and have sand or sand and gravel at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

Trees and shrubs grown as windbreaks and

environmental plantings on the soils in this group should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide can help to remove competing vegetation.

Group 7 consists of excessively drained to well drained soils that are dominantly loamy fine sand or coarser textured and are shallow to sand or to sand and gravel. These soils have a low available water capacity.

Trees and shrubs grown as windbreaks and environmental plantings on the soils in this group should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by droughtiness. Leaving some vegetation on the surface during the early years of establishment helps to control wind erosion. Cultivation or applications of herbicide can help to remove competing vegetation.

Group 8 consists of excessively drained to well drained, loamy soils that have free carbonates within 20 inches of the surface.

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

Group 10 consists of soils or miscellaneous land types that generally are not suitable for windbreaks. One or more characteristics, such as soil depth, texture, wetness, available water capacity, or slope, limit the planting, survival, or growth of trees and shrubs. Onsite investigation may reveal that tree and shrub plantings can be made with special treatment.

Cropland Management Considerations

(See text for a description of the considerations listed in this table.)

Map symbol and component name	Component percent	Cropland management considerations
20B:		
Chapett	90	Potential for surface-water contamination Water erosion Wind erosion
20C2:		
Chapett	90	Potential for surface-water contamination Previously eroded Water erosion Wind erosion
20D2:		
Chapett	90	Slope Potential for surface-water contamination Previously eroded Water erosion Wind erosion
20E:		
Chapett	90	Slope Potential for surface-water contamination Water erosion Wind erosion
38B:		
Waukon	90	Potential for surface-water contamination Water erosion
38C2:		
Waukon	90	Potential for surface-water contamination Previously eroded Water erosion
38D2:		
Waukon	90	Slope Potential for surface-water contamination Previously eroded Water erosion
45B:		
Maddock	90	Limited available water capacity Limited content of organic matter Potential for ground-water contamination Wind erosion
45C:		
Maddock	90	Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
45E:		
Maddock	90	Slope Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
47:		
Colvin	90	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
57A:		
Fargo	90	Potential poor tilth and compaction Potential for ground-water contamination Water table
59:		
Grimstad	90	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
65:		
Foxhome	90	Excessive permeability Potential for ground-water contamination Wind erosion
66:		
Flaming	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
67A:		
Bearden	90	Lime content Potential for ground-water contamination Water table Wind erosion
67B:		
Bearden	90	Lime content Potential for ground-water contamination Potential for surface-water contamination Water erosion Water table Wind erosion
93A:		
Bearden	90	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
111:		
Hangaard	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Water table Wind erosion
184A:		
Hamerly	90	Lime content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
185D2:		
Hattie	90	Slope Lime content Potential poor tilth and compaction Potential for surface-water contamination Previously eroded Water erosion
236:		
Vallers	90	Lime content Potential for ground-water contamination Water table Wind erosion
242B:		
Marquette	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Wind erosion
242D:		
Marquette	90	Slope Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
258B:		
Sandberg	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
258C:		
Sandberg	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
258E:		
Sandberg	90	Slope Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
296:		
Fram	90	Lime content Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
341B:		
Arvilla	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
348:		
Borup	90	Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
372:		
Hamar	90	Limited available water capacity Potential for ground-water contamination Water table Wind erosion
387:		
Roliss	90	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
412:		
Mavie	90	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
422A:		
Bygland	90	Potential poor tilth and compaction Potential for ground-water contamination
422B:		
Bygland	90	Potential poor tilth and compaction Potential for ground-water contamination Potential for surface-water contamination Water erosion
422C2:		
Bygland	90	Potential poor tilth and compaction Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion
426:		
Foldahl	90	Excessive permeability Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
435:		
Syrene	90	Excessive permeability Lime content Limited available water capacity Potential for ground-water contamination Water table Wind erosion
439:		
Strathcona	90	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
450:		
Rauville	90	Flooding Lime content Potential poor tilth and compaction Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
481:		
Kratka	90	Excessive permeability Potential for ground-water contamination Water table Wind erosion
494B:		
Darnen	90	Potential for surface-water contamination Water erosion
506:		
Overly	90	Potential poor tilth and compaction Potential for ground-water contamination Potential for surface-water contamination
540:		
Seelyeville	90	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
543:		
Markey	90	Excessive permeability High content of organic matter Potential for ground-water contamination Water table Wind erosion
544:		
Cathro	90	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
547:		
Deerwood	90	Excessive permeability High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
563:		
Northwood	90	Excessive permeability High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
565:		
Eckvoll	90	Excessive permeability Potential for ground-water contamination Wind erosion
573D:		
Serden	90	Slope Excessive permeability Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
582:		
Roliss	90	Lime content Potential for ground-water contamination Water table Wind erosion
641:		
Clearwater	90	Potential poor tilth and compaction Potential for ground-water contamination Water table
642:		
Clearwater	90	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
643:		
Huot	90	Excessive permeability Lime content Potential for ground-water contamination Wind erosion
645:		
Espelie	90	Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
647:		
Hilaire	90	Excessive permeability Potential for ground-water contamination Wind erosion
650:		
Reiner	90	Potential for ground-water contamination Wind erosion
651:		
Thiefriver	90	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
667B:		
Fairdale	90	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
667C2:		
Fairdale	90	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion Wind erosion
670:		
Knute	90	Potential for ground-water contamination Wind erosion
671:		
Onstad	90	Potential for ground-water contamination
681:		
Brandsvold	90	Potential for ground-water contamination Water table
694D2:		
Zell	90	Slope Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
704:		
Wyrene	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Water table Wind erosion
707A:		
Lizzie	90	Potential for ground-water contamination

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
712:		
Rosewood	90	Excessive permeability Lime content Limited available water capacity Potential for ground-water contamination Water table Wind erosion
713:		
Linveldt	90	Excessive permeability Potential for ground-water contamination Wind erosion
718B:		
Naytahwaush	90	Potential for surface-water contamination Water erosion
718C:		
Naytahwaush	90	Potential for surface-water contamination Water erosion
718E:		
Naytahwaush	90	Slope Potential for surface-water contamination Water erosion
733:		
Berner	90	Excessive permeability High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
735B:		
Halverson	90	Excessive permeability Potential for ground-water contamination Potential for surface-water contamination Wind erosion
735C:		
Halverson	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
737:		
Mahkonce	90	Potential for ground-water contamination Potential for surface-water contamination
746:		
Haslie	90	High content of organic matter Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
749:		
Colvin	90	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
765:		
Smiley	90	Potential for ground-water contamination Water table
767:		
Auganaush	90	Potential for ground-water contamination Water table
791:		
Winterfield	90	Flooding Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
827B:		
Heimdal	60	Potential for surface-water contamination Water erosion
Esmond	30	Lime content Potential for surface-water contamination Water erosion Wind erosion
827C2:		
Heimdal	50	Potential for surface-water contamination Previously eroded Water erosion
Esmond	40	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
908:		
Bearden	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
Fargo	40	Potential poor tilth and compaction Potential for ground-water contamination Water table
935:		
Hegne	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
935:		
Fargo	40	Potential poor tilth and compaction Potential for ground-water contamination Water table
967B:		
Waukon	65	Potential for surface-water contamination Water erosion
Langhei	25	Lime content Potential for surface-water contamination Water erosion Wind erosion
967C2:		
Waukon	60	Potential for surface-water contamination Previously eroded Water erosion
Langhei	30	Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
979D2:		
Langhei	55	Slope Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Waukon	35	Slope Potential for surface-water contamination Previously eroded Water erosion
1006:		
Fluvaquents	45	Flooding Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Haploborolls	45	Slope Potential for surface-water contamination Water erosion
1030:		
Pits, gravel	70	---
Udipsamments	20	Slope Excessive permeability Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
1113:		
Haslie	30	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Seelyeville	30	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Cathro	30	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1117:		
Hedman	90	Lime content Potential for ground-water contamination Water table Wind erosion
1119:		
Nielsville	90	Lime content Potential poor tilth and compaction Potential for ground-water contamination Restricted permeability Water table Wind erosion
1121:		
Hedman	90	Lime content Potential for ground-water contamination Water table Wind erosion
1122:		
Nielsville	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
Perella	40	Ponding Potential poor tilth and compaction Potential for ground-water contamination Potential for surface-water contamination Water table
1142:		
Hedman	50	Lime content Potential for ground-water contamination Water table Wind erosion
Fram	40	Lime content Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
1144:		
Strathcona	45	Excessive permeability Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
Kratka	45	Excessive permeability High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1152B:		
Sugarbush	90	Excessive permeability Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Wind erosion
1152C:		
Sugarbush	90	Excessive permeability Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
1152E:		
Sugarbush	90	Slope Excessive permeability Limited available water capacity Limited content of organic matter Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
1233D:		
Esmond	60	Slope Lime content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Heimdal	30	Slope Potential for surface-water contamination Previously eroded Water erosion
1264:		
Ulen	90	Excessive permeability Lime content Potential for ground-water contamination Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
1278:		
Rosewood	50	Excessive permeability Lime content Limited available water capacity Potential for ground-water contamination Water table Wind erosion
Venlo	40	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1279:		
Vallers	50	Lime content Potential for ground-water contamination Water table Wind erosion
Hamerly	40	Lime content Potential for ground-water contamination Water table Wind erosion
1280:		
Gunclub	90	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
1283:		
Reis	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table
Clearwater	40	Potential poor tilth and compaction Potential for ground-water contamination Water table
1297:		
Augsburg	90	Lime content Potential for ground-water contamination Water table Wind erosion
1299:		
Borup	90	Lime content Potential for ground-water contamination Water table Wind erosion
1304A:		
Glyndon	90	Lime content Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
1304B:		
Glyndon	90	Lime content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
1315A:		
Wheatville	90	Lime content Potential for ground-water contamination Water table Wind erosion
1323B:		
LaDelle	90	Flooding Potential for ground-water contamination Potential for surface-water contamination
1325:		
Bowstring	45	Flooding High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Fluvaquents	45	Flooding Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1356:		
Water, miscellaneous	100	---
1422:		
Northwood	90	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1866:		
Colvin	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
Perella	40	Potential for ground-water contamination Water table
1871:		
Fargo	90	Ponding Potential poor tilth and compaction Potential for ground-water contamination Potential for surface-water contamination Water table

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
1874:		
Radium	90	Excessive permeability Limited available water capacity Potential for ground-water contamination Water table Wind erosion
1878:		
Hamre	90	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1879:		
Seelyeville	90	High content of organic matter Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1882:		
Rosewood	30	Excessive permeability Lime content Limited available water capacity Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
Strathcona	30	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
Berner	30	Excessive permeability High content of organic matter Potential for ground-water contamination Water table Wind erosion
1916:		
Lindaas	90	Potential poor tilth and compaction Potential for ground-water contamination Ponding Water table
1963:		
Bearden	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
Colvin	40	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and component name	Component percent	Cropland management considerations
1964:		
Colvin	50	Lime content Potential poor tilth and compaction Potential for ground-water contamination Water table Wind erosion
Fargo	40	Potential poor tilth and compaction Potential for ground-water contamination Water table

Land Capability and Yields per Acre of Crops and Pasture

(Yields in the "N" columns are for nonirrigated areas; those in the "I" column are for irrigated areas. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil.)

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
20B---------- Chapett	2e	---	4.5	---	70	---	5.8	---	90	---	---	---	1800	---	45	---
20C2---------- Chapett	3e	---	2.8	---	60	---	4.0	---	80	---	---	---	1400	---	35	---
20D2---------- Chapett	4e	---	2.3	---	50	---	3.0	---	60	---	---	---	---	---	30	---
20E---------- Chapett	7e	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
38B---------- Waukon	2e	---	4.5	---	70	---	5.8	---	90	---	---	---	1800	---	40	---
38C2---------- Waukon	3e	---	2.8	---	60	---	3.2	---	75	---	---	---	1400	---	30	---
38D2---------- Waukon	4e	---	2.3	---	45	---	3.0	---	50	---	---	---	875	---	25	---
45B---------- Maddock	4s	---	3.0	---	25	---	3.9	---	40	---	---	---	1200	---	20	---
45C---------- Maddock	6s	---	2.6	---	20	---	3.4	---	30	---	---	---	900	---	20	---
45E---------- Maddock	6s	---	1.0	---	---	---	2.0	---	---	---	---	---	---	---	---	---
47---------- Colvin	2w	---	4.0	---	90	---	---	---	90	---	17.0	---	2000	---	50	---
57A---------- Fargo	2w	---	3.5	---	80	---	---	---	85	---	16.0	---	1900	---	45	---
59---------- Grimstad	2s	---	4.2	---	80	---	5.5	---	80	---	---	---	1700	---	45	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
65---------- Foxhome	3s	---	4.0	---	65	---	5.2	---	60	---	---	---	1450	---	30	---
66---------- Flaming	4s	---	4.0	---	43	---	5.2	---	50	---	---	---	985	---	30	---
67A---------- Bearden	2s	---	5.0	---	100	---	---	---	85	---	19.5	---	2200	---	55	---
67B---------- Bearden	2e	---	4.5	---	90	---	---	---	70	---	19.0	---	2000	---	50	---
93A---------- Bearden	2s	---	4.8	---	95	---	---	---	80	---	19.0	---	2000	---	55	---
111---------- Hangaard	4w	---	3.0	---	40	---	3.8	---	45	---	---	---	1200	---	25	---
184A---------- Hamerly	2s	---	4.8	---	90	---	6.2	---	80	---	18.0	---	2100	---	50	---
185D2---------- Hattie	4e	---	2.3	---	45	---	3.0	---	40	---	---	---	720	---	25	---
236---------- Vallers	2w	---	3.8	---	75	---	4.9	---	80	---	17.0	---	2000	---	45	---
242B---------- Marquette	4s	---	2.8	---	30	---	3.6	---	35	---	---	---	800	---	22	---
242D---------- Marquette	7s	---	1.6	---	---	---	2.0	---	---	---	---	---	---	---	---	---
258B---------- Sandberg	4s	4s	3.0	---	30	---	3.9	---	35	170	---	---	900	---	20	---
258C---------- Sandberg	6s	6s	2.2	---	20	---	2.8	---	30	165	---	---	685	---	15	---
258E---------- Sandberg	7e	---	---	---	---	---	1.2	---	---	---	---	---	---	---	---	---
296---------- Fram	2e	---	4.8	---	85	---	6.2	---	80	---	---	---	1800	---	45	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
341B---------- Arvilla	4s	---	3.5	---	35	---	4.5	---	35	---	---	---	900	---	25	---
348---------- Borup	3w	---	---	---	40	---	---	---	45	---	13.0	---	1300	---	30	---
372---------- Hamar	4w	---	3.0	---	---	---	3.9	---	45	---	---	---	1300	---	25	---
387---------- Roliss	3w	---	2.1	---	45	---	2.7	---	70	---	---	---	1350	---	30	---
412---------- Mavie	3w	---	3.2	---	60	---	4.2	---	45	---	---	---	1600	---	35	---
422A---------- Bygland	1	---	5.5	---	100	---	7.0	---	100	---	19.5	---	4	---	60	---
422B---------- Bygland	2e	---	4.5	---	100	---	5.8	---	95	---	19.5	---	---	---	65	---
422C2---------- Bygland	3e	---	3.0	---	3	---	4.0	---	80	---	16.0	---	---	---	45	---
426---------- Foldahl	3s	---	4.2	---	75	---	5.5	---	65	---	16.0	---	1500	---	35	---
435---------- Syrene	4w	---	3.5	---	55	---	4.6	---	55	---	---	---	1300	---	30	---
439---------- Strathcona	2w	---	3.8	---	70	---	4.9	---	65	---	16.0	---	1800	---	40	---
450---------- Rauville	5w	---	---	---	25	---	---	---	30	---	12.0	---	1100	---	20	---
481---------- Kratka	3w	---	3.6	---	65	---	---	---	55	---	---	---	1600	---	38	---
494B---------- Darnen	2e	---	4.2	---	75	---	5.5	---	80	---	---	---	1900	---	45	---
506---------- Overly	1	---	5.5	---	100	---	6.5	---	95	---	19.0	---	2000	---	60	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
540---------- Seelyeville	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
543---------- Markey	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
544---------- Cathro	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
547---------- Deerwood	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
563---------- Northwood	6w	---	---	---	10	---	---	---	---	---	---	---	---	---	---	---
565---------- Eckvoll	3s	---	4.0	---	65	---	5.2	---	65	---	---	---	1500	---	35	---
573D---------- Serden	7e	---	---	---	---	---	1.6	---	---	---	---	---	---	---	---	---
582---------- Roliss	2w	---	3.5	---	75	---	5.0	---	75	---	17.0	---	2000	---	45	---
641---------- Clearwater	2w	---	3.2	---	70	---	4.2	---	80	---	16.0	---	1800	---	45	---
642---------- Clearwater	2w	---	3.5	---	75	---	4.9	---	85	---	17.0	---	1900	---	50	---
643---------- Huot	2s	---	4.4	---	75	---	5.7	---	75	---	16.0	---	1900	---	45	---
645---------- Espelie	2w	---	3.8	---	70	---	4.2	---	70	---	16.0	---	1650	---	40	---
647---------- Hilaire	3s	---	4.2	---	70	---	5.5	---	65	---	15.0	---	1400	---	35	---
650---------- Reiner	1	---	5.5	---	95	---	6.8	---	100	---	18.0	---	2300	---	55	---
651---------- Thiefriver	2w	---	3.8	---	70	---	4.9	---	75	---	16.0	---	1800	---	40	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
667B---------- Fairdale	2e	---	4.3	---	75	---	5.6	---	75	---	17.0	---	1600	---	35	---
667C2---------- Fairdale	3e	---	2.8	---	65	---	3.6	---	65	---	15.0	---	1300	---	30	---
670---------- Knute	1	---	5.2	---	95	---	6.7	---	95	---	---	---	2300	---	55	---
671---------- Onstad	1	---	5.0	---	95	---	6.2	---	100	---	---	---	2300	---	55	---
681---------- Brandsvold	2w	---	4.0	---	70	---	5.2	---	70	---	---	---	1900	---	45	---
694D2---------- Zell	6e	---	3.0	---	60	---	4.0	---	50	---	---	---	1000	---	20	---
704---------- Wyrene	3e	---	3.2	---	45	---	4.2	---	50	---	---	---	1300	---	20	---
707A---------- Lizzie	2e	---	4.5	---	80	---	5.8	---	90	---	---	---	1800	---	45	---
712---------- Rosewood	3w	---	---	---	60	---	---	---	55	---	---	---	1400	---	35	---
713---------- Linveldt	3s	---	4.0	---	65	---	5.2	---	70	---	---	---	16	---	40	---
718B---------- Naytahwaush	2e	---	4.5	---	80	---	5.8	---	85	---	---	---	1800	---	45	---
718C---------- Naytahwaush	3e	---	3.0	---	70	---	3.9	---	70	---	---	---	1600	---	35	---
718E---------- Naytahwaush	6e	---	---	---	30	---	1.3	---	---	---	---	---	---	---	15	---
733---------- Berner	6w	---	---	---	15	---	---	---	---	---	---	---	---	---	10	---
735B---------- Halverson	3s	---	3.5	---	70	---	4.0	---	85	---	---	---	1500	---	35	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
735C---------- Halverson	4e	---	3.0	---	60	---	3.5	---	75	---	---	---	1400	---	25	---
737---------- Mahkonce	2s	---	4.5	---	75	---	5.8	---	85	---	---	---	1800	---	45	---
746---------- Haslie	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
749---------- Colvin	3w	---	3.8	---	60	---	4.1	---	65	---	---	---	1600	---	35	---
765---------- Smiley	2w	---	4.0	---	80	---	5.2	---	85	---	---	---	2000	---	50	---
767---------- Auganaush	2w	---	4.5	---	70	---	5.8	---	60	---	---	---	1500	---	35	---
791---------- Winterfield	4w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
827B----------			4.5	---	80	---	5.8	---	75	---	---	---	---	---	45	---
Heimdal---------	2e	---														
Esmond----------	3e	---														
827C2----------			2.8	---	60	---	3.6	---	60	---	---	---	1600	---	32	---
Heimdal---------	3e	---														
Esmond----------	4e	---														
908----------			4.6	---	85	---	5.9	---	85	---	17.0	---	2000	---	50	---
Bearden---------	2s	---														
Fargo----------	2w	---														
935---------- Hegne-Fargo	2w	---	3.5	---	75	---	---	---	70	---	16.0	---	1900	---	40	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
967B----------			4.6	---	70	---	6.0	---	75	---	---	---	1800	---	---	---
Waukon----------	2e	---														
Langhei---------	3e	---														
967C2----------			2.5	---	55	---	3.2	---	65	---	---	---	1200	---	---	---
Waukon----------	3e	---														
Langhei---------	4e	---														
979D2----------			1.8	---	40	---	---	---	45	---	---	---	800	---	---	---
Langhei---------	6e	---														
Waukon----------	4e	---														
1006----------			2.5	---	---	---	3.5	---	---	---	---	---	---	---	---	---
Fluvaquents-----	6w	---														
Haploborolls----	6e	---														
1030:																
Pits, gravel.																
Udipsamments----	8s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1113----------	8w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Haslie, Seelyeville, and Cathro																
1117----------	2w	---	3.5	---	75	---	4.6	---	85	---	15.0	---	1800	---	45	---
Hedman																
1119----------	2w	---	4.0	---	85	---	5.2	---	90	---	17.0	---	2000	---	45	---
Nielsville																
1121----------	3w	---	---	---	40	---	---	---	45	---	---	---	1100	---	30	---
Hedman																
1122----------	2w	---	3.5	---	80	---	4.6	---	85	---	17.0	---	1900	---	40	---
Nielsville-Perella																

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
1142---------- Hedman----------	2w	---	4.0	---	75	---	5.2	---	75	---	---	---	1900	---	40	---
Fram----------	2e	---														
1144---------- Strathcona------	3w	---	---	---	40	---	---	---	50	---	---	---	1000	---	25	---
Kratka----------	4w	---														
1152B---------- Sugarbush	3s	---	2.8	---	40	---	3.6	---	45	---	9.0	---	1000	---	25	---
1152C---------- Sugarbush	4e	---	1.8	---	30	---	2.3	---	35	---	---	---	850	---	20	---
1152E---------- Sugarbush	6e	---	1.0	---	15	---	1.2	---	---	---	---	---	---	---	15	---
1233D---------- Esmond----------	6e	---	2.2	---	30	---	2.8	---	30	---	---	---	600	---	20	---
Heimdal---------	4e	---														
1264---------- Ulen	3s	---	4.0	---	65	---	5.2	---	70	---	16.0	---	1300	---	40	---
1278---------- Rosewood-Venlo	3w	---	---	---	45	---	---	---	---	---	---	---	1400	---	35	---
1279---------- Vallers---------	2w	---	3.7	---	65	---	---	---	75	---	20.0	---	1950	---	40	---
Hamerly---------	2s	---														
1280---------- Gunclub	2s	---	5.0	---	95	---	6.5	---	90	---	20.0	---	2000	---	50	---
1283---------- Reis-Clearwater	2w	---	3.6	---	80	---	4.8	---	75	---	16.0	---	1800	---	50	---
1297---------- Augsburg	2w	---	4.0	---	70	---	5.2	---	75	---	18.0	---	1800	---	45	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
1299---------- Borup	2w	---	4.0	---	85	---	5.2	---	80	---	17.0	---	1900	---	45	---
1304A---------- Glyndon	2s	---	5.0	---	100	---	6.5	---	90	---	20.0	---	2300	---	55	---
1304B---------- Glyndon	2e	---	4.5	---	90	---	5.8	---	85	---	18.0	---	2000	---	50	---
1315A---------- Wheatville	2s	---	4.6	---	95	---	6.0	---	70	---	18.0	---	2000	---	55	---
1323B---------- LaDelle	1	---	4.0	---	70	---	5.0	---	65	---	17.0	---	1800	---	40	---
1325---------- Bowstring-Fluvaquents	6w	---	2.2	---	15	---	2.8	---	---	---	---	---	---	---	---	---
1356. Water, miscellaneous																
1422---------- Northwood	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1866---------- Colvin-Perella	2w	---	3.5	---	80	---	---	---	80	---	17.0	---	1800	---	45	---
1871---------- Fargo	3w	---	---	---	25	---	---	---	30	---	13.0	---	1200	---	20	---
1874---------- Radium	4s	---	3.2	---	45	---	4.2	---	45	---	---	---	1400	---	25	---
1878---------- Hamre	6w	---	---	---	15	---	4.2	---	---	---	---	---	---	---	10	---
1879---------- Seelyeville	6w	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1882---------- Rosewood, Strathcona, and Berner	6w	---	---	---	10	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability		Alfalfa hay		Barley		Bromegrass-alfalfa		Corn		Sugar beets		Sunflowers		Spring wheat	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Tons	Tons	Bu	Bu	AUM*	AUM*	Bu	Bu	Tons	Tons	Cwt	Cwt	Bu	Bu
1916---------- Lindaas	2w	---	---	---	80	---	---	---	---	---	16.0	---	---	---	40	---
1963---------- Bearden---------	2s	---	4.2	---	100	---	---	---	90	---	19.5	---	2200	---	55	---
Colvin----------	2w	---														
1964---------- Colvin-Fargo	2w	---	3.8	---	85	---	4.9	---	85	---	18.0	---	2000	---	45	---

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

Prime Farmland

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name.)

Map symbol	Soil name
20B	Chapett fine sandy loam, 2 to 6 percent slopes
38B	Waukon loam, 2 to 6 percent slopes
47	Colvin silty clay loam (where drained)
57A	Fargo silty clay, 0 to 1 percent slopes (where drained)
59	Grimstad fine sandy loam
67A	Bearden silt loam, 0 to 2 percent slopes
67B	Bearden silt loam, 2 to 6 percent slopes
93A	Bearden silty clay loam, 0 to 2 percent slopes
184A	Hamerly loam, 0 to 3 percent slopes
236	Vallers loam (where drained)
296	Fram loam
422A	Bygland silty clay loam, 0 to 2 percent slopes
422B	Bygland silty clay loam, 2 to 6 percent slopes
439	Strathcona fine sandy loam (where drained)
494B	Darnen loam, 2 to 6 percent slopes
506	Overly silty clay loam
582	Roliss loam (where drained)
641	Clearwater clay (where drained)
642	Clearwater loam (where drained)
643	Huot fine sandy loam
645	Espelie fine sandy loam (where drained)
650	Reiner fine sandy loam
651	Thiefriver fine sandy loam (where drained)
667B	Fairdale silt loam, 1 to 6 percent slopes, occasionally flooded (where protected from flooding)
670	Knute fine sandy loam
671	Onstad loam
681	Brandsvold loam (where drained)
707A	Lizzie silt loam, 1 to 3 percent slopes
713	Linveldt fine sandy loam
718B	Naytahwaush loam, 2 to 8 percent slopes
737	Mahkonce loam
749	Colvin silt loam, occasionally flooded (where drained and protected from flooding)
765	Smiley loam (where drained)
767	Auganaush loam (where drained)
827B	Heimdal-Esmond complex, 2 to 6 percent slopes
908	Bearden-Fargo complex (where drained)
935	Hegne-Fargo complex (where drained)
967B	Waukon-Langhei complex, 2 to 6 percent slopes
1117	Hedman loam (where drained)
1119	Nielsville silty clay loam (where drained)
1122	Nielsville-Perella complex (where drained)
1142	Hedman-Fram complex (where drained)
1279	Vallers-Hamerly complex (where drained)
1280	Gunclub silty clay loam
1283	Reis-Clearwater complex (where drained)
1297	Augsburg very fine sandy loam (where drained)
1299	Borup very fine sandy loam (where drained)
1304A	Glyndon very fine sandy loam, 0 to 2 percent slopes
1304B	Glyndon very fine sandy loam, 2 to 6 percent slopes
1315A	Wheatville very fine sandy loam, 0 to 2 percent slopes
1323B	LaDelle silt loam, 0 to 3 percent slopes, occasionally flooded (where protected from flooding)
1866	Colvin-Perella complex (where drained)
1916	Lindaas silty clay loam (where drained)
1963	Bearden-Colvin complex (where drained)
1964	Colvin-Fargo complex (where drained)

Windbreaks and Environmental Plantings

(Absence of an entry indicates that trees generally do not grow to the given height.)

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
20B:					
Chapett	Nanking cherry	American plum, Siberian peashrub, common lilac, silver buffaloberry	Black Hills spruce, blue spruce, Russian-olive	Common hackberry, green ash	Silver maple, eastern cottonwood
20C2:					
Chapett	Nanking cherry	American plum, Siberian peashrub, common lilac, silver buffaloberry	Black Hills spruce, blue spruce, Russian-olive	Common hackberry, green ash	Silver maple, eastern cottonwood
20D2:					
Chapett	Nanking cherry	American plum, Siberian peashrub, common lilac, silver buffaloberry	Black Hills spruce, blue spruce, Russian-olive	Common hackberry, green ash	Silver maple, eastern cottonwood
20E:					
Chapett	Nanking cherry	American plum, Siberian peashrub, common lilac, silver buffaloberry	Black Hills spruce, blue spruce, Russian-olive	Common hackberry, green ash	Silver maple, eastern cottonwood
38B:					
Waukon	Redosier dogwood	American cranberrybush, Siberian peashrub, hedge cotoneaster, beechleaf frangula, gray dogwood, late lilac, southern arrowwood	Manchurian crabapple, nannyberry	Jack pine	Siouxland cottonwood
38C2:					
Waukon	Redosier dogwood	American cranberrybush, Siberian peashrub, hedge cotoneaster, beechleaf frangula, gray dogwood, late lilac, southern arrowwood	Manchurian crabapple, nannyberry	Jack pine	Siouxland cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
38D2:					
Waukon	Redosier dogwood	American cranberrybush, Siberian peashrub, hedge cotoneaster, beechleaf frangula, gray dogwood, late lilac, southern arrowwood	Manchurian crabapple, nannyberry	Jack pine	Siouxland cottonwood
45B:					
Maddock	Siberian peashrub, common lilac, silver buffaloberry	American plum, Siberian crabapple, common chokecherry, eastern redcedar	Bur oak, Russian-olive, green ash, ponderosa pine	---	---
45C, 45E:					
Maddock.					
47:					
Colvin	Redosier dogwood	Siberian peashrub, common lilac, American plum, common chokecherry	Manchurian crabapple, blue spruce	White spruce, golden willow	Carolina poplar, eastern cottonwood
57A:					
Fargo	Redosier dogwood	Siberian peashrub, common lilac, eastern redcedar, American plum, common chokecherry	Black Hills spruce, Siberian crabapple	Green ash, golden willow	Eastern cottonwood
59:					
Grimstad	Common lilac	Siberian peashrub, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
65:					
Foxhome	Siberian peashrub, Tatarian honeysuckle, common chokecherry, common lilac, eastern redcedar, silver buffaloberry	Siberian crabapple, Manchurian crabapple, Russian-olive, green ash	Ponderosa pine, Siberian elm	---	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
66:					
Flaming	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, Tatarian honeysuckle, common chokecherry, eastern redcedar	Manchurian crabapple, blue spruce, white spruce	Golden willow	Eastern cottonwood
67A:					
Bearden	---	American plum, Siberian peashrub, common lilac	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
67B:					
Bearden	---	American plum, Siberian peashrub, common lilac	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
93A:					
Bearden	---	American plum, Siberian peashrub, common lilac	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
111:					
Hangaard	Siberian peashrub, common lilac	Tatarian honeysuckle, common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
184A:					
Hamerly	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, common chokecherry, eastern redcedar, ponderosa pine	Black Hills spruce, green ash	Golden willow	Eastern cottonwood
185D2:					
Hattie	American plum, common chokecherry, common lilac, honeysuckle	Persian lilac, Siberian peashrub, Manchurian crabapple, eastern redcedar	Austrian pine, Russian-olive	Green ash, Siberian elm	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
236:					
Vallers	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
242B:					
Marquette	Siberian peashrub, common lilac, sargent crabapple, silver buffaloberry	Common chokecherry, Russian-olive, blue spruce, eastern redcedar	Green ash, red pine	Siberian elm, eastern cottonwood	---
242D:					
Marquette	Siberian peashrub, common lilac, sargent crabapple, silver buffaloberry	Common chokecherry, Russian-olive, blue spruce, eastern redcedar	Green ash, red pine	Siberian elm, eastern cottonwood	---
258B, 258C, 258E:					
Sandberg.					
296:					
Fram	---	American plum, Siberian peashrub, common lilac, blue spruce, eastern redcedar	Siberian crabapple, common hackberry, ponderosa pine	Golden willow, green ash	Eastern cottonwood
341B:					
Arvilla	Siberian peashrub, common chokecherry, common lilac	Rocky Mountain juniper, Russian-olive, Siberian crabapple, eastern redcedar	Ponderosa pine, green ash	Siberian elm, honeylocust	---
348:					
Borup	Redosier dogwood	---	---	Golden willow, white willow	---
372:					
Hamar	Siberian peashrub, common lilac, silver buffaloberry	---	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine, common hackberry	Green ash, golden willow	Eastern cottonwood
387:					
Roliss	Redosier dogwood	---	---	Golden willow, white willow	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
412:					
Mavie	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
422A:					
Bygland	Peking cotoneaster, redosier dogwood	Siberian peashrub, eastern redcedar, American plum	Black Hills spruce, common chokecherry, ponderosa pine	Golden willow, green ash	Eastern cottonwood
422B:					
Bygland	Peking cotoneaster, redosier dogwood	Siberian peashrub, eastern redcedar, American plum	Black Hills spruce, common chokecherry, ponderosa pine	Golden willow, green ash	Eastern cottonwood
422C2:					
Bygland	Peking cotoneaster, redosier dogwood	Siberian peashrub, eastern redcedar, American plum	Black Hills spruce, common chokecherry, ponderosa pine	Golden willow, green ash	Eastern cottonwood
426:					
Foldahl	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, Tatarian honeysuckle, common chokecherry, eastern redcedar	Manchurian crabapple, blue spruce, white spruce	Golden willow	Eastern cottonwood
435:					
Syrene	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
439:					
Strathcona	Common lilac, redosier dogwood	Siberian peashrub, common chokecherry, eastern arborvitae, eastern redcedar	White spruce, blue spruce, green ash	---	Golden willow, Siberian elm, eastern cottonwood
450:					
Rauville.					
481:					
Kratka	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
494B:					
Darnen	Redosier dogwood	American plum, Siberian peashrub, common lilac, eastern redcedar	Manchurian crabapple, blue spruce, bur oak, Russian-olive	Green ash, ponderosa pine	---
506:					
Overly	---	American plum, Siberian peashrub, common lilac	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
540:					
Seelyeville	---	---	---	Golden willow, white willow	Imperial Carolina poplar
543:					
Markey.					
544:					
Cathro.					
547:					
Deerwood	---	---	---	Golden willow, white willow	Imperial Carolina poplar
563:					
Northwood.					
565:					
Eckvoll	---	American cranberrybush, Siberian peashrub, common lilac, redosier dogwood	Eastern redcedar, eastern arborvitae, blue spruce, white spruce	Eastern white pine, jack pine, red pine, green ash	---
573D:					
Serden.					
582:					
Roliss	Siberian peashrub, common lilac	Common chokecherry, cotoneaster, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
641:					
Clearwater	Siberian peashrub, common lilac	Common chokecherry, cotoneaster, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
642:					
Clearwater	Siberian peashrub, common lilac	Common chokecherry, cotoneaster, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
643:					
Huot	Sargent crabapple	Siberian peashrub, common chokecherry, common lilac, eastern redcedar	Russian-olive, white spruce, bur oak	Common hackberry	Black Hills spruce, Siberian elm, eastern cottonwood
645:					
Espelie	Redosier dogwood	Siberian peashrub, common lilac, American plum, Tatarian honeysuckle, common chokecherry	Manchurian crabapple, blue spruce, white spruce	Golden willow	Carolina poplar, eastern cottonwood
647:					
Hilaire	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, Tatarian honeysuckle, common chokecherry, eastern redcedar	Manchurian crabapple, blue spruce, white spruce	Golden willow	Eastern cottonwood
650:					
Reiner	Common lilac	Siberian peashrub, Tatarian honeysuckle, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
651:					
Thiefriver	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
667B:					
Fairdale	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, common chokecherry, eastern redcedar, ponderosa pine	Black Hills spruce	Green ash, golden willow	Eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
667C2:					
Fairdale	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, common chokecherry, eastern redcedar, ponderosa pine	Black Hills spruce	Green ash, golden willow	Eastern cottonwood
670:					
Knute	---	American plum, Siberian peashrub, blue spruce, common lilac	Black Hills spruce, eastern redcedar, Russian-olive, eastern arborvitae, white spruce	Green ash	Eastern cottonwood, Siouxland cottonwood
671:					
Onstad	---	Gray dogwood, Siberian peashrub, blue spruce, common lilac, silver buffaloberry	Black Hills spruce, eastern redcedar, bur oak, eastern arborvitae, white spruce	Green ash	Eastern cottonwood
681:					
Brandsvold	---	American plum, Siberian peashrub, common lilac, redosier dogwood	Amur maple, white spruce, Black Hills spruce, blue spruce, common hackberry	Siberian elm	Silver maple, Carolina poplar
694D2:					
Zell	American plum, Siberian peashrub, common lilac, silver buffaloberry	Rocky Mountain juniper, eastern redcedar, Russian-olive, common hackberry	Green ash, ponderosa pine, Siberian elm	---	---
704:					
Wyrene	American plum, Peking cotoneaster, redosier dogwood	Siberian peashrub, common chokecherry, eastern redcedar, ponderosa pine	Black Hills spruce, green ash	Golden willow	Eastern cottonwood
707A:					
Lizzie	Nanking cherry	American plum, Siberian peashrub, silver buffaloberry, common chokecherry, common lilac	Black Hills spruce, blue spruce	Common hackberry, red pine	Silver maple, eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
712:					
Rosewood	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
713:					
Linveldt	Common lilac	Siberian peashrub, Tatarian honeysuckle, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
718B:					
Naytahwaush	---	American plum, Siberian peashrub, common lilac, Amur maple	Black Hills spruce, white spruce, Russian-olive, common hackberry	Eastern white pine, green ash	Silver maple
718C:					
Naytahwaush	---	American plum, Siberian peashrub, common lilac, Amur maple	Black Hills spruce, white spruce, Russian-olive, common hackberry	Eastern white pine, green ash	Silver maple
718E:					
Naytahwaush	---	American plum, Siberian peashrub, common lilac, Amur maple	Black Hills spruce, white spruce, Russian-olive, common hackberry	Eastern white pine, green ash	Silver maple
733:					
Berner.					
735B:					
Halverson	Peking cotoneaster	American plum, common lilac, Amur maple, Siberian crabapple	Black Hills spruce, blue spruce, white spruce	Green ash, Siberian elm	Silver maple, eastern cottonwood
735C:					
Halverson	Peking cotoneaster	American plum, common lilac, Amur maple, Siberian crabapple	Black Hills spruce, blue spruce, white spruce	Green ash, Siberian elm	Silver maple, eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
737:					
Mahkonce	---	Siberian peashrub, common lilac, Amur maple, common chokecherry	White spruce, Russian-olive	Eastern white pine, green ash, red pine	Eastern cottonwood
746:					
Haslie.					
749:					
Colvin	Redosier dogwood	Siberian peashrub, common lilac, American plum, common chokecherry	Manchurian crabapple, blue spruce	White spruce, golden willow	Eastern cottonwood
765:					
Smiley	Common lilac, honeysuckle, redosier dogwood, sargent crabapple	Siberian peashrub, late lilac, American plum, common chokecherry, eastern redcedar, gray dogwood, nannyberry, silver buffaloberry	---	---	---
767:					
Auganaush	---	Siberian peashrub, common chokecherry	Amur maple, Black Hills spruce, Russian-olive, eastern arborvitae, white spruce	Norway spruce, northern red oak, green ash	Silver maple, Carolina poplar
791:					
Winterfield	Common ninebark, silky dogwood	American cranberrybush, common lilac, Amur maple, nannyberry	Eastern arborvitae, white spruce	Norway spruce, Siberian crabapple, eastern white pine, green ash	---
827B:					
Heimdal	Nanking cherry	American plum, Siberian peashrub, common lilac, silver buffaloberry	Black Hills spruce, blue spruce, Russian-olive	Common hackberry, green ash	Silver maple, eastern cottonwood
Esmond.					

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
827C2:					
Heimdal	Nanking cherry	American plum, Siberian peashrub, common lilac, silver buffaloberry	Black Hills spruce, blue spruce, Russian-olive	Common hackberry, green ash	Silver maple, eastern cottonwood
Esmond.					
908:					
Bearden	---	American plum, Siberian peashrub, common lilac	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
Fargo	Redosier dogwood	Siberian peashrub, common lilac, eastern redcedar, American plum, common chokecherry	Black Hills spruce, Siberian crabapple	Green ash, golden willow	Eastern cottonwood
935:					
Hegne	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
Fargo	Redosier dogwood	Siberian peashrub, common lilac, eastern redcedar, American plum, common chokecherry	Black Hills spruce, Siberian crabapple	Green ash, golden willow	Eastern cottonwood
967B:					
Waukon	Redosier dogwood	American cranberrybush, Siberian peashrub, hedge cotoneaster, beechleaf frangula, gray dogwood, late lilac, southern arrowwood	Manchurian crabapple, nannyberry	Jack pine	Siouxland cottonwood
Langhei	Rocky Mountain juniper, Siberian peashrub, common lilac, eastern redcedar	Russian-olive, ponderosa pine	Green ash, Siberian elm	---	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
967C2:					
Waukon	Redosier dogwood	American cranberrybush, Siberian peashrub, hedge cotoneaster, beechleaf frangula, gray dogwood, late lilac, southern arrowwood	Manchurian crabapple, nannyberry	Jack pine	Siouxland cottonwood
Langhei	Rocky Mountain juniper, Siberian peashrub, common lilac, eastern redcedar	Russian-olive, ponderosa pine	Green ash, Siberian elm	---	---
979D2:					
Langhei	Rocky Mountain juniper, Siberian peashrub, common lilac, eastern redcedar	Russian-olive, ponderosa pine	Green ash, Siberian elm	---	---
Waukon	Redosier dogwood	American cranberrybush, Siberian peashrub, hedge cotoneaster, beechleaf frangula, gray dogwood, late lilac, southern arrowwood	Manchurian crabapple, nannyberry	Jack pine	Siouxland cottonwood
1006:					
Fluvaquents.					
Haploborolls	---	American plum, Siberian peashrub, common lilac, eastern redcedar	Siberian crabapple, Russian-olive, bur oak, ponderosa pine, blue spruce	Green ash, honeylocust	Siberian elm
1030:					
Pits, gravel.					
Udipsamments.					

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1113:					
Haslie.					
Seelyeville.					
Cathro.					
1117:					
Hedman	Siberian peashrub, common lilac, redosier dogwood	Common chokecherry	Eastern redcedar, Russian-olive, blue spruce, white spruce	Golden willow, green ash, Siberian elm	Eastern cottonwood
1119:					
Nielsville	Siberian crabapple, common lilac	Siberian peashrub, American plum, eastern redcedar	Blue spruce, ponderosa pine, common hackberry, green ash	---	Golden willow, Siberian elm, Siouxland cottonwood
1121:					
Hedman	Redosier dogwood	Black spruce	Tamarack, black ash	Golden willow, white willow	---
1122:					
Nielsville	Siberian crabapple, common lilac	Siberian peashrub, American plum, eastern redcedar	Blue spruce, ponderosa pine, common hackberry, green ash	---	Golden willow, Siberian elm, Siouxland cottonwood
Perella	Siberian peashrub, common lilac, silver buffaloberry	---	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine, common hackberry	Green ash, golden willow	Eastern cottonwood
1142:					
Hedman	Siberian peashrub, common lilac, redosier dogwood	Common chokecherry	Eastern redcedar, Russian-olive, blue spruce, white spruce	Golden willow, green ash, Siberian elm	Eastern cottonwood
Fram	---	American plum, Siberian peashrub, common lilac, blue spruce, eastern redcedar	Siberian crabapple, common hackberry, ponderosa pine	Golden willow, green ash	Eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1144:					
Strathcona	Redosier dogwood	Siberian peashrub, gray dogwood	Eastern arborvitae, white spruce, Russian-olive, green ash	Golden willow	Siberian elm, eastern cottonwood
Kratka	Redosier dogwood, silver buffaloberry	Siberian peashrub, gray dogwood	White spruce, Russian-olive, green ash	White willow, golden willow	Siberian elm, eastern cottonwood, robusta cottonwood
1152B:					
Sugarbush	Late lilac, sargent crabapple	American plum, eastern arborvitae, Amur maple, Manchurian crabapple, Siberian peashrub, bur oak, common chokecherry, common hackberry, eastern redcedar	---	---	Eastern cottonwood
1152C:					
Sugarbush	Late lilac, sargent crabapple	American plum, eastern arborvitae, Amur maple, Manchurian crabapple, Siberian peashrub, bur oak, common chokecherry, common hackberry, eastern redcedar	---	---	Eastern cottonwood
1152E:					
Sugarbush	Late lilac, sargent crabapple	American plum, eastern arborvitae, Amur maple, Manchurian crabapple, Siberian peashrub, bur oak, common chokecherry, common hackberry, eastern redcedar	---	---	Eastern cottonwood
1233D:					
Esmond.					
Heimdal.					

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1264:					
Ulen	Common lilac	Siberian peashrub, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
1278:					
Rosewood	Sandbar willow, Siberian peashrub, redosier dogwood	Common chokecherry, common lilac, eastern arborvitae	Black Hills spruce, black ash	Laurel willow, silver maple	Siberian elm, eastern cottonwood
Venlo.					
1279:					
Vallers	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
Hamerly	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, common chokecherry, eastern redcedar, ponderosa pine	Black Hills spruce, green ash	Golden willow	Eastern cottonwood
1280:					
Gunclub	Siberian crabapple	American plum, Siberian peashrub, blue spruce, common lilac, eastern redcedar	Ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, Siouxland cottonwood
1283:					
Reis	Common lilac	Siberian peashrub, cotoneaster, common chokecherry, eastern redcedar	White spruce, Russian-olive, blue spruce, green ash	Siberian elm	Golden willow, eastern cottonwood
Clearwater	Siberian peashrub, common lilac	Common chokecherry, cotoneaster, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
1297:					
Augsburg	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood
1299:					
Borup	Siberian peashrub, common lilac	Common chokecherry, eastern redcedar	Russian-olive, blue spruce, bur oak, white spruce	Golden willow, Siberian elm	Eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1304A:					
Glyndon	Common lilac	Siberian peashrub, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
1304B:					
Glyndon	Common lilac	Siberian peashrub, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
1315A:					
Wheatville	Common lilac	Siberian peashrub, common chokecherry, eastern redcedar	Russian-olive, blue spruce, white spruce, bur oak	Golden willow	Siberian elm, eastern cottonwood
1323B:					
LaDelle	---	American plum, Siberian peashrub, common lilac	Manchurian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
1325:					
Bowstring.					
Fluvaquents.					
1356:					
Water, miscellaneous.					
1422:					
Northwood.					
1866:					
Colvin	Redosier dogwood	Siberian peashrub, common lilac, American plum, common chokecherry	Manchurian crabapple, blue spruce	White spruce, golden willow	Carolina poplar, eastern cottonwood
Perella	Peking cotoneaster, redosier dogwood	American plum, Siberian peashrub, common chokecherry, eastern redcedar, ponderosa pine	Black Hills spruce	Green ash, golden willow	Eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1871:					
Fargo	Redosier dogwood	Siberian peashrub, common lilac, American plum, common chokecherry	Manchurian crabapple, blue spruce, white spruce	Golden willow	Carolina poplar, eastern cottonwood
1874:					
Radium	Siberian peashrub, common lilac, cotoneaster	Common chokecherry	Black Hills spruce, Russian-olive, white spruce, red pine, common hackberry	Siberian elm, eastern cottonwood, green ash	---
1878:					
Hamre	---	---	---	Golden willow, white willow	Imperial Carolina poplar
1879:					
Seelyeville.					
1882:					
Rosewood.					
Strathcona.					
Berner.					
1916:					
Lindaas	Redosier dogwood	Siberian peashrub, common lilac, eastern redcedar, American plum, common chokecherry	Black Hills spruce, Siberian crabapple	Green ash, golden willow	Eastern cottonwood
1963:					
Bearden	---	American plum, Siberian peashrub, common lilac	Siberian crabapple, eastern redcedar, blue spruce, ponderosa pine	Common hackberry, golden willow, green ash	Siberian elm, eastern cottonwood
Colvin	Redosier dogwood	Siberian peashrub, common lilac, American plum, common chokecherry	Manchurian crabapple, blue spruce	White spruce, golden willow	Carolina poplar, eastern cottonwood

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1964:					
Colvin	Redosier dogwood	Siberian peashrub, common lilac, American plum, common chokecherry	Manchurian crabapple, blue spruce	White spruce, golden willow	Carolina poplar, eastern cottonwood
Fargo	Redosier dogwood	Siberian peashrub, common lilac, eastern redcedar, American plum, common chokecherry	Black Hills spruce, Siberian crabapple	Green ash, golden willow	Eastern cottonwood

Windbreak Suitability Groups

(Suitable shrubs and trees with their mature heights are listed in the "Windbreaks and Environmental Plantings" table. Absence of an entry indicates that a windbreak suitability group is not assigned.)

Map symbol and component name	Windbreak suitability group
20B, 20C2, 20D2, 20E:	
Chapett	3
38B, 38C2, 38D2:	
Waukon	3
45B, 45C:	
Maddock	5
45E:	
Maddock	10
47:	
Colvin	2K drained, 10 undrained
57A:	
Fargo	2
59:	
Grimstad	1K
65:	
Foxhome	6G
66:	
Flaming	1
67A, 67B, 93A:	
Bearden	1
111:	
Hangaard	2
184A:	
Hamerly	1
185D2:	
Hattie	4C
236:	
Vallers	2K
242B, 242D:	
Marquette	7
258B, 258C, 258E:	
Sandberg	7
296:	
Fram	1K
341B:	
Arvilla	6G
348:	
Borup	2K drained, 10 undrained

Windbreak Suitability Groups--Continued

Map symbol and component name	Windbreak suitability group
372:	
Hamar	2
387:	
Roliss	2K drained, 10 undrained
412:	
Mavie	2K
422A, 422B, 422C2:	
Bygland	4
426:	
Foldahl	1
435:	
Syrene	2K
439:	
Strathcona	2K
450:	
Rauville	10
481:	
Kratka	2
494B:	
Darnen	3
506:	
Overly	1
540:	
Seelyeville	10
543:	
Markey	2 drained, 10 undrained
544:	
Cathro	2 drained, 10 undrained
547:	
Deerwood	2 drained, 10 undrained
563:	
Northwood	2 drained, 10 undrained
565:	
Eckvoll	1
573D:	
Serden	10
582:	
Roliss	2K
641, 642:	
Clearwater	2K
643:	
Huot	1K

Windbreak Suitability Groups--Continued

Map symbol and component name	Windbreak suitability group
645:	
Espelie	2
647:	
Hilaire	1
650:	
Reiner	1
651:	
Thiefriver	2K
667B, 667C2:	
Fairdale	1
670:	
Knute	1
671:	
Onstad	1
681:	
Brandsvold	2
694D2:	
Zell	8
704:	
Wyrene	1
707A:	
Lizzie	3
712:	
Rosewood	2K
713:	
Linveldt	1
718B, 718C, 718E:	
Naytahwaush	4
733:	
Berner	10
735B, 735C:	
Halverson	5
737:	
Mahkonce	4
746:	
Haslie	10
749:	
Colvin	2K
765:	
Smiley	2
767:	
Auganaush	2

Windbreak Suitability Groups--Continued

Map symbol and component name	Windbreak suitability group
791:	
Winterfield	1
827B, 827C2:	
Heimdal	3
Esmond	8
908:	
Bearden	1
Fargo	2
935:	
Hegne	2K
Fargo	2
967B, 967C2:	
Waukon	3
Langhei	8
979D2:	
Langhei	8
Waukon	3
1006:	
Fluvaquents	10
Haploborolls	3
1030:	
Pits, gravel	10
Udipsamments	10
1113:	
Haslie	10
Seelyeville	10
Cathro	10
1117:	
Hedman	2K
1119:	
Nielsville	2K
1121:	
Hedman	2K drained, 10 undrained
1122:	
Nielsville	2K
Perella	2
1142:	
Hedman	2K
Fram	1K

Windbreak Suitability Groups--Continued

Map symbol and component name	Windbreak suitability group
1144:	
Strathcona	10
Kratka	10
1152B, 1152C, 1152E:	
Sugarbush	6G
1233D:	
Esmond	8
Heimdal	3
1264:	
Ulen	1K
1278:	
Rosewood	2K
Venlo	2
1279:	
Vallers	2K
Hamerly	1
1280:	
Gunclub	1K
1283:	
Reis	2K
Clearwater	2K
1297:	
Augsburg	2K
1299:	
Borup	2K
1304A, 1304B:	
Glyndon	1K
1315A:	
Wheatville	1K
1323B:	
LaDelle	1
1325:	
Bowstring	10
Fluvaquents	10
1356:	
Water, miscellaneous.	
1422:	
Northwood	2 drained, 10 undrained

Windbreak Suitability Groups--Continued

Map symbol and component name	Windbreak suitability group
1866:	
Colvin	2
Perella	2
1871:	
Fargo	2
1874:	
Radium	1
1878:	
Hamre	2 drained, 10 undrained
1879:	
Seelyeville	10
1882:	
Rosewood	10
Strathcona	10
Berner	10
1916:	
Lindaas	2
1963:	
Bearden	1
Colvin	2
1964:	
Colvin	2
Fargo	2

Forest Land

The wooded areas in the northeastern, southeastern, and central lakes areas of Polk County support such tree species as aspen, basswood, elm, red maple, oak, and white pine. The beach and interbeach areas, which were once dominated by tall prairie grass species, now support small stands of quaking aspen, poplar, dogwood, and bur oak. In the western half of the county, most of the wooded areas are in narrow bands along major rivers and drainageways. The main tree species are elm, aspen, box elder, green ash, cottonwood, and basswood. Tall prairie grass species once grew in the nonwooded areas.

Red pine and Scotch pine are the main reforestation tree species in the eastern half of the county, and some plantations are used for production of Christmas trees. Hardwoods, such as oaks and maples, are commonly harvested for lumber and fuel wood. Softwoods, such as aspen and conifers, are harvested for pulpwood and chipboard manufacturing.

Forest Land Management Considerations

Information about the hazards and limitations that should be considered in areas used as forest land are given in the tables “Forest Land Harvest Equipment Considerations,” “Forest Haul Road Considerations,” “Forest Log Landing Considerations,” and “Forest Land Site Preparation and Planting Considerations.”

Forest Land Harvest Equipment Considerations

For most soils spring is the most limiting season. Alternate thawing and freezing during snowmelt cause saturation and low strength of the surface soil layers. When thawing is complete, saturation continues for short periods in well drained soils to nearly all year in very poorly drained depressional soils. Degrees of wetness are generally proportionate to water table height and duration. The water table generally is lower in summer during the heavy use of moisture by vegetation and is nearer the surface during periods when absorbed precipitation is greater than the vegetation requires. Harvesting during periods of saturation usually results in severe soil damage, except when the soil is frozen. The preferred season for timber harvest on many soils is winter, when wetness and low soil strength can be overcome by freezing.

Considerations shown in the table are as follows:

Slope.—The upper slope limit is more than 15 percent.

Flooding.—The map unit component is frequently flooded.

Wetness.—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

Depth to hard rock.—The depth to hard bedrock is less than 10 inches.

Rubbly surface.—The word “rubbly” is in the map unit name.

Surface stones.—The words “extremely stony” are in the map unit name.

Surface boulders.—The word “bouldery” is in the map unit name.

Areas of rock outcrop.—The words “Rock outcrop” are in the map unit name.

Susceptible to rutting and wheel slippage (low strength).—The AASHTO classification is A-6, A-7, or A-8 in any layer at a depth of 20 inches or less.

Poor traction (loose sandy material).—The USDA texture includes sands or loamy sands in any layer at a depth of 10 inches or less.

Forest Haul Road Considerations

Haul roads serve as transportation routes from log landings to primary roads. Generally, haul roads are unpaved, but some are graveled.

Considerations shown in the table are as follows:

Slope.—The slope is 8 percent or more.

Flooding.—The map unit component is frequently flooded.

Wetness.—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

Depth to hard rock.—The depth to hard bedrock is less than 20 inches.

Depth to soft rock.—The depth to soft bedrock is less than 20 inches.

Surface boulders.—The word “bouldery” is in the map unit name.

Areas of rock outcrop.—The words “Rock outcrop” are in the map unit name.

Low bearing strength.—The AASHTO classification is A-6, A-7, or A-8 in any layer at a depth of 20 inches or less.

Rubbly surface.—The word “rubbly” is in the map unit name.

Forest Log Landing Considerations

Log landings are areas where logs are assembled for transportation. Areas that require little or no cutting, filling, or surface preparation are desired.

Considerations shown in the table are as follows:

Slope.—The slope is more than 3 percent.

Flooding.—The map unit component is occasionally flooded or frequently flooded.

Wetness.—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

Surface boulders.—The word “bouldery” is in the map unit name.

Areas of rock outcrop.—The words “Rock outcrop” are in the map unit name.

Susceptible to rutting and wheel slippage (low strength).—The AASHTO classification is A-6, A-7, or A-8 in any layer at a depth of 20 inches or less.

Rubbly surface.—The word “rubbly” is in the map unit name.

Forest Land Site Preparation and Planting Considerations

Considerations shown in the table are as follows:

Slope.—The upper slope limit is more than 15 percent.

Flooding.—The map unit component is frequently flooded.

Wetness.—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

Depth to hard rock.—The depth to hard bedrock is less than 20 inches.

Surface stones.—The word “stony” is in the map unit name.

Surface boulders.—The word “bouldery” is in the map unit name.

Areas of rock outcrop.—The words “Rock outcrop” are in the map unit name.

Water erosion.—The slope is 8 percent or more.

Potential poor tilth and compaction.—The AASHTO classification is A-6 or A-7 in the upper 10 inches.

Rubbly surface.—The word “rubbly” is in the map unit name.

Cobbly surface.—The word “cobbly” is in the map unit name.

Forest Productivity

The table “Forest Productivity” at the end of this section can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

Trees to manage are those that are suitable for commercial wood production.

Forest Land Harvest Equipment Considerations

(Only the soils suited to use as forest land are listed. See text for a description of the considerations listed in this table.)

Map symbol and component name	Component percent	Forest land harvest equipment considerations
20B:		
Chapett	90	Susceptible to rutting and wheel slippage
20C2:		
Chapett	90	Susceptible to rutting and wheel slippage
20D2:		
Chapett	90	Slope Susceptible to rutting and wheel slippage
20E:		
Chapett	90	Slope Susceptible to rutting and wheel slippage
38B:		
Waukon	90	Susceptible to rutting and wheel slippage
38C2:		
Waukon	90	Susceptible to rutting and wheel slippage
38D2:		
Waukon	90	Slope Susceptible to rutting and wheel slippage
242B:		
Marquette	90	Poor traction (loose sandy material)
242D:		
Marquette	90	Slope Poor traction (loose sandy material)
422A:		
Bygland	90	Susceptible to rutting and wheel slippage
422B:		
Bygland	90	Susceptible to rutting and wheel slippage
422C2:		
Bygland	90	Susceptible to rutting and wheel slippage
565:		
Eckvoll	90	Poor traction (loose sandy material)
670:		
Knute	90	Susceptible to rutting and wheel slippage
681:		
Brandsvold	90	Wetness Susceptible to rutting and wheel slippage
707A:		
Lizzie	90	Susceptible to rutting and wheel slippage
713:		
Linveldt	90	Susceptible to rutting and wheel slippage
718B:		
Naytahwaush	90	Susceptible to rutting and wheel slippage

Forest Land Harvest Equipment Considerations--Continued

Map symbol and component name	Component percent	Forest land harvest equipment considerations
718C:		
Naytahwaush	90	Susceptible to rutting and wheel slippage
718E:		
Naytahwaush	90	Slope Susceptible to rutting and wheel slippage
735B:		
Halverson	90	No major considerations
735C:		
Halverson	90	No major considerations
737:		
Mahkonce	90	Susceptible to rutting and wheel slippage
746:		
Haslie	90	Wetness Susceptible to rutting and wheel slippage
767:		
Auganaush	90	Wetness Susceptible to rutting and wheel slippage
791:		
Winterfield	90	Wetness Poor traction (loose sandy material)
967B:		
Waukon	65	Susceptible to rutting and wheel slippage
Langhei	25	Susceptible to rutting and wheel slippage
967C2:		
Waukon	60	Susceptible to rutting and wheel slippage
Langhei	30	Susceptible to rutting and wheel slippage
979D2:		
Langhei	55	Slope Susceptible to rutting and wheel slippage
Waukon	35	Slope Susceptible to rutting and wheel slippage
1152B:		
Sugarbush	90	Poor traction (loose sandy material)
1152C:		
Sugarbush	90	Poor traction (loose sandy material)
1152E:		
Sugarbush	90	Slope Poor traction (loose sandy material)
1878:		
Hamre	90	Wetness Susceptible to rutting and wheel slippage
1879:		
Seelyeville	90	Wetness Susceptible to rutting and wheel slippage

Forest Haul Road Considerations

(Only the soils suited to use as forest land are listed. See text for a description of the considerations listed in this table.)

Map symbol and component name	Component percent	Forest haul road considerations
20B:		
Chapett	90	Low bearing strength
20C2:		
Chapett	90	Slope Low bearing strength
20D2:		
Chapett	90	Slope Low bearing strength
20E:		
Chapett	90	Slope Low bearing strength
38B:		
Waukon	90	Low bearing strength
38C2:		
Waukon	90	Slope Low bearing strength
38D2:		
Waukon	90	Slope Low bearing strength
242B:		
Marquette	90	Slope
242D:		
Marquette	90	Slope
422A:		
Bygland	90	Low bearing strength
422B:		
Bygland	90	Low bearing strength
422C2:		
Bygland	90	Slope Low bearing strength
565:		
Eckvoll	90	No major considerations
670:		
Knute	90	Low bearing strength
681:		
Brandsvold	90	Wetness Low bearing strength
707A:		
Lizzie	90	Low bearing strength
713:		
Linveldt	90	Low bearing strength

Forest Haul Road Considerations--Continued

Map symbol and component name	Component percent	Forest haul road considerations
718B:		
Naytahwaush	90	Slope Low bearing strength
718C:		
Naytahwaush	90	Slope Low bearing strength
718E:		
Naytahwaush	90	Slope Low bearing strength
735B:		
Halverson	90	No major considerations
735C:		
Halverson	90	Slope
737:		
Mahkonce	90	Low bearing strength
767:		
Auganaush	90	Wetness Low bearing strength
791:		
Winterfield	90	Wetness
967B:		
Waukon	65	Low bearing strength
Langhei	25	Low bearing strength
967C2:		
Waukon	60	Slope Low bearing strength
Langhei	30	Slope Low bearing strength
979D2:		
Langhei	55	Slope Low bearing strength
Waukon	35	Slope Low bearing strength
1152B:		
Sugarbush	90	Slope
1152C:		
Sugarbush	90	Slope
1152E:		
Sugarbush	90	Slope
1878:		
Hamre	90	Wetness Low bearing strength
1879:		
Seelyeville	90	Wetness Low bearing strength

Forest Log Landing Considerations

(Only the soils suited to use as forest land are listed. See text for a description of the considerations listed in this table.)

Map symbol and component name	Component percent	Forest log landing considerations
20B:		
Chapett	90	Susceptible to rutting and wheel slippage
20C2:		
Chapett	90	Slope Susceptible to rutting and wheel slippage
20D2:		
Chapett	90	Slope Susceptible to rutting and wheel slippage
20E:		
Chapett	90	Slope Susceptible to rutting and wheel slippage
38B:		
Waukon	90	Susceptible to rutting and wheel slippage
38C2:		
Waukon	90	Slope Susceptible to rutting and wheel slippage
38D2:		
Waukon	90	Slope Susceptible to rutting and wheel slippage
242B:		
Marquette	90	No major considerations
242D:		
Marquette	90	Slope
422A:		
Bygland	90	Susceptible to rutting and wheel slippage
422B:		
Bygland	90	Susceptible to rutting and wheel slippage
422C2:		
Bygland	90	Slope Susceptible to rutting and wheel slippage
565:		
Eckvoll	90	No major considerations
670:		
Knute	90	Susceptible to rutting and wheel slippage
681:		
Brandsvold	90	Wetness Susceptible to rutting and wheel slippage
707A:		
Lizzie	90	Susceptible to rutting and wheel slippage
713:		
Linveldt	90	Susceptible to rutting and wheel slippage

Forest Log Landing Considerations--Continued

Map symbol and component name	Component percent	Forest log landing considerations
718B:		
Naytahwaush	90	Susceptible to rutting and wheel slippage
718C:		
Naytahwaush	90	Slope Susceptible to rutting and wheel slippage
718E:		
Naytahwaush	90	Slope Susceptible to rutting and wheel slippage
735B:		
Halverson	90	No major considerations
735C:		
Halverson	90	Slope
737:		
Mahkonce	90	Susceptible to rutting and wheel slippage
767:		
Auganaush	90	Wetness Susceptible to rutting and wheel slippage
791:		
Winterfield	90	Flooding Wetness
967B:		
Waukon	65	Susceptible to rutting and wheel slippage
Langhei	25	Susceptible to rutting and wheel slippage
967C2:		
Waukon	60	Slope Susceptible to rutting and wheel slippage
Langhei	30	Slope Susceptible to rutting and wheel slippage
979D2:		
Langhei	55	Slope Susceptible to rutting and wheel slippage
Waukon	35	Slope Susceptible to rutting and wheel slippage
1152B:		
Sugarbush	90	No major considerations
1152C:		
Sugarbush	90	Slope
1152E:		
Sugarbush	90	Slope
1878:		
Hamre	90	Wetness Susceptible to rutting and wheel slippage
1879:		
Seelyeville	90	Wetness Susceptible to rutting and wheel slippage

Forest Land Site Preparation and Planting Considerations

(Only the soils suited to use as forest land are listed. See text for a description of the considerations listed in this table.)

Map symbol and component name	Component percent	Forest land site preparation and planting considerations
20B:		
Chapett	90	Potential poor tilth and compaction
20C2:		
Chapett	90	Water erosion Potential poor tilth and compaction
20D2:		
Chapett	90	Slope Water erosion
20E:		
Chapett	90	Slope Water erosion Potential poor tilth and compaction
38B:		
Waukon	90	Potential poor tilth and compaction
38C2:		
Waukon	90	Water erosion Potential poor tilth and compaction
38D2:		
Waukon	90	Slope Water erosion Potential poor tilth and compaction
242B:		
Marquette	90	Water erosion
242D:		
Marquette	90	Slope Water erosion
422A:		
Bygland	90	Potential poor tilth and compaction
422B:		
Bygland	90	Potential poor tilth and compaction
422C2:		
Bygland	90	Water erosion Potential poor tilth and compaction
565:		
Eckvoll	90	No major considerations
670:		
Knute	90	Potential poor tilth and compaction
681:		
Brandsvold	90	Wetness Potential poor tilth and compaction
707A:		
Lizzie	90	Potential poor tilth and compaction
713:		
Linveldt	90	Potential poor tilth and compaction

Forest Land Site Preparation and Planting Considerations--Continued

Map symbol and component name	Component percent	Forest land site preparation and planting considerations
718B:		
Naytahwaush	90	Water erosion Potential poor tilth and compaction
718C:		
Naytahwaush	90	Water erosion Potential poor tilth and compaction
718E:		
Naytahwaush	90	Slope Water erosion Potential poor tilth and compaction
735B:		
Halverson	90	No major considerations
735C:		
Halverson	90	Water erosion
737:		
Mahkonce	90	Potential poor tilth and compaction
767:		
Auganaush	90	Wetness Potential poor tilth and compaction
791:		
Winterfield	90	Wetness
967B:		
Waukon	65	Potential poor tilth and compaction
Langhei	25	Potential poor tilth and compaction
967C2:		
Waukon	60	Water erosion Potential poor tilth and compaction
Langhei	30	Water erosion Potential poor tilth and compaction
979D2:		
Langhei	55	Slope Water erosion Potential poor tilth and compaction
Waukon	35	Slope Water erosion Potential poor tilth and compaction
1152B:		
Sugarbush	90	Water erosion
1152C:		
Sugarbush	90	Water erosion
1152E:		
Sugarbush	90	Slope Water erosion
1878:		
Hamre	90	Wetness Potential poor tilth and compaction
1879:		
Seelyeville	90	Wetness

Forest Productivity

(Absence of an entry indicates that the soil was not evaluated or is not suited to use as forest land.)

Map symbol and soil name	Component percent	Potential productivity: Common trees	Site index	Volume of wood fiber	Trees to manage
				Ft^3/acre	
20B:					
Chapett	90	American basswood	65	57	Scotch pine, green ash, northern red oak, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	53	43	
		Green ash	55	43	
		Northern red oak	53	43	
		Paper birch	58	57	
		Quaking aspen	75	86	
		Sugar maple	54	29	
20C2:					
Chapett	90	American basswood	65	57	Scotch pine, green ash, northern red oak, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	53	43	
		Green ash	55	43	
		Northern red oak	53	43	
		Paper birch	58	57	
		Quaking aspen	75	86	
		Sugar maple	54	29	
20D2:					
Chapett	90	American basswood	65	57	Scotch pine, green ash, northern red oak, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	53	43	
		Green ash	55	43	
		Northern red oak	53	43	
		Paper birch	58	57	
		Quaking aspen	75	86	
		Sugar maple	54	29	
20E:					
Chapett	90	American basswood	65	57	Scotch pine, green ash, northern red oak, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	53	43	
		Green ash	55	43	
		Northern red oak	53	43	
		Paper birch	58	57	
		Quaking aspen	75	86	
		Sugar maple	54	29	
38B:					
Waukon	90	American basswood	80	86	Eastern white pine, jack pine, red pine, white spruce
		American elm	70	---	
		Green ash	62	57	
		Northern red oak	60	57	
		Quaking aspen	72	86	
		Sugar maple	58	43	

Forest Productivity--Continued

Map symbol and soil name	Component percent	Potential productivity: Common trees	Site index	Volume of wood fiber	Trees to manage
				Ft^3/acre	
38C2:					
Waukon	90	American basswood	80	86	Eastern white pine, jack pine, red pine, white spruce
		American elm	70	---	
		Green ash	62	57	
		Northern red oak	60	57	
		Quaking aspen	72	86	
		Sugar maple	58	43	
38D2:					
Waukon	90	American basswood	80	86	Eastern white pine, jack pine, red pine, white spruce
		American elm	70	---	
		Green ash	62	57	
		Northern red oak	60	57	
		Quaking aspen	72	86	
		Sugar maple	58	43	
242B:					
Marquette	90	Bur oak	---	---	Jack pine, red pine, white spruce
		Eastern white pine	55	100	
		Jack pine	65	100	
		Paper birch	---	---	
		Quaking aspen	63	72	
		Red pine	55	86	
		White spruce	50	100	
242D:					
Marquette	90	Bur oak	---	---	Jack pine, red pine, white spruce
		Eastern white pine	55	100	
		Jack pine	65	100	
		Paper birch	---	---	
		Quaking aspen	63	72	
		Red pine	55	86	
		White spruce	50	100	
422A:					
Bygland	90	American elm	---	---	Common hackberry, green ash
		Bur oak	58	43	
		Green ash	61	57	
422B:					
Bygland	90	American elm	---	---	Common hackberry, green ash
		Bur oak	58	43	
		Green ash	61	57	
422C2:					
Bygland	90	American elm	---	---	Common hackberry, green ash
		Bur oak	58	43	
		Green ash	61	57	
565:					
Eckvoll	90	American basswood	60	57	Northern red oak, red pine, white spruce
		Bur oak	45	29	
		Eastern white pine	55	100	
		Quaking aspen	70	86	
		Red pine	60	100	
		White spruce	60	114	

Forest Productivity--Continued

Map symbol and soil name	Component percent	Potential productivity: Common trees	Site index	Volume of wood fiber (Ft^3/acre)	Trees to manage
670:					
Knute	90	American basswood	69	57	Scotch pine, common hackberry, green ash, northern red oak, white spruce
		Bigtooth aspen	75	86	
		Bur oak	53	43	
		Green ash	55	43	
		Northern red oak	53	43	
		Paper birch	59	57	
		Quaking aspen	73	86	
		Sugar maple	53	29	
681:					
Brandsvold	90	American basswood	62	57	Black spruce, eastern arborvitae, green ash, white spruce
		American elm	---	---	
		Bigtooth aspen	76	86	
		Black ash	60	43	
		Green ash	57	43	
		Paper birch	60	57	
		Quaking aspen	74	86	
707A:					
Lizzie	90	American basswood	65	57	Scotch pine, green ash, northern red oak, red pine, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	53	43	
		Green ash	55	43	
		Northern red oak	53	43	
		Paper birch	58	57	
		Quaking aspen	75	86	
		Sugar maple	54	29	
713:					
Linveldt	90	Bur oak	60	57	Eastern white pine, red pine, white spruce
		Quaking aspen	74	86	
718B:					
Naytahwaush	90	American basswood	50	29	Balsam fir, eastern white pine, northern red oak, red pine, white spruce
		Northern red oak	60	57	
		Quaking aspen	77	86	
		Sugar maple	51	29	
		White spruce	52	100	
718C:					
Naytahwaush	90	American basswood	50	29	Balsam fir, eastern white pine, northern red oak, red pine, white spruce
		Northern red oak	60	57	
		Quaking aspen	77	86	
		Sugar maple	51	29	
		White spruce	52	100	
718E:					
Naytahwaush	90	American basswood	50	29	Balsam fir, eastern white pine, northern red oak, red pine, white spruce
		Northern red oak	60	57	
		Quaking aspen	77	86	
		Sugar maple	51	29	
		White spruce	52	100	

Forest Productivity--Continued

Map symbol and soil name	Component percent	Potential productivity: Common trees	Site index	Volume of wood fiber	Trees to manage
				Ft^3/acre	
735B:					
Halverson	90	American basswood	63	57	Green ash, northern red oak, red pine, white oak, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	55	43	
		Northern red oak	56	43	
		Quaking aspen	72	86	
735C:					
Halverson	90	American basswood	63	57	Green ash, northern red oak, red pine, white oak, white spruce
		American elm	---	---	
		Bigtooth aspen	70	86	
		Bur oak	55	43	
		Northern red oak	56	43	
		Quaking aspen	72	86	
737:					
Mahkonce	90	American basswood	65	57	Eastern white pine, red pine, white spruce
		Balsam fir	60	114	
		Northern red oak	62	57	
		Quaking aspen	80	100	
		Sugar maple	62	43	
		White spruce	60	114	
767:					
Auganaush	90	American basswood	65	57	Balsam fir, eastern arborvitae, quaking aspen, tamarack, white spruce
		American elm	---	---	
		Balsam fir	60	114	
		Balsam poplar	70	---	
		Black ash	65	43	
		Quaking aspen	75	86	
		White spruce	60	114	
791:					
Winterfield	90	American elm	---	---	Black spruce, eastern arborvitae, eastern white pine, white spruce
		Balsam fir	55	114	
		Black ash	55	29	
		Eastern white pine	---	---	
		Paper birch	55	57	
		Quaking aspen	65	72	
		White spruce	55	100	
967B:					
Waukon	65	American basswood	80	86	Eastern white pine, jack pine, red pine, white spruce
		American elm	70	---	
		Green ash	62	57	
		Northern red oak	60	57	
		Quaking aspen	72	86	
		Sugar maple	58	43	
Langhei	25	---	---	---	---
967C2:					
Waukon	60	American basswood	80	86	Eastern white pine, jack pine, red pine, white spruce
		American elm	70	---	
		Green ash	62	57	
		Northern red oak	60	57	
		Quaking aspen	72	86	
		Sugar maple	58	43	

Forest Productivity--Continued

Map symbol and soil name	Component percent	Potential productivity: Common trees	Site index	Volume of wood fiber (Ft^3/acre)	Trees to manage
967C2:					
Langhei	30	---	---	---	---
979D2:					
Langhei	55	---	---	---	---
Waukon	35	American basswood	80	86	Eastern white pine, jack pine, red pine, white spruce
		American elm	70	---	
		Green ash	62	57	
		Northern red oak	60	57	
		Quaking aspen	72	86	
		Sugar maple	58	43	
1152B:					
Sugarbush	90	Bur oak	45	29	Eastern white pine, jack pine, red pine
		Eastern white pine	50	86	
		Jack pine	55	72	
		Paper birch	55	57	
		Quaking aspen	60	57	
		Red pine	55	86	
		Sugar maple	45	29	
1152C:					
Sugarbush	90	Bur oak	45	29	Eastern white pine, jack pine, red pine
		Eastern white pine	50	86	
		Jack pine	55	72	
		Paper birch	55	57	
		Quaking aspen	60	57	
		Red pine	55	86	
		Sugar maple	45	29	
1152E:					
Sugarbush	90	Bur oak	45	29	Eastern white pine, jack pine, red pine
		Eastern white pine	50	86	
		Jack pine	55	72	
		Paper birch	55	57	
		Quaking aspen	60	57	
		Red pine	55	86	
		Sugar maple	45	29	
1878:					
Hamre	90	Black spruce	25	29	Black spruce
		Quaking aspen	40	29	
		Tamarack	35	29	
1879:					
Seelyeville	90	Balsam fir	45	86	Balsam fir, black spruce, eastern arborvitae, tamarack
		Black ash	56	29	
		Black spruce	35	43	
		Eastern arborvitae	29	43	
		Tamarack	50	43	

Recreation

Polk County offers a variety of recreational opportunities. Boating, camping, cross-country skiing, hunting, fishing, and snowmobiling are among the most common outdoor activities.

Many public access lakes more than 40 acres in size in the eastern half of the county provide excellent fishing and boating. Presently, five lake resorts in Polk County offer boating and fishing opportunities. There is a canoe route on the Red Lake River with established stops as it flows through Polk County.

Polk County has more than 16,050 acres of State-owned Wildlife Production Areas operated by the U.S. Fish and Wildlife Service. These areas are open to public hunting. A private hunting preserve is located southwest of Erskine.

Crookston, East Grand Forks, Erskine, Fosston, Lengby, McIntosh, and Mentor all have community parks and picnic areas, some of which have overnight camping facilities. Public and private campgrounds are also in the Maple Lake, Union Lake, and Sarah Lake areas south of Mentor, at Cross Lake northeast of Fosston, and at Cameron Lake east of Erskine.

There are golf courses in Climax, Crookston, East Grand Forks, Erskine, and Fosston.

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

Camp areas are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The soils are rated on the basis of soil properties that influence the ease of developing camp areas and performance of the areas after development. Also considered are the soil properties that influence trafficability and promote the growth of vegetation after heavy use.

Picnic areas are natural or landscaped tracts of land that are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Playgrounds are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and that can withstand heavy foot traffic and maintain an adequate cover of vegetation. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Paths and trails are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. The soils are rated on the basis of soil properties that influence trafficability and erodibility. Paths and trails should remain firm under foot traffic and not be dusty when dry.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use.

They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

The interpretive ratings in this table help engineers, planners, and others to understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

The degree of soil limitation is expressed as slight, moderate, or severe.

Slight means that soil properties are favorable for the rated use. The limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

Moderate means that soil properties are moderately favorable for the rated use. The limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than that of soils rated *slight*.

Severe means that soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive maintenance. Overcoming the limitations generally is difficult and costly.

The information in the table “Recreational Development” can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in the table “Building Site Development” and interpretations for septic tank absorption fields in the table “Sanitary Facilities.”

Recreational Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
20B:					
Chapett	Slight	Slight	Moderate: slope small stones	Slight	Slight
20C2:					
Chapett	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
20D2:					
Chapett	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
20E:					
Chapett	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
38B:					
Waukon	Slight	Slight	Moderate: slope	Slight	Slight
38C2:					
Waukon	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
38D2:					
Waukon	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
45B:					
Maddock	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
45C:					
Maddock	Moderate: slope too sandy	Moderate: slope too sandy	Severe: slope	Moderate: too sandy	Moderate: slope droughty
45E:					
Maddock	Severe: slope	Severe: slope	Severe: slope	Moderate: slope too sandy	Severe: slope
47:					
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
57A:					
Fargo	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
59:					
Grimstad	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
65:					
Foxhome	Slight	Slight	Slight	Slight	Slight
66:					
Flaming	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: droughty
67A:					
Bearden	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
67B:					
Bearden	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: slope wetness	Moderate: wetness	Moderate: wetness
93A:					
Bearden	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
111:					
Hangaard	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness droughty
184A:					
Hamerly	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
185D2:					
Hattie	Severe: too clayey	Severe: too clayey	Severe: slope too clayey	Severe: too clayey	Severe: too clayey
236:					
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
242B:					
Marquette	Slight	Slight	Moderate: slope small stones	Slight	Severe: droughty
242D:					
Marquette	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope droughty
258B:					
Sandberg	Moderate: too sandy	Moderate: too sandy	Severe: small stones	Slight	Severe: droughty
258C:					
Sandberg	Moderate: slope too sandy	Moderate: slope too sandy	Severe: slope small stones	Slight	Severe: slope droughty
258E:					
Sandberg	Severe: slope too sandy	Severe: slope too sandy	Severe: slope small stones	Moderate: slope	Severe: slope droughty

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
296:					
Fram	Moderate: wetness	Moderate: wetness	Moderate: slope wetness	Moderate: wetness	Moderate: wetness
341B:					
Arvilla	Slight	Slight	Moderate: slope	Slight	Moderate: droughty
348:					
Borup	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
372:					
Hamar	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: wetness droughty
387:					
Roliss	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
412:					
Mavie	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
422A:					
Bygland	Slight	Slight	Slight	Slight	Slight
422B:					
Bygland	Slight	Slight	Moderate: slope	Slight	Slight
422C2:					
Bygland	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
426:					
Foldahl	Slight	Slight	Slight	Slight	Moderate: droughty
435:					
Syrene	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
439:					
Strathcona	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
450:					
Rauville	Severe: flooding wetness	Severe: wetness	Severe: flooding wetness	Severe: wetness	Severe: flooding wetness
481:					
Kratka	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
494B:					
Darnen	Slight	Slight	Moderate: slope	Slight	Slight
506:					
Overly	Slight	Slight	Slight	Slight	Slight

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
540:					
Seelyeville	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
543:					
Markey	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
544:					
Cathro	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
547:					
Deerwood	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
563:					
Northwood	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
565:					
Eckvoll	Moderate: too sandy	Moderate: too sandy	Moderate: small stones	Moderate: too sandy	Slight
573D:					
Serden	Severe: slope too sandy	Severe: slope too sandy	Severe: slope too sandy	Severe: too sandy	Severe: slope
582:					
Roliss	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
641:					
Clearwater	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
642:					
Clearwater	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
643:					
Huot	Slight	Slight	Moderate: small stones	Slight	Moderate: droughty
645:					
Espelie	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
647:					
Hilaire	Slight	Slight	Moderate: small stones	Slight	Moderate: droughty
650:					
Reiner	Slight	Slight	Moderate: small stones	Slight	Slight

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
651:					
Thiefriver	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
667B:					
Fairdale	Severe: flooding	Slight	Moderate: slope	Slight	Moderate: flooding
667C2:					
Fairdale	Severe: flooding	Moderate: slope	Severe: slope	Slight	Moderate: flooding slope
670:					
Knute	Slight	Slight	Moderate: small stones	Slight	Slight
671:					
Onstad	Slight	Slight	Moderate: small stones	Slight	Slight
681:					
Brandsvold	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
694D2:					
Zell	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
704:					
Wyrene	Moderate: wetness	Moderate: wetness	Moderate: small stones wetness	Moderate: wetness	Moderate: wetness droughty
707A:					
Lizzie	Slight	Slight	Moderate: slope	Slight	Slight
712:					
Rosewood	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
713:					
Linveldt	Slight	Slight	Moderate: small stones	Slight	Slight
718B:					
Naytahwaush	Slight	Slight	Moderate: slope	Slight	Slight
718C:					
Naytahwaush	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
718E:					
Naytahwaush	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
733:					
Berner	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
735B:					
Halverson	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
735C:					
Halverson	Moderate: slope too sandy	Moderate: slope too sandy	Severe: slope	Moderate: too sandy	Moderate: slope droughty
737:					
Mahkonce	Slight	Slight	Moderate: slope	Slight	Slight
746:					
Haslie	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
749:					
Colvin	Severe: flooding wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
765:					
Smiley	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
767:					
Auganaush	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
791:					
Winterfield	Severe: flooding wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
827B:					
Heimdal	Slight	Slight	Moderate: slope small stones	Slight	Slight
Esmond	Slight	Slight	Moderate: slope small stones	Slight	Slight
827C2:					
Heimdal	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Esmond	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
908:					
Bearden	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Fargo	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
935:					
Hegne	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
Fargo	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
967B:					
Waukon	Slight	Slight	Moderate: slope	Slight	Slight
Langhei	Slight	Slight	Moderate: slope	Slight	Slight
967C2:					
Waukon	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Langhei	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
979D2:					
Langhei	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Waukon	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
1006:					
Fluvaquents	Severe: flooding ponding	Severe: ponding	Severe: flooding ponding	Severe: ponding	Severe: flooding ponding
Haploborolls	Severe: flooding slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
1030:					
Pits, gravel.					
Udipsamments	Severe: slope too sandy	Severe: slope too sandy	Severe: slope too sandy	Severe: slope too sandy	Severe: slope
1113:					
Haslie	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
Seelyeville	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
Cathro	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
1117:					
Hedman	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1119:					
Nielsville	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
1121:					
Hedman	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1122:					
Nielsville	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Perella	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1142:					
Hedman	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Fram	Moderate: wetness	Moderate: wetness	Moderate: slope wetness	Moderate: wetness	Moderate: wetness
1144:					
Strathcona	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
Kratka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1152B:					
Sugarbush	Slight	Slight	Moderate: slope	Slight	Moderate: large stones droughty
1152C:					
Sugarbush	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: large stones slope droughty
1152E:					
Sugarbush	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
1233D:					
Esmond	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Heimdal	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
1264:					
Ulen	Slight	Slight	Slight	Slight	Moderate: droughty
1278:					
Rosewood	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Venlo	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1279:					
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Hamerly	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
1280:					
Gunclub	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness
1283:					
Reis	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
Clearwater	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
1297:					
Augsburg	Severe: percs slowly wetness	Severe: percs slowly wetness	Severe: percs slowly wetness	Severe: wetness	Severe: wetness
1299:					
Borup	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
1304A:					
Glyndon	Slight	Slight	Slight	Slight	Slight
1304B:					
Glyndon	Slight	Slight	Moderate: slope	Slight	Slight
1315A:					
Wheatville	Moderate: percs slowly	Moderate: percs slowly	Moderate: percs slowly	Slight	Slight
1323B:					
LaDelle	Severe: flooding	Slight	Moderate: flooding	Slight	Moderate: flooding
1325:					
Bowstring	Severe: excess humus flooding ponding	Severe: excess humus ponding	Severe: excess humus flooding ponding	Severe: excess humus ponding	Severe: excess humus flooding ponding
Fluvaquents	Severe: flooding ponding	Severe: ponding	Severe: flooding ponding	Severe: ponding	Severe: flooding ponding
1356:					
Water, miscellaneous.					
1422:					
Northwood	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1866:					
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Perella	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Slight	Slight
1871:					
Fargo	Severe: too clayey ponding	Severe: too clayey ponding	Severe: too clayey ponding	Severe: too clayey ponding	Severe: too clayey ponding
1874:					
Radium	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Severe: droughty
1878:					
Hamre	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
1879:					
Seelyeville	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding	Severe: excess humus ponding
1882:					
Rosewood	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Strathcona	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Berner	Severe: excess humus wetness	Severe: excess humus wetness	Severe: excess humus wetness	Severe: excess humus wetness	Severe: excess humus wetness
1916:					
Lindaas	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1963:					
Bearden	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
1964:					
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Fargo	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness

Wildlife Habitat

Terry Wolfe, area wildlife manager, Minnesota Department of Natural Resources, helped prepare this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing the existing plant cover, and fostering the natural establishment of desirable plants.

The conditions of wildlife habitat are related to soil, topography, climate, and land use. Farming is the major land use in most of Polk County and thus has the greatest effect on wildlife habitat.

In the western one-third of the county, farming is quite intensive. The topography is flat. The timbered areas along the rivers provide habitat for deer and some other forest wildlife. The strings of timber provide travelways for wildlife, including such uncommon animals as timber wolves and some wildcats. The Grand Marais marshes provide wetland habitat and are used by prairie waterfowl, wading birds, shore birds, and furbearers, such as muskrats, beaver, mink, and weasels.

In the central one-third of the county, the beach ridges of glacial Lake Agassiz provide a variety of habitats. Farming has not been so intensive in this part of the survey area. Scattered aspen groves support deer, moose, ruffed grouse, song birds, furbearers, and other forest wildlife. Shallow marshes in low areas between the ridges provide habitat for sandhill cranes, ducks, Canada geese, American bitterns, marbled godwits, and aquatic furbearers. Remaining tracts of prairie grasslands provide habitat for prairie chickens, prairie voles, western fringed prairie orchids, and many other species.

Much of eastern Polk County is dotted with wetlands, potholes, and lakes of varying sizes (fig. 23). Waterfowl, various birds, and furbearers are common. Deer and other forest wildlife inhabit the remaining woodlands. Aspen is the dominant tree species, but bur oak, green ash, black ash, elm, cottonwood, and box elders are common. In the Maple-Union Lake area, sugar maple, basswood, and red oak grow in scattered groves. On the eastern edge of the county, particularly in the southeast corner, various pines and spruce grow.

The table “Wildlife Habitat” at the end of this section provides information on the potential of the soils for various elements and types of wildlife habitat.

Elements of Wildlife Habitat

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are corn, soybeans, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are bromegrass, timothy, orchardgrass, clover, alfalfa, wheatgrass, and birdsfoot trefoil.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds that provide food and cover for wildlife. Examples are bluestems, indiangrass, blueberry, goldenrod, lambsquarters, dandelions, blackberry, ragweed, wheatgrass, and nightshade.

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity, and flooding. The length of the growing season also is important.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, box elder, birch, maple, green ash, willow, and American elm.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that provide habitat or supply food in the form of browse, seed, or fruit-like cones. Examples are pine, spruce, cedar, and tamarack.

Shrubs are bushy woody plants that produce fruit,

Figure 23.—In the eastern part of Polk County, areas of organic soils and the interbeach areas provide important habitat for wildlife.

buds, twigs, bark, and foliage. Examples of fruit-producing shrubs that are suitable for planting on soils that have good potential for these plants are hawthorn, honeysuckle, American plum, redosier dogwood, chokecherry, highbush cranberry, elderberry, gooseberry, serviceberry, silver buffaloberry, and crabapple.

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of the root zone, the amount of water available to plants, and wetness.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweeds, wild millet, rushes, sedges, bulrushes, wild rice, arrowhead, waterplantain, cattail, prairie cordgrass, bluejoint grass, asters, and beggarticks.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

Shallow water areas have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability.

Kinds of Wildlife Habitat

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include Hungarian partridge, ring-necked pheasant, bobwhite quail, sharp-tailed grouse, meadowlark, field sparrow, killdeer, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of hardwoods or conifers or a mixture of these and associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include wild turkey, ruffed grouse, thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, white-tailed deer, black bear, and moose.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas, bogs, or flood plains that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, bitterns, rails, kingfishers, muskrat, otter, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include pronghorn antelope, mule deer, coyote, sharp-tailed grouse, greater prairie chicken, meadowlark, gopher, and lark bunting.

Wildlife Habitat

(See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
20B:												
Chapett	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
20C2:												
Chapett	Fair	Good	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---
20D2:												
Chapett	Poor	Fair	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---
20E:												
Chapett	Poor	Fair	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---
38B:												
Waukon	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
38C2:												
Waukon	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
38D2:												
Waukon	Fair	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
45B:												
Maddock	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor	Fair	Fair	Very poor	Fair
45C:												
Maddock	Poor	Fair	Good	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor	Fair
45E:												
Maddock	Very poor	Very poor	Good	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair
47:												
Colvin	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	Good	Fair
57A:												
Fargo	Good	Good	Fair	---	---	Poor	Poor	Good	Fair	---	Fair	Poor
59:												
Grimstad	Fair	Good	Fair	Fair	Fair	---	Fair	Fair	Fair	Fair	Fair	---
65:												
Foxhome	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	---
66:												
Flaming	Fair	Fair	Good	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair
67A:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
67B:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
93A:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
111:												
Hangaard	Poor	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
184A:												
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair
185D2:												
Hattie	Fair	Good	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor	Fair
236:												
Vallers	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair
242B:												
Marquette	Poor	Poor	Fair	Poor	Poor	---	Very poor	Very poor	Poor	Poor	Very poor	---
242D:												
Marquette	Poor	Poor	Fair	Poor	Poor	---	Very poor	Very poor	Poor	Poor	Very poor	---
258B:												
Sandberg	Poor	Poor	Good	Poor	Poor	---	Very poor	Very poor	Good	Good	Very poor	---
258C:												
Sandberg	Poor	Poor	Good	Poor	Poor	---	Very poor	Very poor	Good	Good	Very poor	---
258E:												
Sandberg	Very poor	Very poor	Good	Poor	Poor	---	Very poor	Very poor	Poor	Poor	Very poor	---
296:												
Fram	Good	Good	Good	---	---	Fair	Fair	Poor	Good	---	Poor	Fair
341B:												
Arvilla	Fair	Good	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Fair	Very poor	Poor
348:												
Borup	Fair	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Fair	Good	Fair
372:												
Hamar	Poor	Good	Fair	Good	Very poor	Fair	Fair	Fair	Fair	Very poor	Fair	Fair
387:												
Roliss	Good	Good	Fair	Fair	Fair	---	Very poor	Poor	Good	Fair	Very poor	---
412:												
Mavie	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair
422A:												
Bygland	Good	Good	Good	Fair	---	Fair	Poor	Poor	Good	Poor	Poor	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
422B:												
Bygland	Good	Good	Good	Fair	---	Fair	Poor	Poor	Good	Poor	Poor	---
422C2:												
Bygland	Good	Good	Good	Fair	---	Fair	Poor	Poor	Good	Poor	Poor	---
426:												
Foldahl	Fair	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor	---
435:												
Syrene	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair
439:												
Strathcona	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair
450:												
Rauville	Very poor	Poor	Fair	Poor	Very poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair
481:												
Kratka	Fair	Good	Good	Fair	Poor	---	Good	Fair	Fair	Fair	Fair	---
494B:												
Darnen	Good	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair
506:												
Overly	Good	Good	Good	Good	Very poor	---	Very poor	Very poor	Good	Very poor	Very poor	Good
540:												
Seelyeville	Very poor	Poor	Good	Poor	Poor	---	Good	Good	Fair	Poor	Good	---
543:												
Markey	Very poor	Very poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
544:												
Cathro	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
547:												
Deerwood	Very poor	Very poor	Poor	Poor	Poor	Poor	Good	Good	Very poor	Poor	Good	Poor
563:												
Northwood	Very poor	Very poor	Poor	Poor	Poor	Poor	Good	Good	Very poor	Poor	Good	---
565:												
Eckvoll	Poor	Fair	Good	Good	Good	---	Poor	Poor	Fair	Good	Poor	---
573D:												
Serden	Very poor	Very poor	Fair	Poor	Poor	Good	Very poor	Very poor	Poor	Poor	Very poor	Fair
582:												
Roliss	Good	Good	Good	Fair	---	---	Good	Fair	Good	Fair	Fair	---
641:												
Clearwater	Good	Good	Fair	Fair	Fair	---	Poor	Good	Good	Fair	Fair	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
642:												
Clearwater	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Fair	---
643:												
Huot	Fair	Good	Fair	Fair	Fair	Fair	Poor	Poor	Good	Fair	Fair	Fair
645:												
Espelie	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair
647:												
Hilaire	Fair	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	---
650:												
Reiner	Good	Good	Good	Good	Good	---	Poor	Poor	Fair	Fair	Poor	Fair
651:												
Thiefriver	Good	Good	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
667B:												
Fairdale	Good	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair
667C2:												
Fairdale	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
670:												
Knute	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
671:												
Onstad	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
681:												
Brandsvold	Fair	Fair	Good	Fair	Fair	---	Good	Good	Fair	Fair	Good	---
694D2:												
Zell	Very poor	Fair	Fair	Poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Fair
704:												
Wyrene	Fair	Good	Good	---	---	Fair	Fair	Very poor	Fair	---	Poor	Fair
707A:												
Lizzie	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
712:												
Rosewood	Fair	Fair	Fair	Fair	Fair	---	Good	Good	Fair	Fair	Good	---
713:												
Linveldt	Good	Good	Good	Good	Fair	---	Poor	Poor	Good	Good	Poor	---
718B:												
Naytahwaush	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
718C:												
Naytahwaush	Fair	Good	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
718E:												
Naytahwaush	Very poor	Poor	Fair	Good	Good	---	Very poor	Very poor	Poor	Good	Very poor	---
733:												
Berner	Very poor	Fair	Fair	Poor	Poor	---	Good	Good	Fair	Poor	Good	Fair
735B:												
Halverson	Fair	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
735C:												
Halverson	Fair	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
737:												
Mahkonce	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
746:												
Haslie	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
749:												
Colvin	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	Good	Fair
765:												
Smiley	Good	Good	Fair	Fair	Fair	Fair	Fair	Good	Fair	---	Good	Fair
767:												
Auganaush	Poor	Fair	Fair	Fair	Fair	---	Good	Fair	Fair	Fair	Fair	---
791:												
Winterfield	Poor	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair	---
827B:												
Heimdal	Good	Good	Good	Good	---	Good	Very poor	Very poor	Good	---	Very poor	---
Esmond	Fair	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair
827C2:												
Heimdal	Fair	Good	Good	Fair	---	Fair	Very poor	Very poor	Good	---	Very poor	---
Esmond	Poor	Fair	Good	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
908:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Fargo	Good	Good	Fair	---	---	Poor	Poor	Good	Fair	---	Fair	Poor
935:												
Hegne	Fair	Fair	Fair	Fair	Poor	Fair	Poor	Good	Fair	Fair	Fair	Fair
Fargo	Good	Good	Fair	---	---	Poor	Poor	Good	Fair	---	Fair	Poor
967B:												
Waukon	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
967B:												
Langhei	Good	Good	Fair	Fair	Fair	Fair	Poor	Very poor	Good	Fair	Very poor	Fair
967C2:												
Waukon	Good	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
Langhei	Fair	Good	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor	Fair
979D2:												
Langhei	Fair	Fair	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor	Fair
Waukon	Fair	Good	Good	Good	Good	---	Very poor	Very poor	Good	Good	Very poor	---
1006:												
Fluvaquents	Very poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Very poor	Poor	Good	Poor
Haploborolls	Poor	Fair	Good	Good	Good	Fair	Very poor	Very poor	Fair	Good	Very poor	Fair
1030:												
Pits, gravel.												
Udipsamments.												
1113:												
Haslie	Very poor	Very poor	Poor	Very poor	Very poor	---	Good	Good	Poor	Very poor	Good	---
Seelyeville	Very poor	Very poor	Very poor	Very poor	Very poor	---	Good	Good	Very poor	Very poor	Good	---
Cathro	Very poor	Very poor	Very poor	Very poor	Very poor	---	Good	Good	Very poor	Very poor	Good	---
1117:												
Hedman	Good	Good	Fair	Fair	Poor	---	Good	Good	Good	Fair	Fair	---
1119:												
Nielsville	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Fair
1121:												
Hedman	Fair	Fair	Fair	Fair	Fair	---	Good	Good	Fair	Fair	Good	---
1122:												
Nielsville	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Fair
Perella	Poor	Fair	Good	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair
1142:												
Hedman	Good	Good	Fair	Fair	Poor	---	Good	Good	Good	Fair	Fair	---
Fram	Good	Good	Good	---	---	Fair	Fair	Poor	Good	---	Poor	Fair

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1144:												
Strathcona	Fair	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	Poor
Kratka	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
1152B:												
Sugarbush	Fair	Fair	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---
1152C:												
Sugarbush	Fair	Fair	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---
1152E:												
Sugarbush	Poor	Fair	Good	Good	Good	---	Very poor	Very poor	Fair	Good	Very poor	---
1233D:												
Esmond	Poor	Fair	Good	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
Heimdal	Fair	Good	Good	Fair	---	Fair	Very poor	Very poor	Good	---	Very poor	---
1264:												
Ulen	Fair	Good	Good	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor	---
1278:												
Rosewood	Fair	Fair	Fair	Fair	Fair	---	Good	Good	Fair	Fair	Good	---
Venlo	Very poor	Poor	Poor	---	---	Poor	Good	Good	Poor	---	Good	Poor
1279:												
Vallers	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair
1280:												
Gunclub	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Fair
1283:												
Reis	Fair	Fair	Fair	Poor	Fair	Fair	Good	Good	Fair	Poor	Good	Fair
Clearwater	Good	Good	Fair	Fair	Fair	---	Poor	Good	Good	Fair	Fair	---
1297:												
Augsburg	Good	Good	Fair	Fair	Poor	Fair	Fair	Fair	Good	Fair	Fair	---
1299:												
Borup	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair
1304A:												
Glyndon	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	---
1304B:												
Glyndon	Good	Good	Good	Fair	Poor	Fair	Poor	Poor	Good	Fair	Poor	Fair
1315A:												
Wheatville	Good	Good	Good	Fair	Poor	Fair	Poor	Fair	Good	Fair	Fair	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1323B:												
LaDelle	Good	Good	Fair	Good	Very poor	Good	Very poor	Very poor	Good	Very poor	Very poor	Fair
1325:												
Bowstring	Very poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
Fluvaquents	Very poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Very poor	Poor	Good	---
1356:												
Water, miscellaneous.												
1422:												
Northwood	Fair	Fair	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good	Poor
1866:												
Colvin	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	Good	Fair
Perella	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
1871:												
Fargo	Very poor	Poor	Fair	---	---	Poor	Poor	Good	Poor	---	Fair	Poor
1874:												
Radium	Poor	Poor	Fair	Poor	---	Fair	Poor	Very poor	Poor	Poor	Very poor	Fair
1878:												
Hamre	Very poor	Very poor	Poor	Poor	Poor	Poor	Good	Good	Very poor	Poor	Good	Poor
1879:												
Seelyeville	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
1882:												
Rosewood	Very poor	Very poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Fair	Poor
Strathcona	Very poor	Very poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Fair	Poor
Berner	Very poor	Very poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Fair	Poor
1916:												
Lindaas	Poor	Poor	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Fair
1963:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Colvin	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	Good	Fair
1964:												
Colvin	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	Good	Fair
Fargo	Good	Good	Fair	---	---	Poor	Poor	Good	Fair	---	Fair	Poor

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the data in the tables described under the heading "Soil Properties."

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

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

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

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

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

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

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

Building Site Development

The table "Building Site Development" shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and

observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

The table “Sanitary Facilities” shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. It also shows the suitability of the soils for use as daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of *slight, moderate,* or *severe* are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of *good, fair,* and *poor* are given for daily cover for landfill.

A rating of *slight* or *good* indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of *moderate* or *fair* indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of *severe* or *poor* indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

Septic tank absorption fields are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively impervious soil material for the lagoon floor and sides

is desirable to minimize seepage and contamination of local ground water.

The table gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Trench sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

Area sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in the table are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources

Conservation Service or the Cooperative Extension Service.

Construction Materials

The table “Construction Materials” gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

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

Soils rated *good* contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have one or more of the following characteristics: a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction (fig. 24). Specifications for each use vary widely. In the table, only the probability of finding material in suitable quantity in or below the soil is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter

Figure 24.—An area of Sandberg soils that has been excavated for sand and gravel.

content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

The table "Water Management" gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In the table, the soils are rated as a

source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

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

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

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

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff.

Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

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

Building Site Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
20B:						
Chapett	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
20C2:						
Chapett	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope
20D2:						
Chapett	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
20E:						
Chapett	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
38B:						
Waukon	Slight	Slight	Slight	Moderate: slope	Moderate: frost action low strength	Slight
38C2:						
Waukon	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action low strength slope	Moderate: slope
38D2:						
Waukon	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
45B:						
Maddock	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
45C:						
Maddock	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope droughty
45E:						
Maddock	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
47:						
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
57A:						
Fargo	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
59:						
Grimstad	Severe: wetness cutbanks cave	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: frost action wetness	Moderate: wetness
65:						
Foxhome	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Severe: frost action	Slight
66:						
Flaming	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Moderate: droughty
67A:						
Bearden	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Moderate: wetness
67B:						
Bearden	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell slope wetness	Severe: frost action low strength	Moderate: wetness
93A:						
Bearden	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Moderate: wetness
111:						
Hangaard	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness droughty
184A:						
Hamerly	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness
185D2:						
Hattie	Severe: cutbanks cave	Severe: shrink-swell	Severe: shrink-swell	Severe: shrink-swell slope	Severe: low strength shrink-swell	Severe: too clayey
236:						
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
242B:						
Marquette	Severe: cutbanks cave	Slight	Slight	Moderate: slope	Slight	Severe: droughty
242D:						
Marquette	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope droughty
258B:						
Sandberg	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe: droughty

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
258C:						
Sandberg	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Severe: slope droughty
258E:						
Sandberg	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope droughty
296:						
Fram	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness
341B:						
Arvilla	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
348:						
Borup	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action ponding	Severe: ponding
372:						
Hamar	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Moderate: frost action wetness	Moderate: wetness droughty
387:						
Roliss	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action low strength ponding	Severe: ponding
412:						
Mavie	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
422A:						
Bygland	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Severe: shrink-swell	Severe: low strength shrink-swell	Slight
422B:						
Bygland	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Severe: shrink-swell	Severe: low strength shrink-swell	Slight
422C2:						
Bygland	Moderate: slope too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell slope wetness	Severe: shrink-swell slope	Severe: low strength shrink-swell	Moderate: slope
426:						
Foldahl	Severe: cutbanks cave	Slight	Moderate: shrink-swell wetness	Slight	Severe: frost action	Moderate: droughty
435:						
Syrene	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
439:						
Strathcona	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
450:						
Rauville	Severe: wetness cutbanks cave	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: flooding wetness
481:						
Kratka	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
494B:						
Darnen	Slight	Slight	Moderate: shrink-swell	Moderate: slope	Moderate: frost action	Slight
506:						
Overly	Moderate: too clayey wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: frost action low strength	Slight
540:						
Seelyeville	Severe: excess humus ponding	Severe: low strength subsides ponding	Severe: low strength subsides ponding	Severe: low strength subsides ponding	Severe: frost action subsides ponding	Severe: excess humus ponding
543:						
Markey	Severe: excess humus ponding cutbanks cave	Severe: low strength subsides ponding	Severe: subsides ponding	Severe: low strength subsides ponding	Severe: frost action subsides ponding	Severe: excess humus ponding
544:						
Cathro	Severe: excess humus ponding	Severe: subsides ponding	Severe: subsides ponding	Severe: subsides ponding	Severe: frost action subsides ponding	Severe: excess humus ponding
547:						
Deerwood	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: excess humus ponding
563:						
Northwood	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action ponding	Severe: excess humus ponding
565:						
Eckvoll	Severe: cutbanks cave	Slight	Moderate: shrink-swell wetness	Slight	Severe: frost action	Slight
573D:						
Serden	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
582:						
Roliss	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
641:						
Clearwater	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness
642:						
Clearwater	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: wetness
643:						
Huot	Severe: cutbanks cave	Slight	Severe: shrink-swell	Slight	Severe: frost action	Moderate: droughty
645:						
Espelie	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: wetness
647:						
Hilaire	Severe: cutbanks cave	Slight	Severe: shrink-swell	Slight	Severe: frost action	Moderate: droughty
650:						
Reiner	Moderate: wetness	Slight	Moderate: wetness	Slight	Severe: frost action	Slight
651:						
Thiefriver	Severe: wetness cutbanks cave	Severe: wetness	Severe: shrink-swell wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
667B:						
Fairdale	Moderate: flooding wetness	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding
667C2:						
Fairdale	Moderate: flooding slope wetness	Severe: flooding	Severe: flooding	Severe: flooding slope	Severe: flooding	Moderate: flooding slope
670:						
Knute	Moderate: wetness	Slight	Moderate: wetness	Slight	Moderate: frost action	Slight
671:						
Onstad	Moderate: wetness	Slight	Moderate: wetness	Slight	Moderate: frost action	Slight

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
681:						
Brandsvold	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
694D2:						
Zell	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Severe: frost action	Moderate: slope
704:						
Wyrene	Severe: wetness cutbanks cave	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: frost action wetness	Moderate: wetness droughty
707A:						
Lizzie	Severe: cutbanks cave	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: frost action low strength	Slight
712:						
Rosewood	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
713:						
Linveldt	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Severe: frost action	Slight
718B:						
Naytahwaush	Moderate: too clayey	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
718C:						
Naytahwaush	Moderate: slope too clayey	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: slope	Severe: low strength	Moderate: slope
718E:						
Naytahwaush	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
733:						
Berner	Severe: excess humus ponding cutbanks cave	Severe: low strength subsides ponding	Severe: subsides ponding	Severe: low strength subsides ponding	Severe: frost action subsides ponding	Severe: excess humus ponding
735B:						
Halverson	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
735C:						
Halverson	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope droughty
737:						
Mahkonce	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Severe: shrink-swell	Severe: frost action low strength shrink-swell	Slight

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
746:						
Haslie	Severe: excess humus ponding	Severe: low strength ponding	Severe: low strength ponding	Severe: low strength ponding	Severe: frost action ponding	Severe: excess humus ponding
749:						
Colvin	Severe: wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: wetness
765:						
Smiley	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
767:						
Auganaush	Severe: wetness	Severe: shrink-swell wetness	Severe: wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: wetness
791:						
Winterfield	Severe: wetness cutbanks cave	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: wetness
827B:						
Heimdal	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
Esmond	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
827C2:						
Heimdal	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope
Esmond	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope
908:						
Bearden	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Moderate: wetness
Fargo	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness
935:						
Hegne	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness
Fargo	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
967B:						
Waukon	Slight	Slight	Slight	Moderate: slope	Moderate: frost action low strength	Slight
Langhei	Slight	Slight	Slight	Moderate: slope	Moderate: frost action low strength	Slight
967C2:						
Waukon	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action low strength slope	Moderate: slope
Langhei	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action low strength slope	Moderate: slope
979D2:						
Langhei	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Waukon	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
1006:						
Fluvaquents	Severe: ponding cutbanks cave	Severe: flooding ponding	Severe: flooding ponding	Severe: flooding ponding	Severe: flooding frost action ponding	Severe: flooding ponding
Haploborolls	Severe: slope	Severe: flooding slope	Severe: flooding slope	Severe: flooding slope	Severe: slope	Severe: slope
1030:						
Pits, gravel.						
Udipsamments	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
1113:						
Haslie	Severe: excess humus ponding	Severe: low strength subsides ponding	Severe: low strength subsides ponding	Severe: low strength subsides ponding	Severe: frost action subsides ponding	Severe: excess humus ponding
Seelyeville	Severe: excess humus ponding	Severe: low strength ponding	Severe: low strength ponding	Severe: low strength ponding	Severe: frost action ponding	Severe: excess humus ponding
Cathro	Severe: excess humus ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action ponding	Severe: excess humus ponding
1117:						
Hedman	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1119:						
Nielsville	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
1121:						
Hedman	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action ponding	Severe: ponding
1122:						
Nielsville	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
Perella	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action low strength ponding	Severe: ponding
1142:						
Hedman	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
Fram	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness
1144:						
Strathcona	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action ponding	Severe: ponding
Kratka	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1152B:						
Sugarbush	Severe: cutbanks cave	Slight	Slight	Moderate: slope	Slight	Moderate: large stones droughty
1152C:						
Sugarbush	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: large stones slope droughty
1152E:						
Sugarbush	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
1233D:						
Esmond	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Heimdal	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1264:						
Ulen	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Moderate: droughty
1278:						
Rosewood	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Venlo	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1279:						
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
Hamerly	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness
1280:						
Gunclub	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Moderate: wetness
1283:						
Reis	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness
Clearwater	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness
1297:						
Augsburg	Severe: wetness cutbanks cave	Severe: wetness	Severe: shrink-swell wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
1299:						
Borup	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
1304A:						
Glyndon	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Severe: frost action	Slight
1304B:						
Glyndon	Severe: cutbanks cave	Slight	Moderate: wetness	Moderate: slope	Severe: frost action	Slight
1315A:						
Wheatville	Severe: cutbanks cave	Slight	Severe: shrink-swell	Slight	Severe: frost action	Slight

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1323B:						
LaDelle	Moderate: flooding wetness	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding frost action low strength	Moderate: flooding
1325:						
Bowstring	Severe: excess humus ponding cutbanks cave	Severe: flooding subsides ponding	Severe: flooding subsides ponding	Severe: flooding subsides ponding	Severe: flooding subsides ponding	Severe: excess humus flooding ponding
Fluvaquents	Severe: ponding cutbanks cave	Severe: flooding ponding	Severe: flooding ponding	Severe: flooding ponding	Severe: flooding frost action ponding	Severe: flooding ponding
1356:						
Water, miscellaneous.						
1422:						
Northwood	Severe: excess humus ponding cutbanks cave	Severe: low strength ponding	Severe: ponding	Severe: low strength ponding	Severe: frost action low strength ponding	Severe: excess humus ponding
1866:						
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
Perella	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Slight
1871:						
Fargo	Severe: ponding cutbanks cave	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: too clayey ponding
1874:						
Radium	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Slight	Severe: droughty
1878:						
Hamre	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action ponding	Severe: excess humus ponding
1879:						
Seelyeville	Severe: excess humus ponding	Severe: low strength subsides ponding	Severe: low strength subsides ponding	Severe: low strength subsides ponding	Severe: frost action subsides ponding	Severe: excess humus ponding
1882:						
Rosewood	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1882:						
Strathcona	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
Berner	Severe: wetness cutbanks cave	Severe: wetness subsides	Severe: wetness subsides	Severe: wetness subsides	Severe: frost action wetness subsides	Severe: excess humus wetness
1916:						
Lindaas	Severe: ponding	Severe: shrink-swell ponding	Severe: ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
1963:						
Bearden	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Moderate: wetness
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
1964:						
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
Fargo	Severe: wetness cutbanks cave	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness

Sanitary Facilities

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
20B:					
Chapett	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Good
20C2:					
Chapett	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
20D2:					
Chapett	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
20E:					
Chapett	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
38B:					
Waukon	Moderate: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
38C2:					
Waukon	Moderate: percs slowly slope	Severe: slope	Moderate: slope too clayey	Moderate: slope	Fair: slope too clayey
38D2:					
Waukon	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
45B:					
Maddock	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage too sandy
45C:					
Maddock	Severe: poor filter	Severe: seepage slope	Severe: seepage too sandy	Severe: seepage	Poor: seepage too sandy
45E:					
Maddock	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage slope too sandy
47:					
Colvin	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
57A:					
Fargo	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
59:					
Grimstad	Severe: wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Fair: wetness
65:					
Foxhome	Severe: wetness	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Fair: too clayey wetness
66:					
Flaming	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy
67A:					
Bearden	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Poor: hard to pack
67B:					
Bearden	Severe: percs slowly wetness	Moderate: slope	Severe: wetness	Severe: wetness	Poor: hard to pack
93A:					
Bearden	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Poor: hard to pack
111:					
Hangaard	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
184A:					
Hamerly	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
185D2:					
Hattie	Severe: percs slowly	Severe: slope	Severe: too clayey	Moderate: slope	Poor: hard to pack too clayey
236:					
Vallers	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
242B:					
Marquette	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
242D:					
Marquette	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage small stones too sandy

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
258B:					
Sandberg	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
258C:					
Sandberg	Severe: poor filter	Severe: seepage slope	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
258E:					
Sandberg	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage small stones too sandy
296:					
Fram	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: wetness
341B:					
Arvilla	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
348:					
Borup	Severe: ponding poor filter	Severe: seepage ponding	Severe: seepage too sandy ponding	Severe: seepage ponding	Poor: ponding
372:					
Hamar	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
387:					
Roliss	Severe: percs slowly ponding	Severe: ponding	Severe: ponding	Severe: ponding	Poor: ponding
412:					
Mavie	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
422A:					
Bygland	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: hard to pack
422B:					
Bygland	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: hard to pack

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
422C2:					
Bygland	Severe: percs slowly wetness	Severe: slope wetness	Severe: wetness	Severe: wetness	Poor: hard to pack
426:					
Foldahl	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Fair: small stones too clayey wetness
435:					
Syrene	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
439:					
Strathcona	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
450:					
Rauville	Severe: flooding percs slowly wetness	Severe: flooding seepage wetness	Severe: flooding seepage wetness	Severe: flooding wetness	Poor: hard to pack too clayey wetness
481:					
Kratka	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
494B:					
Darnen	Moderate: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
506:					
Overly	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: thin layer
540:					
Seelyeville	Severe: percs slowly subsides ponding	Severe: excess humus seepage ponding	Severe: excess humus seepage ponding	Severe: seepage ponding	Poor: excess humus ponding
543:					
Markey	Severe: percs slowly subsides ponding	Severe: excess humus seepage ponding	Severe: seepage too sandy ponding	Severe: seepage ponding	Poor: seepage too sandy ponding
544:					
Cathro	Severe: percs slowly ponding	Severe: excess humus seepage ponding	Severe: ponding	Severe: seepage ponding	Poor: ponding

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
547:					
Deerwood	Severe: ponding poor filter	Severe: excess humus seepage ponding	Severe: seepage too sandy ponding	Severe: seepage ponding	Poor: seepage too sandy ponding
563:					
Northwood	Severe: ponding	Severe: excess humus seepage ponding	Severe: ponding	Severe: seepage ponding	Poor: ponding
565:					
Eckvoll	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Fair: too clayey wetness
573D:					
Serden	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage slope too sandy
582:					
Roliss	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
641:					
Clearwater	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
642:					
Clearwater	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
643:					
Huot	Severe: percs slowly wetness poor filter	Severe: seepage	Severe: too clayey wetness	Severe: seepage wetness	Poor: hard to pack too clayey
645:					
Espelie	Severe: percs slowly wetness	Severe: seepage	Severe: too clayey wetness	Severe: seepage wetness	Poor: hard to pack too clayey wetness
647:					
Hilaire	Severe: percs slowly wetness poor filter	Severe: seepage	Severe: too clayey wetness	Severe: seepage wetness	Poor: hard to pack too clayey

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
650:					
Reiner	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: small stones too clayey wetness
651:					
Thiefriver	Severe: percs slowly wetness poor filter	Severe: seepage	Severe: too clayey wetness	Severe: seepage wetness	Poor: hard to pack too clayey wetness
667B:					
Fairdale	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Fair: too clayey wetness
667C2:					
Fairdale	Severe: flooding wetness	Severe: flooding slope wetness	Severe: flooding wetness	Severe: flooding wetness	Fair: slope too clayey wetness
670:					
Knute	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: wetness
671:					
Onstad	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: wetness
681:					
Brandsvold	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
694D2:					
Zell	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
704:					
Wyrene	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy
707A:					
Lizzie	Moderate: percs slowly	Severe: seepage	Severe: seepage	Slight	Fair: too clayey
712:					
Rosewood	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
713:					
Linveldt	Severe: wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Fair: too clayey wetness

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
718B:					
Naytahwaush	Severe: percs slowly	Moderate: slope	Moderate: too clayey	Slight	Fair: too clayey
718C:					
Naytahwaush	Severe: percs slowly	Severe: slope	Moderate: slope too clayey	Moderate: slope	Fair: slope too clayey
718E:					
Naytahwaush	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
733:					
Berner	Severe: percs slowly ponding poor filter	Severe: excess humus seepage ponding	Severe: excess humus ponding	Severe: seepage ponding	Poor: excess humus ponding
735B:					
Halverson	Severe: percs slowly	Severe: seepage	Slight	Severe: seepage	Good
735C:					
Halverson	Severe: percs slowly	Severe: seepage slope	Moderate: slope	Severe: seepage	Fair: slope
737:					
Mahkonce	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
746:					
Haslie	Severe: percs slowly ponding	Severe: excess humus seepage ponding	Severe: excess humus ponding	Severe: seepage ponding	Poor: hard to pack ponding
749:					
Colvin	Severe: flooding percs slowly wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Poor: wetness
765:					
Smiley	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
767:					
Auganaush	Severe: percs slowly wetness	Severe: wetness	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
791:					
Winterfield	Severe: flooding wetness poor filter	Severe: flooding seepage wetness	Severe: flooding seepage wetness	Severe: flooding seepage wetness	Poor: seepage too sandy wetness

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
827B:					
Heimdal	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Good
Esmond	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Good
827C2:					
Heimdal	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
Esmond	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
908:					
Bearden	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Poor: hard to pack
Fargo	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
935:					
Hegne	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
Fargo	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
967B:					
Waukon	Moderate: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Langhei	Moderate: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
967C2:					
Waukon	Moderate: percs slowly slope	Severe: slope	Moderate: slope too clayey	Moderate: slope	Fair: slope too clayey
Langhei	Moderate: percs slowly slope	Severe: slope	Moderate: slope too clayey	Moderate: slope	Fair: slope too clayey
979D2:					
Langhei	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Waukon	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1006:					
Fluvaquents	Severe: flooding ponding poor filter	Severe: flooding seepage ponding	Severe: flooding seepage ponding	Severe: flooding seepage ponding	Poor: seepage ponding
Haploborolls	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
1030:					
Pits, gravel.					
Udipsamments	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage slope too sandy
1113:					
Haslie	Severe: percs slowly subsides ponding	Severe: excess humus seepage ponding	Severe: excess humus too clayey ponding	Severe: seepage ponding	Poor: hard to pack too clayey ponding
Seelyeville	Severe: percs slowly ponding	Severe: excess humus seepage ponding	Severe: excess humus seepage ponding	Severe: seepage ponding	Poor: excess humus ponding
Cathro	Severe: percs slowly ponding	Severe: excess humus seepage ponding	Severe: ponding	Severe: seepage ponding	Poor: ponding
1117:					
Hedman	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
1119:					
Nielsville	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Poor: thin layer wetness
1121:					
Hedman	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Poor: ponding
1122:					
Nielsville	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Poor: thin layer wetness
Perella	Severe: percs slowly ponding	Severe: ponding	Severe: ponding	Severe: ponding	Poor: ponding
1142:					
Hedman	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Fram	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: wetness

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1144:					
Strathcona	Severe: percs slowly ponding poor filter	Severe: seepage ponding	Severe: ponding	Severe: seepage ponding	Poor: ponding
Kratka	Severe: percs slowly ponding poor filter	Severe: seepage ponding	Severe: ponding	Severe: seepage ponding	Poor: ponding
1152B:					
Sugarbush	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
1152C:					
Sugarbush	Severe: poor filter	Severe: seepage slope	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
1152E:					
Sugarbush	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage small stones too sandy
1233D:					
Esmond	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Heimdal	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
1264:					
Ulen	Severe: wetness poor filter	Severe: seepage wetness	Severe: too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy
1278:					
Rosewood	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
Venlo	Severe: ponding poor filter	Severe: seepage ponding	Severe: seepage too sandy ponding	Severe: seepage ponding	Poor: seepage too sandy ponding
1279:					
Vallers	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Hamerly	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1280:					
Gunclub	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Fair: thin layer too clayey wetness
1283:					
Reis	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
Clearwater	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness
1297:					
Augsburg	Severe: percs slowly wetness	Severe: seepage	Severe: too clayey wetness	Severe: seepage wetness	Poor: hard to pack too clayey wetness
1299:					
Borup	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: wetness
1304A:					
Glyndon	Severe: wetness	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Fair: too sandy wetness
1304B:					
Glyndon	Severe: wetness	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Fair: too sandy wetness
1315A:					
Wheatville	Severe: percs slowly wetness	Severe: seepage	Severe: too clayey wetness	Severe: seepage wetness	Poor: hard to pack too clayey
1323B:					
LaDelle	Severe: flooding percs slowly wetness	Severe: flooding	Severe: flooding wetness	Severe: flooding	Poor: hard to pack
1325:					
Bowstring	Severe: flooding percs slowly ponding	Severe: excess humus flooding seepage	Severe: flooding seepage ponding	Severe: flooding seepage ponding	Poor: excess humus ponding
Fluvaquents	Severe: flooding ponding poor filter	Severe: flooding seepage ponding	Severe: flooding seepage ponding	Severe: flooding seepage ponding	Poor: seepage ponding

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1356: Water, miscellaneous.					
1422: Northwood	Severe: percs slowly ponding	Severe: excess humus seepage ponding	Severe: ponding	Severe: seepage ponding	Poor: ponding
1866: Colvin	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Perella	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
1871: Fargo	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1874: Radium	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy
1878: Hamre	Severe: percs slowly ponding	Severe: excess humus ponding	Severe: ponding	Severe: ponding	Poor: ponding
1879: Seelyeville	Severe: percs slowly subsides ponding	Severe: excess humus seepage ponding	Severe: excess humus seepage ponding	Severe: seepage ponding	Poor: excess humus ponding
1882: Rosewood	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
Strathcona	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
Berner	Severe: percs slowly wetness poor filter	Severe: excess humus seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
1916: Lindaas	Severe: percs slowly ponding	Severe: seepage ponding	Severe: ponding	Severe: ponding	Poor: ponding

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1963:					
Bearden	Severe: percs slowly wetness	Slight	Severe: wetness	Severe: wetness	Poor: hard to pack
Colvin	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
1964:					
Colvin	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Fargo	Severe: percs slowly wetness	Slight	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey wetness

Construction Materials

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
20B:				
Chapett	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
20C2:				
Chapett	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope, small stones too clayey
20D2:				
Chapett	Fair: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
20E:				
Chapett	Poor: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
38B:				
Waukon	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
38C2:				
Waukon	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones too clayey
38D2:				
Waukon	Fair: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
45B:				
Maddock	Good	Probable	Improbable: too sandy	Poor: too sandy
45C:				
Maddock	Good	Probable	Improbable: too sandy	Poor: too sandy
45E:				
Maddock	Fair: slope	Probable	Improbable: too sandy	Poor: slope too sandy
47:				
Colvin	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
57A:				
Fargo	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
59:				
Grimstad	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
65:				
Foxhome	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Poor: small stones
66:				
Flaming	Fair: wetness	Probable	Improbable: too sandy	Poor: too sandy
67A:				
Bearden	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
67B:				
Bearden	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
93A:				
Bearden	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
111:				
Hangaard	Poor: wetness	Probable	Probable	Poor: small stones too sandy wetness
184A:				
Hamerly	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
185D2:				
Hattie	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
236:				
Vallers	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
242B:				
Marquette	Good	Probable	Probable	Poor: area reclaim small stones too sandy
242D:				
Marquette	Fair: slope	Probable	Probable	Poor: area reclaim small stones too sandy
258B:				
Sandberg	Good	Probable	Probable	Poor: area reclaim small stones

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
258C:				
Sandberg	Good	Probable	Probable	Poor: area reclaim small stones
258E:				
Sandberg	Fair: slope	Probable	Probable	Poor: area reclaim slope small stones
296:				
Fram	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
341B:				
Arvilla	Good	Probable	Probable	Poor: area reclaim small stones too sandy
348:				
Borup	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
372:				
Hamar	Fair: wetness	Probable	Improbable: too sandy	Poor: too sandy
387:				
Roliss	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
412:				
Mavie	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: small stones too sandy wetness
422A:				
Bygland	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
422B:				
Bygland	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
422C2:				
Bygland	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
426:				
Foldahl	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
435:				
Syrene	Poor: wetness	Probable	Improbable: too sandy	Poor: small stones too sandy wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
439:				
Strathcona	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
450:				
Rauville	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
481:				
Kratka	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
494B:				
Darnen	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
506:				
Overly	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
540:				
Seelyeville	Poor: wetness	Improbable: excess humus	Improbable: excess humus	Poor: excess humus wetness
543:				
Markey	Poor: wetness	Probable	Improbable: too sandy	Poor: excess humus wetness
544:				
Cathro	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
547:				
Deerwood	Poor: wetness	Probable	Improbable: too sandy	Poor: small stones too sandy wetness
563:				
Northwood	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
565:				
Eckvoll	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
573D:				
Serden	Fair: slope	Probable	Improbable: too sandy	Poor: slope too sandy
582:				
Roliss	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
641:				
Clearwater	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
642:				
Clearwater	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
643:				
Huot	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Fair: small stones thin layer
645:				
Espelie	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: small stones too clayey wetness
647:				
Hilaire	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: small stones too sandy
650:				
Reiner	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: small stones
651:				
Thiefriver	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
667B:				
Fairdale	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Good
667C2:				
Fairdale	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Fair: slope
670:				
Knute	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
671:				
Onstad	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
681:				
Brandsvold	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
694D2:				
Zell	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope
704:				
Wyrene	Fair: wetness	Probable	Probable	Poor: small stones
707A:				
Lizzie	Good	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
712:				
Rosewood	Poor: wetness	Probable	Improbable: too sandy	Poor: too sandy wetness
713:				
Linveldt	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Poor: small stones
718B:				
Naytahwaush	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: thin layer
718C:				
Naytahwaush	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: thin layer
718E:				
Naytahwaush	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: slope thin layer
733:				
Berner	Poor: wetness	Improbable: excess humus	Improbable: excess humus	Poor: excess humus wetness
735B:				
Halverson	Good	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
735C:				
Halverson	Good	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
737:				
Mahkonce	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
746:				
Haslie	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess humus wetness
749:				
Colvin	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
765:				
Smiley	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
767:				
Auganaush	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
791:				
Winterfield	Poor: wetness	Probable	Improbable: too sandy	Poor: too sandy wetness
827B:				
Heimdal	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Esmond	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
827C2:				
Heimdal	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones
Esmond	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones
908:				
Bearden	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
Fargo	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
935:				
Hegne	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
Fargo	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
967B:				
Waukon	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
Langhei	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
967C2:				
Waukon	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones too clayey
Langhei	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones too clayey
979D2:				
Langhei	Fair: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Waukon	Fair: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
1006:				
Fluvaquents	Poor: wetness	Probable	Improbable: too sandy	Poor: wetness
Haploborolls	Fair: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
1030:				
Pits, gravel.				
Udipsamments	Poor: slope	Probable	Probable	Poor: slope too sandy
1113:				
Haslie	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess humus wetness
Seelyeville	Poor: wetness	Improbable: excess humus	Improbable: excess humus	Poor: excess humus wetness
Cathro	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
1117:				
Hedman	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1119:				
Nielsville	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1121:				
Hedman	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1122:				
Nielsville	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
Perella	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1142:				
Hedman	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
Fram	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1144:				
Strathcona	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: too sandy wetness
Kratka	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
1152B:				
Sugarbush	Good	Probable	Probable	Poor: area reclaim small stones too sandy
1152C:				
Sugarbush	Good	Probable	Probable	Poor: area reclaim small stones too sandy
1152E:				
Sugarbush	Fair: slope	Probable	Probable	Poor: area reclaim small stones too sandy
1233D:				
Esmond	Fair: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Heimdal	Fair: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
1264:				
Ulen	Fair: wetness	Improbable: thin layer	Improbable: too sandy	Poor: too sandy
1278:				
Rosewood	Poor: wetness	Probable	Improbable: too sandy	Poor: too sandy wetness
Venlo	Poor: wetness	Probable	Improbable: too sandy	Poor: too sandy wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1279:				
Vallers	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
Hamerly	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1280:				
Gunclub	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
1283:				
Reis	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
Clearwater	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1297:				
Augsburg	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1299:				
Borup	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1304A:				
Glyndon	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
1304B:				
Glyndon	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
1315A:				
Wheatville	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Fair: thin layer too sandy
1323B:				
LaDelle	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
1325:				
Bowstring	Poor: wetness	Improbable: excess humus	Improbable: excess humus	Poor: excess humus wetness
Fluvaquents	Poor: wetness	Probable	Improbable: too sandy	Poor: wetness
1356:				
Water, miscellaneous.				

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1422:				
Northwood	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1866:				
Colvin	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
Perella	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
1871:				
Fargo	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1874:				
Radium	Fair: wetness	Probable	Improbable: too sandy	Poor: small stones too sandy
1878:				
Hamre	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1879:				
Seelyeville	Poor: wetness	Improbable: excess humus	Improbable: excess humus	Poor: excess humus wetness
1882:				
Rosewood	Poor: wetness	Probable	Improbable: too sandy	Poor: too sandy wetness
Strathcona	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
Berner	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess humus wetness
1916:				
Lindaas	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
1963:				
Bearden	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
Colvin	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1964:				
Colvin	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1964:				
Fargo	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness

Water Management

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
20B:							
Chapett	Moderate: seepage slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope soil blowing	Soil blowing	Rooting depth
20C2:							
Chapett	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope soil blowing	Slope soil blowing	Rooting depth slope
20D2:							
Chapett	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope soil blowing	Slope soil blowing	Rooting depth slope
20E:							
Chapett	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope soil blowing	Slope soil blowing	Rooting depth slope
38B:							
Waukon	Moderate: seepage slope	Moderate: piping	Severe: no water	Deep to water	Slope	Favorable	Favorable
38C2:							
Waukon	Severe: slope	Moderate: piping	Severe: no water	Deep to water	Slope	Slope	Slope
38D2:							
Waukon	Severe: slope	Moderate: piping	Severe: no water	Deep to water	Slope	Slope	Slope
45B:							
Maddock	Severe: seepage	Severe: seepage piping	Severe: no water	Deep to water	Fast intake slope droughty	Too sandy soil blowing	Droughty
45C:							
Maddock	Severe: seepage slope	Severe: seepage piping	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Slope droughty

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
45E:							
Maddock	Severe: seepage slope	Severe: seepage piping	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Slope droughty
47:							
Colvin	Moderate: seepage	Severe: wetness	Severe: slow refill	Frost action	Wetness	Wetness	Wetness
57A:							
Fargo	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
59:							
Grimstad	Severe: seepage	Severe: piping wetness	Severe: cutbanks cave	Favorable	Wetness	Erodes easily wetness soil blowing	Erodes easily
65:							
Foxhome	Severe: seepage	Severe: piping	Severe: cutbanks cave	Frost action	Wetness soil blowing	Wetness soil blowing	Favorable
66:							
Flaming	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Cutbanks cave	Fast intake wetness droughty	Too sandy wetness soil blowing	Droughty
67A:							
Bearden	Slight	Severe: wetness	Severe: slow refill	Frost action	Wetness	Erodes easily percs slowly wetness	Erodes easily rooting depth
67B:							
Bearden	Moderate: slope	Severe: wetness	Severe: slow refill	Frost action slope	Slope wetness	Erodes easily percs slowly wetness	Erodes easily rooting depth
93A:							
Bearden	Slight	Severe: wetness	Severe: slow refill	Frost action	Wetness	Erodes easily percs slowly wetness	Erodes easily rooting depth
111:							
Hangaard	Severe: seepage	Severe: seepage wetness	Severe: cutbanks cave	Cutbanks cave	Wetness droughty	Too sandy wetness soil blowing	Wetness droughty

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
184A:							
Hamerly	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Erodes easily wetness	Erodes easily
185D2:							
Hattie	Severe: slope	Severe: hard to pack	Severe: no water	Deep to water	Percs slowly slope slow intake	Percs slowly slope	Percs slowly slope
236:							
Vallers	Slight	Severe: piping wetness	Severe: slow refill	Frost action	Wetness	Erodes easily wetness	Erodes easily wetness
242B:							
Marquette	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Fast intake slope droughty	Too sandy soil blowing	Droughty
242D:							
Marquette	Severe: seepage slope	Severe: seepage	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Slope droughty
258B:							
Sandberg	Severe: seepage	Severe: seepage piping	Severe: no water	Deep to water	Slope droughty	Too sandy soil blowing	Droughty
258C:							
Sandberg	Severe: seepage slope	Severe: seepage piping	Severe: no water	Deep to water	Slope droughty	Slope too sandy soil blowing	Slope droughty
258E:							
Sandberg	Severe: seepage slope	Severe: seepage piping	Severe: no water	Deep to water	Slope droughty	Slope too sandy soil blowing	Slope droughty
296:							
Fram	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Erodes easily wetness	Erodes easily

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
341B:							
Arvilla	Severe: seepage	Severe: seepage piping	Severe: no water	Deep to water	Soil blowing droughty	Too sandy soil blowing	Droughty
348:							
Borup	Severe: seepage	Severe: piping ponding	Severe: cutbanks cave	Frost action ponding cutbanks cave	Excess salt ponding	Ponding	Wetness
372:							
Hamar	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Cutbanks cave	Fast intake wetness droughty	Too sandy wetness soil blowing	Wetness droughty
387:							
Roliss	Moderate: seepage	Severe: piping ponding	Severe: slow refill	Frost action ponding	Ponding	Ponding	Wetness
412:							
Mavie	Severe: seepage	Severe: piping wetness	Severe: slow refill cutbanks cave	Frost action	Wetness soil blowing droughty	Erodes easily wetness soil blowing	Erodes easily wetness droughty
422A:							
Bygland	Slight	Moderate: hard to pack piping wetness	Severe: slow refill	Frost action percs slowly	Wetness	Erodes easily wetness	Erodes easily percs slowly
422B:							
Bygland	Moderate: slope	Moderate: hard to pack piping wetness	Severe: slow refill	Frost action percs slowly slope	Slope wetness	Erodes easily wetness	Erodes easily percs slowly
422C2:							
Bygland	Severe: slope	Moderate: hard to pack piping wetness	Severe: slow refill	Frost action percs slowly slope	Slope wetness	Erodes easily slope wetness	Erodes easily percs slowly slope
426:							
Foldahl	Severe: seepage	Severe: piping	Severe: slow refill cutbanks cave	Frost action	Wetness droughty	Erodes easily wetness soil blowing	Erodes easily droughty

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
435:							
Syrene	Severe: seepage	Severe: seepage wetness	Severe: cutbanks cave	Cutbanks cave	Wetness soil blowing droughty	Erodes easily too sandy wetness	Erodes easily wetness droughty
439:							
Strathcona	Severe: seepage	Severe: piping wetness	Severe: slow refill cutbanks cave	Frost action	Wetness soil blowing	Wetness soil blowing	Wetness
450:							
Rauville	Severe: seepage	Severe: hard to pack wetness	Severe: slow refill cutbanks cave	Flooding frost action	Flooding wetness	Wetness	Wetness
481:							
Kratka	Severe: seepage	Severe: piping wetness	Severe: slow refill cutbanks cave	Favorable	Wetness soil blowing droughty	Erodes easily wetness soil blowing	Erodes easily wetness droughty
494B:							
Darnen	Moderate: seepage slope	Severe: piping	Severe: no water	Deep to water	Slope	Favorable	Favorable
506:							
Overly	Slight	Severe: piping	Severe: slow refill	Deep to water	Erodes easily percs slowly	Erodes easily	Erodes easily percs slowly
540:							
Seelyeville	Severe: seepage	Severe: excess humus ponding	Severe: slow refill	Frost action subsides ponding	Soil blowing ponding	Soil blowing ponding	Wetness
543:							
Markey	Severe: seepage	Severe: seepage piping ponding	Severe: slow refill cutbanks cave	Frost action subsides ponding	Soil blowing ponding	Too sandy soil blowing ponding	Wetness
544:							
Cathro	Severe: seepage	Severe: piping ponding	Severe: slow refill	Frost action subsides ponding	Soil blowing ponding	Soil blowing ponding	Wetness

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
547:							
Deerwood	Severe: seepage	Severe: seepage piping ponding	Severe: cutbanks cave	Subsides ponding cutbanks cave	Soil blowing ponding	Too sandy soil blowing ponding	Wetness
563:							
Northwood	Severe: seepage	Severe: piping ponding	Severe: cutbanks cave	Frost action subsides ponding	Rooting depth soil blowing ponding	Erodes easily soil blowing ponding	Erodes easily rooting depth wetness
565:							
Eckvoll	Severe: seepage	Moderate: piping wetness	Severe: slow refill cutbanks cave	Frost action	Fast intake wetness soil blowing	Erodes easily wetness soil blowing	Erodes easily
573D:							
Serden	Severe: seepage slope	Severe: seepage piping	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Slope droughty
582:							
Roliss	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Frost action	Wetness	Wetness	Wetness
641:							
Clearwater	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
642:							
Clearwater	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly wetness	Percs slowly wetness	Percs slowly wetness
643:							
Huot	Severe: seepage	Severe: hard to pack	Severe: slow refill cutbanks cave	Frost action percs slowly	Wetness droughty	Percs slowly wetness soil blowing	Percs slowly droughty
645:							
Espelie	Severe: seepage	Severe: wetness	Severe: slow refill cutbanks cave	Frost action percs slowly	Wetness soil blowing droughty	Percs slowly wetness soil blowing	Percs slowly wetness droughty

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
647:							
Hilaire	Severe: seepage	Severe: hard to pack	Severe: slow refill cutbanks cave	Frost action percs slowly	Fast intake wetness droughty	Percs slowly wetness soil blowing	Percs slowly droughty
650:							
Reiner	Moderate: seepage	Severe: piping	Moderate: slow refill deep to water	Frost action	Wetness soil blowing	Wetness soil blowing	Rooting depth
651:							
Thiefriver	Severe: seepage	Severe: wetness	Severe: slow refill cutbanks cave	Frost action percs slowly	Wetness soil blowing droughty	Percs slowly wetness soil blowing	Percs slowly wetness droughty
667B:							
Fairdale	Moderate: seepage slope	Severe: piping	Moderate: slow refill deep to water	Deep to water	Slope	Favorable	Favorable
667C2:							
Fairdale	Severe: slope	Severe: piping	Moderate: slow refill deep to water	Deep to water	Slope	Slope	Slope
670:							
Knute	Moderate: seepage	Severe: piping	Moderate: slow refill deep to water	Favorable	Wetness soil blowing	Wetness soil blowing	Favorable
671:							
Onstad	Moderate: seepage	Severe: piping	Moderate: slow refill deep to water	Favorable	Wetness	Wetness	Favorable
681:							
Brandsvold	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Frost action	Wetness	Wetness	Wetness
694D2:							
Zell	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily slope	Erodes easily slope

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
704:							
Wyrene	Severe: seepage	Severe: seepage wetness	Severe: cutbanks cave	Cutbanks cave	Wetness soil blowing droughty	Too sandy wetness soil blowing	Droughty
707A:							
Lizzie	Severe: seepage	Severe: piping	Severe: no water	Deep to water	Favorable	Erodes easily	Erodes easily
712:							
Rosewood	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Cutbanks cave	Wetness droughty	Too sandy wetness soil blowing	Wetness droughty
713:							
Linveldt	Severe: seepage	Severe: piping	Severe: cutbanks cave	Frost action	Wetness	Wetness soil blowing	Favorable
718B:							
Naytahwaush	Moderate: slope	Slight	Severe: no water	Deep to water	Percs slowly slope	Erodes easily	Erodes easily percs slowly
718C:							
Naytahwaush	Severe: slope	Slight	Severe: no water	Deep to water	Percs slowly slope	Erodes easily slope	Erodes easily percs slowly slope
718E:							
Naytahwaush	Severe: slope	Slight	Severe: no water	Deep to water	Percs slowly slope	Erodes easily slope	Erodes easily percs slowly slope
733:							
Berner	Severe: seepage	Severe: excess humus ponding	Severe: slow refill cutbanks cave	Frost action subsides ponding	Rooting depth soil blowing ponding	Soil blowing ponding	Rooting depth wetness
735B:							
Halverson	Severe: seepage	Severe: piping	Severe: no water	Deep to water	Fast intake slope droughty	Soil blowing	Droughty

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
735C:							
Halverson	Severe: seepage slope	Severe: piping	Severe: no water	Deep to water	Fast intake slope droughty	Slope soil blowing	Slope droughty
737:							
Mahkonce	Slight	Moderate: wetness	Severe: slow refill	Frost action percs slowly	Wetness	Wetness	Percs slowly
746:							
Haslie	Severe: seepage	Severe: excess humus ponding	Severe: slow refill	Percs slowly subsides ponding	Percs slowly soil blowing ponding	Percs slowly soil blowing ponding	Percs slowly wetness
749:							
Colvin	Moderate: seepage	Severe: wetness	Severe: slow refill	Flooding frost action	Flooding wetness	Erodes easily wetness	Erodes easily wetness
765:							
Smiley	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Wetness	Wetness
767:							
Auganaush	Slight	Severe: wetness	Severe: slow refill	Frost action percs slowly	Percs slowly wetness	Percs slowly wetness	Percs slowly wetness
791:							
Winterfield	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Flooding cutbanks cave	Wetness droughty	Too sandy wetness soil blowing	Wetness droughty
827B:							
Heimdal	Moderate: seepage slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope	Favorable	Rooting depth
Esmond	Moderate: seepage slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope	Favorable	Rooting depth

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
827C2:							
Heimdal	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope	Slope	Rooting depth slope
Esmond	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope	Slope	Rooting depth slope
908:							
Bearden	Slight	Severe: wetness	Severe: slow refill	Frost action	Wetness	Erodes easily percs slowly wetness	Erodes easily rooting depth
Fargo	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
935:							
Hegne	Slight	Severe: wetness	Severe: slow refill	Percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
Fargo	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
967B:							
Waukon	Moderate: seepage slope	Moderate: piping	Severe: no water	Deep to water	Slope	Favorable	Favorable
Langhei	Moderate: seepage slope	Severe: piping	Severe: no water	Deep to water	Slope	Favorable	Favorable
967C2:							
Waukon	Severe: slope	Moderate: piping	Severe: no water	Deep to water	Slope	Slope	Slope
Langhei	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope	Slope
979D2:							
Langhei	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope	Slope
Waukon	Severe: slope	Moderate: piping	Severe: no water	Deep to water	Slope	Slope	Slope

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1006:							
Fluvaquents	Severe: seepage	Severe: seepage piping ponding	Severe: cutbanks cave	Flooding frost action ponding	Rooting depth ponding droughty	Too sandy ponding	Rooting depth wetness droughty
Haploborolls	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope	Slope
1030:							
Pits, gravel.							
Udipsamments	Severe: seepage slope	Severe: seepage piping	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Slope droughty
1113:							
Haslie	Severe: seepage	Severe: excess humus ponding	Severe: slow refill	Percs slowly subsides ponding	Percs slowly ponding	Percs slowly ponding	Percs slowly wetness
Seelyeville	Severe: seepage	Severe: excess humus ponding	Severe: slow refill	Frost action ponding	Ponding	Ponding	Wetness
Cathro	Severe: seepage	Severe: piping ponding	Severe: slow refill	Frost action ponding	Ponding	Ponding	Wetness
1117:							
Hedman	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Wetness	Wetness
1119:							
Nielsville	Slight	Severe: wetness	Severe: slow refill	Frost action	Percs slowly wetness	Wetness	Wetness
1121:							
Hedman	Moderate: seepage	Severe: piping ponding	Moderate: slow refill	Frost action ponding	Ponding	Ponding	Wetness

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1122:							
Nielsville	Slight	Severe: wetness	Severe: slow refill	Frost action	Percs slowly wetness	Wetness	Wetness
Perella	Moderate: seepage	Severe: piping ponding	Severe: slow refill	Frost action ponding	Ponding	Ponding	Wetness
1142:							
Hedman	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Wetness	Wetness
Fram	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Erodes easily wetness	Erodes easily
1144:							
Strathcona	Severe: seepage	Severe: piping ponding	Severe: slow refill cutbanks cave	Frost action ponding	Soil blowing ponding	Soil blowing ponding	Wetness
Kratka	Severe: seepage	Severe: piping ponding	Severe: slow refill cutbanks cave	Ponding	Soil blowing ponding	Soil blowing ponding	Rooting depth wetness
1152B:							
Sugarbush	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Fast intake slope droughty	Too sandy soil blowing	Rooting depth droughty
1152C:							
Sugarbush	Severe: seepage slope	Severe: seepage	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Rooting depth slope droughty
1152E:							
Sugarbush	Severe: seepage slope	Severe: seepage	Severe: no water	Deep to water	Fast intake slope droughty	Slope too sandy soil blowing	Rooting depth slope droughty
1233D:							
Esmond	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope	Slope	Rooting depth slope
Heimdal	Severe: slope	Severe: piping	Severe: no water	Deep to water	Rooting depth slope	Slope	Rooting depth slope

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1264:							
Ulen	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Cutbanks cave	Wetness droughty	Too sandy wetness soil blowing	Droughty
1278:							
Rosewood	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Cutbanks cave	Wetness droughty	Too sandy wetness soil blowing	Wetness droughty
Venlo	Severe: seepage	Severe: seepage piping ponding	Severe: cutbanks cave	Ponding cutbanks cave	Ponding droughty	Too sandy soil blowing ponding	Wetness droughty
1279:							
Vallers	Slight	Severe: piping wetness	Severe: slow refill	Frost action	Wetness	Erodes easily wetness	Erodes easily wetness
Hamerly	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Frost action	Wetness	Erodes easily wetness	Erodes easily
1280:							
Gunclub	Slight	Severe: wetness	Severe: slow refill	Frost action	Percs slowly wetness	Wetness	Favorable
1283:							
Reis	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
Clearwater	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness
1297:							
Augsburg	Severe: seepage	Severe: hard to pack wetness	Severe: slow refill cutbanks cave	Frost action percs slowly	Percs slowly wetness soil blowing	Percs slowly wetness soil blowing	Percs slowly wetness
1299:							
Borup	Severe: seepage	Severe: piping wetness	Severe: cutbanks cave	Frost action cutbanks cave	Wetness soil blowing	Wetness soil blowing	Wetness

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1304A:							
Glyndon	Severe: seepage	Severe: piping	Severe: cutbanks cave	Frost action cutbanks cave	Wetness soil blowing	Erodes easily wetness soil blowing	Erodes easily
1304B:							
Glyndon	Severe: seepage	Severe: piping	Severe: cutbanks cave	Frost action slope cutbanks cave	Slope wetness soil blowing	Erodes easily wetness soil blowing	Erodes easily
1315A:							
Wheatville	Severe: seepage	Severe: hard to pack	Severe: slow refill cutbanks cave	Frost action percs slowly	Wetness soil blowing	Percs slowly wetness soil blowing	Percs slowly
1323B:							
LaDelle	Moderate: seepage	Severe: hard to pack	Severe: slow refill	Deep to water	Flooding	Favorable	Favorable
1325:							
Bowstring	Severe: seepage	Severe: excess humus ponding	Severe: slow refill cutbanks cave	Flooding subsides ponding	Flooding ponding	Ponding	Wetness
Fluvaquents	Severe: seepage	Severe: seepage piping ponding	Severe: cutbanks cave	Flooding frost action ponding	Rooting depth ponding droughty	Too sandy ponding	Rooting depth wetness droughty
1356:							
Water, miscellaneous.							
1422:							
Northwood	Severe: seepage	Severe: piping ponding	Severe: slow refill cutbanks cave	Percs slowly subsides ponding	Percs slowly soil blowing ponding	Erodes easily soil blowing ponding	Erodes easily rooting depth wetness
1866:							
Colvin	Moderate: seepage	Severe: wetness	Severe: slow refill	Frost action	Wetness	Wetness	Wetness
Perella	Moderate: seepage	Severe: piping	Severe: slow refill	Frost action percs slowly	Percs slowly wetness	Wetness	Percs slowly

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1871:							
Fargo	Slight	Severe: hard to pack ponding	Severe: slow refill	Frost action percs slowly ponding	Percs slowly slow intake ponding	Percs slowly ponding	Percs slowly wetness
1874:							
Radium	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Cutbanks cave	Fast intake wetness droughty	Too sandy wetness soil blowing	Rooting depth droughty
1878:							
Hamre	Moderate: seepage	Severe: piping ponding	Severe: slow refill	Frost action ponding	Soil blowing ponding	Soil blowing ponding	Wetness
1879:							
Seelyeville	Severe: seepage	Severe: excess humus ponding	Severe: slow refill	Frost action subsides ponding	Soil blowing ponding	Soil blowing ponding	Wetness
1882:							
Rosewood	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Frost action cutbanks cave	Wetness droughty	Too sandy wetness soil blowing	Wetness droughty
Strathcona	Severe: seepage	Severe: piping wetness	Severe: slow refill cutbanks cave	Frost action	Wetness soil blowing droughty	Wetness soil blowing	Wetness droughty
Berner	Severe: seepage	Severe: wetness	Severe: slow refill cutbanks cave	Frost action subsides	Rooting depth wetness soil blowing	Wetness soil blowing	Rooting depth wetness
1916:							
Lindaas	Moderate: seepage	Severe: piping ponding	Severe: no water	Frost action percs slowly ponding	Percs slowly ponding	Erodes easily ponding	Erodes easily percs slowly wetness
1963:							
Bearden	Slight	Severe: wetness	Severe: slow refill	Frost action	Wetness	Erodes easily percs slowly wetness	Erodes easily rooting depth
Colvin	Moderate: seepage	Severe: wetness	Severe: slow refill	Frost action	Wetness	Wetness	Wetness

Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1964:							
Colvin	Moderate: seepage	Severe: wetness	Severe: slow refill	Frost action	Wetness	Wetness	Wetness
Fargo	Slight	Severe: hard to pack wetness	Severe: slow refill	Frost action percs slowly	Percs slowly slow intake wetness	Percs slowly wetness	Percs slowly wetness

Soil Properties

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

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

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

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

Engineering Index Properties

The table “Engineering Index Properties” gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, “gravelly.” Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1998) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1998).

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

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

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

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

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

Physical Properties

The table “Physical Properties of the Soils” shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$- or $^1/_{10}$-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability (K_{sat}) refers to the ability of a soil to transmit water or air. The term “permeability,” as used in soil surveys, indicates saturated hydraulic conductivity (K_{sat}). The estimates in the table indicate the rate of water movement, in inches per hour, when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

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

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. Volume change is influenced by the amount and type of clay minerals in the soil.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in

the soil at various stages of decomposition. In the table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained by returning crop residue to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of several factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

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

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Chemical Properties

The table “Chemical Properties of the Soils” shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Cation-exchange capacity is the total amount of extractable bases 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. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

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

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less

than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

Gypsum is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Water Features

The table “Water Features” gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Hydrologic soil groups are groups of soils that, when saturated, have the same runoff potential under similar storm and ground cover conditions. The soil properties that affect the runoff potential are those that influence the minimum rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the intake rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes (fig. 25). Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

The table gives the frequency and duration of flooding and the time of year when flooding is most likely to occur. Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as none, rare, occasional, or frequent. *None* means flooding is not probable; *rare* that it is unlikely but is possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather

Figure 25.—Flooding along the Red River during spring snowmelt in an area of Fluvaquents-Haploborolls complex, 0 to 30 percent slopes.

conditions (the chance of flooding is more than 50 percent in any year).

Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 to 30 days), and *very long* (more than 30 days). The time of year that flooding is most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is a zone of saturation at the highest average depth during the wettest season. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. Indicated in the table are the depth to the seasonal high water table, the kind of water table, and the months of the year when the water table usually is highest.

An *apparent* water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time for adjustments in the surrounding soil.

A *perched* water table is one that is above an unsaturated zone in the soil. The basis for determining

that a water table is perched may be general knowledge of the area. The water table is proven to be perched if the water level in a borehole is observed to fall when the borehole is extended.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. “More than 6.0” indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. *Ponding duration* is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 to 30 days), and *very long* (more than 30 days). *Maximum ponding depth* refers to the depth of the water above the surface of the soil.

Soil Features

The table “Soil Features” gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

A *low* potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a *moderate* potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a *high* potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate content, texture, moisture content, and acidity of the soil.

Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Properties

(Absence of an entry indicates that the data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
20B:												
Chapett---------	0-8	Fine sandy loam	SC, SM	A-2-4, A-4	0-1	0-5	95-100	85-95	50-80	30-50	15-25	2-10
	8-19	Sandy clay loam, sandy loam, loam	CL, SC, ML	A-4, A-6	0-1	0-5	95-100	85-95	55-85	55-70	20-40	8-20
	19-30	Fine sandy loam, loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
	30-80	Fine sandy loam, loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
20C2:												
Chapett---------	0-9	Fine sandy loam	SC, SM	A-2-4, A-4	0-1	0-5	95-100	85-95	50-80	30-50	15-25	2-10
	9-21	Sandy clay loam, sandy loam, loam	CL, SC, ML	A-4, A-6	0-1	0-5	95-100	85-95	55-85	55-70	20-40	8-20
	21-33	Fine sandy loam, loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
	33-80	Fine sandy loam, loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
20D2:												
Chapett---------	0-12	Fine sandy loam	SC, SM	A-2-4, A-4	0-1	0-5	95-100	85-95	50-80	30-50	15-25	2-10
	12-21	Sandy clay loam, sandy loam, loam	CL, SC, ML	A-4, A-6	0-1	0-5	95-100	85-95	55-85	55-70	20-40	8-20
	21-31	Fine sandy loam, loam, sandy loam	CL, SM, ML, SC	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
	31-80	Fine sandy loam, loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct	Pct					Pct	
20E:												
Chapett---------	0-4	Fine sandy loam	SC, SM	A-2-4, A-4	0-1	0-5	95-100	85-95	50-80	30-50	15-25	2-10
	4-15	Sandy clay loam, sandy loam, loam	CL, SC, ML	A-4, A-6	0-1	0-5	95-100	85-95	55-85	55-70	20-40	8-20
	15-50	Fine sandy loam, loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
	50-80	Fine sandy loam, loam, sandy loam	CL, SM, ML, SC	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
38B:												
Waukon----------	0-6	Loam----------	CL-ML, CL, ML	A-4, A-6	0-1	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-29	Clay loam, loam	CL, ML	A-6, A-7	0-1	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	29-80	Loam, clay loam	CL, ML	A-6	0-1	0-3	95-100	90-100	70-95	50-80	30-40	10-20
38C2:												
Waukon----------	0-7	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	7-18	Clay loam, loam	CL, ML	A-6, A-7	0-1	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	18-80	Loam, clay loam	CL, ML	A-6	0-1	0-3	95-100	90-100	70-95	50-80	30-40	10-20
38D2:												
Waukon----------	0-6	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-18	Clay loam, loam	CL, ML	A-6, A-7	0-1	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	18-80	Loam, clay loam	CL, ML	A-6	0-1	0-3	95-100	90-100	70-95	50-80	30-40	10-20
45B:												
Maddock---------	0-10	Loamy fine sand	SC-SM, SM	A-2	0	0	100	95-100	50-80	15-35	15-20	NP-5
	10-80	Loamy sand, loamy fine sand, fine sand	SM, SP-SM	A-2, A-3	0	0	100	95-100	60-100	5-35	15-20	NP-3
45C:												
Maddock---------	0-10	Loamy fine sand	SC-SM, SM	A-2	0	0	100	95-100	50-80	15-35	15-20	NP-5
	10-80	Loamy sand, loamy fine sand, fine sand	SM, SP-SM	A-2, A-3	0	0	100	95-100	60-100	5-35	15-20	NP-3
45E:												
Maddock---------	0-10	Loamy fine sand	SC-SM, SM	A-2	0	0	100	95-100	50-80	15-35	15-20	NP-5
	10-80	Loamy sand, loamy fine sand, fine sand	SM, SP-SM	A-2, A-3	0	0	100	95-100	60-100	5-35	15-20	NP-3

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
47:												
Colvin----------	0-9	Silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	35-50	15-30
	9-24	Silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	24-80	Loam, silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
57A:												
Fargo----------	0-10	Silty clay-----	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	10-19	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	19-80	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
59:												
Grimstad--------	0-16	Fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	100	80-100	15-50	15-30	NP-7
	16-31	Loamy sand, loamy fine sand, fine sand	SM, SP-SM	A-2, A-3	0	0	100	95-100	80-90	5-35	15-25	NP-10
	31-80	Sandy loam, fine sandy loam, loam	CL, SC-SM, CL-ML, SC	A-4, A-6	0	0-3	95-100	85-100	70-90	40-85	15-40	5-20
65:												
Foxhome---------	0-10	Sandy loam-----	SM	A-4	0	0-2	95-100	90-100	75-90	35-50	15-30	NP-5
	10-15	Loamy sand, sandy loam, gravelly loam	SM, SP-SM	A-2, A-4	0	0-2	95-100	70-100	45-80	10-50	20-30	NP-5
	15-23	Very gravelly sand, very gravelly coarse sand, very gravelly loamy sand	GP, SP-SM, GP-GM, SP	A-1	0	2-5	50-75	40-60	20-50	0-10	---	NP
	23-80	Loam, clay loam, silt loam	CL, ML, CL-ML	A-4, A-6	0	1-5	90-100	85-100	75-90	50-80	20-40	1-15
66:												
Flaming---------	0-12	Loamy fine sand	SM, SP-SM	A-2, A-3	0	0	100	100	75-90	5-30	---	NP
	12-80	Fine sand, loamy sand, sand	SM, SP-SM	A-2, A-3	0	0	100	100	75-90	5-30	---	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
67A:												
Bearden---------	0-8	Silt loam------	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	20-40	5-20
	8-28	Silt loam, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	28-42	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	42-80	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
67B:												
Bearden---------	0-7	Silt loam------	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	20-40	5-20
	7-17	Silt loam, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	17-30	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	30-80	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
93A:												
Bearden---------	0-10	Silty clay loam	CH, CL	A-6, A-7	0	0	100	100	95-100	80-95	25-55	10-30
	10-18	Silt loam, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	18-26	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	26-80	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
111:												
Hangaard--------	0-10	Sandy loam-----	SM	A-2, A-4	0	0-3	95-100	80-100	50-75	20-45	---	NP
	10-15	Loamy sand, coarse sandy loam, loamy coarse sand	SM, SP-SM	A-1, A-3, A-2	0	0-3	80-100	60-95	35-70	5-25	---	NP
	15-80	Gravelly coarse sand, gravelly sand, coarse sand	SP, SP-SM	A-1, A-2, A-3	0	0-3	70-95	55-90	30-60	0-10	---	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
184A:												
Hamerly---------	0-9	Loam----------	CL, CL-ML	A-4, A-6	---	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-20	Loam, clay loam	CL, CL-ML	A-4, A-6	---	0-5	95-100	85-95	80-95	60-75	20-40	5-20
	20-80	Loam, clay loam	CL, CL-ML	A-4, A-6	---	0-5	95-100	85-95	80-95	60-75	20-40	5-20
185D2:												
Hattie----------	0-8	Clay----------	CH	A-7	0	0	95-100	90-100	75-100	70-95	50-70	23-43
	8-80	Clay, silty clay	CH	A-7	0	0	95-100	90-100	75-100	70-95	50-75	23-45
236:												
Vallers---------	0-14	Loam----------	ML, OL	A-4	0	0	95-100	90-100	80-90	50-80	30-40	4-10
	14-35	Clay loam, silty clay loam, loam	CL	A-6	0	0	95-100	90-100	80-95	50-80	30-40	11-20
	35-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-95	60-85	20-40	5-20
242B:												
Marquette-------	0-8	Loamy sand-----	SC-SM, SP-SM, SM	A-2	0	0-5	90-100	85-100	50-75	10-35	0-20	NP-5
	8-18	Very gravelly fine sandy loam, very gravelly loam, very gravelly sandy loam	GM, GC, SC, SM	A-1, A-2	0	0-15	45-85	20-55	10-45	5-35	0-30	NP-10
	18-80	Stratified fine sand to extremely gravelly coarse sand	GP, GP-GM, SP	A-1, A-3, A-2	0	0-10	40-90	15-90	0-65	0-30	0-14	NP
242D:												
Marquette-------	0-7	Loamy sand-----	SC-SM, SP-SM, SM	A-2	0	0-5	90-100	85-100	50-75	10-35	0-20	NP-5
	7-16	Very gravelly fine sandy loam, very gravelly loam, very gravelly sandy loam	GC, SM, GM, SC	A-1, A-2	0	0-15	45-85	20-55	10-45	5-35	0-30	NP-10
	16-80	Stratified fine sand to extremely gravelly coarse sand	GP-GM, GP, SP	A-1, A-3, A-2	0	0-10	40-90	15-90	0-65	0-30	0-14	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct	Pct					Pct	
258B:												
Sandberg--------	0-19	Loamy sand-----	SM, SP-SM	A-1, A-2	0-3	0-5	85-100	50-95	40-75	10-25	---	NP-5
	19-25	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand	SM, SP-SM	A-1, A-2, A-3	0-3	0-5	75-95	50-95	35-70	5-25	---	NP-5
	25-38	Gravelly coarse sand, coarse sand, sand	SP, SP-SM	A-2, A-1, A-3	0-3	0-5	60-95	50-95	30-65	2-10	---	NP
	38-80	Gravelly coarse sand, coarse sand, sand	SP, SP-SM	A-2, A-1, A-3	0-3	0-5	60-95	50-95	30-65	2-10	---	NP
258C:												
Sandberg--------	0-10	Loamy sand-----	SM, SP-SM	A-1, A-2	0-3	0-5	85-100	50-95	40-75	10-25	---	NP-5
	10-38	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand	SM, SP-SM	A-1, A-2, A-3	0-3	0-5	75-95	50-95	35-70	5-25	---	NP-5
	38-59	Gravelly coarse sand, coarse sand, sand	SP, SP-SM	A-1, A-2, A-3	0-3	0-5	60-95	50-95	30-65	2-10	---	NP
	59-80	Gravelly coarse sand, coarse sand, sand	SP, SP-SM	A-2, A-1, A-3	0-3	0-5	60-95	50-95	30-65	2-10	---	NP
258E:												
Sandberg--------	0-9	Loamy sand-----	SM, SP-SM	A-1, A-2	0-3	0-5	85-100	50-95	40-75	10-25	---	NP-5
	9-16	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand	SM, SP-SM	A-1, A-3, A-2	0-3	0-5	75-95	50-95	35-70	5-25	---	NP-5
	16-41	Gravelly coarse sand, coarse sand, sand	SP, SP-SM	A-1, A-2, A-3	0-3	0-5	60-95	50-95	30-65	2-10	---	NP
	41-80	Gravelly coarse sand, coarse sand, sand	SP, SP-SM	A-2, A-1, A-3	0-3	0-5	60-95	50-95	30-65	2-10	---	NP
296:												
Fram----------	0-22	Loam----------	ML	A-4	0	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	22-80	Sandy loam, fine sandy loam, loam	ML, SM	A-4	0	0-1	95-100	90-100	60-100	35-90	20-40	NP-10

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
341B:												
Arvilla---------	0-8	Sandy loam-----	SC, SC-SM, SM	A-2, A-6, A-4	0	0	95-100	90-100	50-80	20-45	15-30	NP-15
	8-16	Sandy loam, loam, coarse sandy loam	SC, SM, SC-SM	A-2, A-4, A-6	0	0	90-100	85-100	50-80	20-45	15-40	NP-15
	16-80	Gravelly coarse sand, coarse sand, very gravelly coarse sand	GM, SP-SM, GP-GM, SP	A-1, A-2, A-3	0	0	35-100	25-100	10-60	0-15	---	NP
348:												
Borup----------	0-15	Loam----------	ML	A-4	0	0	100	100	95-100	70-95	20-34	NP-7
	15-24	Very fine sandy loam, loamy very fine sand, silt loam	ML	A-4	0	0	100	100	95-100	60-95	0-30	NP-5
	24-80	Loamy very fine sand, very fine sand, very fine sandy loam	ML	A-4	0	0	100	100	85-100	50-90	0-30	NP-5
372:												
Hamar----------	0-8	Loamy fine sand	SC-SM, SM	A-2, A-4	0	0	100	100	85-100	15-40	0-25	NP-5
	8-13	Loamy fine sand, loamy sand, fine sand	SC-SM, SM, SP-SM	A-2, A-4	0	0	100	100	70-100	10-40	0-25	NP-5
	13-80	Fine sand, loamy sand, loamy fine sand	SC-SM, SP-SM, SM	A-2	0	0	100	100	70-100	10-35	0-25	NP-5
387:												
Roliss----------	0-15	Loam----------	CL, CL-ML	A-4, A-6	0	0	95-100	80-100	80-100	60-90	20-40	5-20
	15-20	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	95-100	80-100	80-90	60-80	20-50	10-30
	20-47	Loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0	95-100	80-98	80-95	60-80	20-50	5-30
	47-80	Loam, clay loam, silty clay loam	CL, CL-ML	A-6, A-4, A-7	0	0	95-100	80-100	80-95	60-80	20-50	5-30

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
412:												
Mavie----------	0-8	Fine sandy loam	SM	A-2, A-4	---	0-3	95-100	85-100	55-85	30-50	15-30	NP-7
	8-16	Loam, fine sandy loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	---	2-5	95-100	85-100	70-95	40-75	20-35	5-15
	16-30	Very gravelly coarse sand, very gravelly sand, very gravelly loamy sand	GP-GM, SP, GP, SP-SM	A-1	---	2-5	30-65	15-55	10-30	1-10	---	NP
	30-80	Loam, silt loam, clay loam	CL, CL-ML, ML	A-4, A-6	---	1-5	95-100	75-90	70-85	50-75	20-40	2-15
422A:												
Bygland---------	0-7	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	95-100	35-50	15-25
	7-29	Silty clay, clay, silty clay loam	CL, CH, MH	A-7	0	0	100	100	95-100	85-100	45-70	20-45
	29-37	Silty clay loam, silt loam, silty clay	CH, CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	37-80	Stratified silty clay loam to silt loam	CH, CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
422B:												
Bygland---------	0-9	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	95-100	35-50	15-25
	9-22	Silty clay, clay, silty clay loam	CH, CL, MH	A-7	0	0	100	100	95-100	85-100	45-70	20-45
	22-32	Silty clay loam, silt loam, silty clay	CH, CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	32-80	Stratified silty clay loam to silt loam	CH, CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
422C2:												
Bygland---------	0-9	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	95-100	35-50	15-25
	9-20	Silty clay, clay, silty clay loam	CH, MH, CL	A-7	0	0	100	100	95-100	85-100	45-70	20-45
	20-31	Silty clay loam, silt loam, silty clay	CH, CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	31-80	Stratified silty clay loam to silt loam	CH, CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
426:												
Foldahl---------	0-12	Loamy fine sand	SM, SP-SM	A-2	0	0	100	95-100	70-85	12-35	---	NP
	12-30	Fine sand, loamy fine sand, sand	SM, SP-SM	A-2, A-3	0-1	0-3	95-100	90-100	70-85	5-35	---	NP
	30-44	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	1-5	95-100	75-95	70-90	50-85	15-40	5-20
	44-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	1-5	95-100	75-95	70-90	50-85	15-40	5-20
435:												
Syrene----------	0-11	Sandy loam-----	SC, SM, SC-SM	A-4	0-1	0-3	95-100	85-100	55-70	35-50	15-35	NP-10
	11-18	Loam, sandy loam, sandy clay loam	ML, SM	A-4	0-1	0-3	95-100	85-100	55-75	35-65	20-40	1-10
	18-80	Stratified loamy fine sand to gravelly coarse sand	SP, SP-SM	A-2, A-1, A-3	0-3	2-5	75-95	55-80	30-60	0-10	5-20	NP-5
439:												
Strathcona------	0-10	Fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	65-85	30-50	20-30	5-10
	10-17	Fine sandy loam, sandy loam, loamy fine sand	SC-SM, SM	A-2, A-4	0	0	100	95-100	65-85	30-50	20-30	5-10
	17-30	Sand, fine sand, loamy fine sand	SM, SP-SM	A-1, A-2	0	0-1	95-100	85-100	60-80	10-30	0-14	NP
	30-80	Fine sandy loam, loam, clay loam	CL, CL-ML	A-4, A-6	0	0-1	95-100	85-98	70-90	50-70	25-40	5-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct	Pct					Pct	
450:												
Rauville--------	0-36	Silty clay loam	CH, CL, ML, MH	A-6, A-7	0	0	100	100	90-100	85-100	35-60	15-28
	36-80	Silty clay loam, silt loam, silty clay	CL, CH, MH, ML	A-6, A-7	0	0	100	100	90-100	85-100	35-60	15-28
481:												
Kratka----------	0-10	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	10-25	Loamy sand, sand, loamy fine sand	SP-SM	A-2, A-3	0	0	95-100	90-100	50-80	5-10	---	NP
	25-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	75-100	55-80	21-43	5-21
494B:												
Darnen----------	0-28	Loam----------	CL-ML, CL, ML	A-4	0	0	100	100	85-100	60-90	20-35	2-10
	28-38	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	100	100	85-100	60-90	20-45	5-25
	38-60	Loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0	90-100	90-100	80-95	60-85	20-45	5-25
506:												
Overly----------	0-18	Silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-100	30-45	10-25
	18-46	Silty clay loam, silt loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0	100	100	90-100	80-100	25-50	5-30
	46-80	Stratified silt loam to silty clay	CL, CL-ML	A-4, A-7, A-6	0	0	100	100	90-100	80-100	25-50	5-30
540:												
Seelyeville-----	0-20	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	20-80	Muck, mucky peat	PT	A-8	0	0	---	---	---	---	---	---
543:												
Markey----------	0-32	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	32-80	Fine sand, loamy sand, coarse sand	SM, SP-SM, SP	A-2, A-3	0	0	100	75-100	60-75	0-20	---	NP
544:												
Cathro----------	0-24	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	24-42	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	42-80	Sandy loam, loam, clay loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0-5	85-100	75-100	60-100	35-90	20-40	5-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
547:												
Deerwood--------	0-14	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	14-35	Fine sand, loamy sand, fine sandy loam	SM, SP-SM	A-2, A-4	---	0-5	95-100	90-100	50-75	12-50	0-20	NP-4
	35-80	Fine sand, sand, gravelly sand	SM, SP, SP-SM	A-2, A-1, A-3	---	0-5	75-100	55-100	35-70	1-25	0-14	NP
563:												
Northwood-------	0-9	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	9-16	Fine sandy loam, loamy fine sand, loamy sand	SC-SM, SM	A-2, A-4	---	0-3	95-100	90-100	51-85	15-50	0-35	NP-10
	16-31	Coarse sand, fine sand, loamy fine sand	SM, SP-SM	A-2, A-3	---	0-3	95-100	80-100	70-95	5-35	0-14	NP
	31-80	Loam, clay loam, fine sandy loam	CL, CL-ML, ML	A-4, A-6	---	0-3	95-100	90-100	75-100	50-80	20-40	3-20
565:												
Eckvoll---------	0-7	Loamy fine sand	SC-SM, SM	A-2, A-4	0	0-2	90-100	85-100	45-80	25-40	15-20	NP-7
	7-26	Fine sand, sand, loamy fine sand	SM, SP-SM	A-1, A-3, A-2	0	0-2	90-100	85-100	45-75	5-30	15-20	NP-4
	26-35	Clay loam, sandy clay loam, loam	CL, SC	A-4, A-6, A-7	0	0-5	90-100	85-98	65-95	45-75	25-50	7-25
	35-80	Loam, clay loam, fine sandy loam	CL	A-4, A-7, A-6	0	0-5	90-100	85-98	70-95	50-80	25-45	7-20
573D:												
Serden----------	0-3	Fine sand------	SM	A-2	0	0	100	100	65-85	15-25	---	NP
	3-80	Fine sand, sand	SM, SP-SM	A-2, A-3	0	0	100	100	65-85	5-25	---	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
582:												
Roliss----------	0-9	Loam----------	CL, CL-ML	A-4, A-6	0	0	95-100	80-100	80-100	60-90	20-40	5-20
	9-14	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	95-100	80-100	80-90	60-80	20-50	10-30
	14-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	95-100	80-100	80-95	60-80	20-50	5-30
	20-80	Loam, clay loam, silty clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	95-100	80-100	80-95	60-80	20-50	5-30
641:												
Clearwater------	0-12	Clay----------	CH, CL	A-7	0	0-1	95-100	90-97	80-95	70-95	45-80	20-50
	12-26	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-1	95-100	90-97	80-95	70-95	40-80	20-50
	26-80	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-1	95-100	90-100	80-97	75-95	40-80	20-50
642:												
Clearwater------	0-10	Loam----------	CL-ML, ML, SM, SC-SM	A-4, A-6	0	0-1	95-100	90-97	65-85	45-65	20-35	NP-11
	10-20	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-1	95-100	90-97	80-95	70-95	40-80	20-50
	20-80	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-1	95-100	90-100	80-97	75-95	40-80	20-50
643:												
Huot----------	0-14	Fine sandy loam	SC-SM, SM	A-4	0	0	90-100	75-100	50-85	25-55	15-30	NP-8
	14-26	Loamy fine sand, fine sandy loam	SC-SM, SM	A-2, A-4	0	0	90-100	75-100	60-85	25-55	15-30	NP-8
	26-34	Loamy fine sand, fine sand	SM, SP-SM	A-2, A-3	0	0	90-100	75-100	50-80	15-35	0-20	NP
	34-80	Clay, silty clay, silty clay loam	CH	A-7	0	0-1	95-100	85-100	85-100	70-95	60-80	35-50

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
645:												
Espelie---------	0-9	Fine sandy loam	ML, CL, SC, SM	A-2, A-4	0	0	95-100	85-100	60-85	30-65	15-25	NP-8
	9-22	Loamy sand, loamy fine sand, fine sand	SM, SP-SM	A-1, A-4, A-2	---	0-5	85-100	60-100	30-80	10-40	10-20	NP-4
	22-80	Clay, silty clay, clay loam	CH, CL	A-7	---	1-3	90-100	85-100	80-100	70-100	40-65	20-40
647:												
Hilaire---------	0-10	Loamy fine sand	ML, SC-SM, CL-ML, SM	A-2, A-4	0	0	90-100	75-100	50-85	20-55	15-25	NP-7
	10-16	Loamy sand, loamy fine sand, sand	SM, SP-SM	A-1, A-4, A-2	0	0-2	85-100	75-100	45-85	10-40	15-20	NP-4
	16-25	Gravelly loamy sand, loamy sand, sand	SM, SP-SM	A-1, A-2	0	0-5	85-100	65-100	30-70	10-30	15-20	NP-4
	25-80	Clay, silty clay, silty clay loam	CH, CL	A-7	0	1-3	95-100	85-100	75-95	65-90	40-70	20-45
650:												
Reiner----------	0-9	Fine sandy loam	ML, SM	A-4	0	0-5	85-100	75-100	55-85	35-55	15-35	NP-10
	9-20	Clay loam, loam, sandy clay loam	CL	A-4, A-7, A-6	0	0-3	85-100	75-100	60-95	55-80	25-50	7-25
	20-80	Loam, clay loam, fine sandy loam	CL, CL-ML, ML	A-4, A-6	0	0-3	85-100	75-100	55-100	50-80	25-45	3-20
651:												
Thiefriver------	0-12	Fine sandy loam	ML, CL-ML, SC-SM, SM	A-4	0	0	95-100	80-100	70-90	35-55	15-30	NP-10
	12-23	Loamy fine sand, fine sandy loam, loamy sand	ML, CL-ML, SC-SM, SM	A-2, A-4	0	0	95-100	80-100	60-90	10-55	15-30	NP-10
	23-32	Fine sand, loamy fine sand, loamy sand	SM, SP-SM	A-2, A-3	0	0-3	90-100	80-100	50-80	5-35	---	NP
	32-80	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-3	100	95-100	95-100	90-100	40-70	20-40

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
667B:												
Fairdale--------	0-9	Silt loam------	CL-ML, CL, ML	A-4, A-6	0	0	100	100	85-100	60-90	20-40	3-15
	9-80	Stratified very fine sandy loam to silty clay loam	CL, CL-ML, ML	A-4, A-6	0	0	100	100	85-100	55-90	20-40	NP-20
667C2:												
Fairdale--------	0-8	Silt loam------	CL, ML, CL-ML	A-4, A-6	0	0	100	100	85-100	60-90	20-40	3-15
	8-80	Stratified very fine sandy loam to silty clay loam	CL-ML, CL, ML	A-4, A-6	0	0	100	100	85-100	55-90	20-40	NP-20
670:												
Knute----------	0-7	Fine sandy loam	SC-SM, SC, SM	A-2-4, A-4	0	0-5	95-100	85-95	50-80	30-50	20-30	2-10
	7-18	Sandy clay loam, loam, fine sandy loam	CL	A-4, A-6	0	0-5	95-100	85-95	55-85	55-70	30-40	8-20
	18-36	Fine sandy loam, sandy loam, loam	ML, SC, CL, SM	A-4, A-6	0	0-5	95-100	85-95	50-85	35-65	20-30	3-12
	36-80	Fine sandy loam, sandy loam, loam	ML, SC, CL, SM	A-4, A-6	0	0-5	95-100	85-95	50-85	35-65	15-25	3-12
671:												
Onstad----------	0-10	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-5	95-100	85-95	55-85	50-70	20-35	3-15
	10-17	Fine sandy loam, sandy loam, loam	CL, SM, ML, SC	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-15
	17-47	Fine sandy loam, sandy loam, loam	ML, CL, SC, SM	A-4, A-6	0-1	0-5	95-100	85-95	50-85	35-65	15-30	3-12
	47-80	Fine sandy loam, sandy loam, loam	ML, SC, SM	A-4, A-6	0-1	0-5	90-100	85-95	50-85	35-65	15-30	3-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
681:												
Brandsvold------	0-10	Loam----------	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	85-95	65-85	50-65	20-30	5-15
	10-19	Sandy clay loam, loam, fine sandy loam	CL, SC	A-4, A-6	0-1	0-5	95-100	80-95	70-85	45-65	30-40	10-20
	19-36	Fine sandy loam, loam, sandy loam	CL-ML, ML, SM, SC-SM	A-4	0-1	0-5	95-100	80-95	65-85	35-60	20-30	5-10
	36-80	Fine sandy loam, loam, sandy loam	ML, SC-SM, CL-ML, SM	A-4	0-1	0-5	95-100	80-95	65-85	35-60	20-30	5-10
694D2:												
Zell----------	0-7	Silt loam------	CL, ML	A-4, A-6	0	0	100	95-100	90-100	80-100	30-40	5-15
	7-14	Silt loam, very fine sandy loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	70-100	25-40	5-15
	14-80	Silt loam, very fine sandy loam, loam	CL-ML, ML	A-4	0	0	100	95-100	85-100	60-100	15-25	NP-7
704:												
Wyrene----------	0-21	Sandy loam-----	ML, SC, SM, SC-SM	A-2, A-4	0	0	95-100	85-100	60-90	30-65	10-30	NP-10
	21-80	Coarse sand, gravelly coarse sand, gravelly sand	SM, SP-SM	A-1, A-3, A-2	---	0-5	60-90	55-80	30-70	5-15	0-20	NP
707A:												
Lizzie----------	0-14	Silt loam------	CL, CL-ML	A-4, A-6	0	0	100	97-100	85-100	60-90	28-32	9-13
	14-24	Silt loam, silty clay loam, loam	CL, ML	A-4, A-6	0	0	100	97-100	80-100	75-95	28-43	9-21
	24-36	Silt loam, loam, fine sandy loam	CL, CL-ML	A-4, A-6	0	0	100	97-100	85-100	60-90	15-30	NP-11
	36-80	Very fine sandy loam, silt loam, loamy very fine sand	CL-ML, SC-SM, SM	A-2-4, A-4	0	0	100	97-100	65-95	15-90	15-26	NP-8

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
712:												
Rosewood--------	0-10	Fine sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	100	97-100	65-90	30-50	15-30	NP-10
	10-17	Fine sandy loam, loamy fine sand, sandy loam	SC, SM, SC-SM	A-2, A-4	0	0	100	95-100	60-85	25-45	15-30	NP-10
	17-30	Fine sand, sand	SM, SP-SM	A-2, A-1, A-3	0	0	85-100	75-95	45-75	5-25	5-15	NP
	30-80	Fine sand, sand, coarse sand	SP, SM, SP-SM	A-2, A-1, A-3	0	0	85-100	75-95	40-80	5-35	5-15	NP
713:												
Linveldt--------	0-9	Fine sandy loam	SC-SM, SM	A-2, A-4	0	0-5	95-100	80-100	55-90	20-50	15-25	2-7
	9-16	Sandy clay loam, loam, sandy loam	CL, CL-ML, SC-SM, SC	A-2, A-6, A-4	0-1	0-5	95-100	80-100	50-90	25-75	25-40	6-15
	16-29	Loamy sand, sand, coarse sand	SC-SM, SM, SP-SM	A-1, A-2, A-3	0-1	0-5	65-100	55-100	30-80	5-30	15-20	NP-5
	29-80	Loam, clay loam, fine sandy loam	CL-ML, SC, CL, SC-SM	A-4, A-6	0-1	0-3	90-100	80-100	60-90	40-70	25-40	6-20
718B:												
Naytahwaush-----	0-7	Loam----------	CL, ML	A-6	0	0-5	95-100	90-100	75-90	60-90	30-40	10-15
	7-31	Clay, silty clay, clay loam	CH, CL	A-7	0	0-5	95-100	90-100	75-95	70-90	45-65	25-40
	31-80	Clay loam, silty clay loam, loam	CL	A-6, A-7	0	0-5	95-100	90-100	75-95	60-90	35-50	15-25
718C:												
Naytahwaush-----	0-4	Loam----------	CL, ML	A-6	0	0-5	95-100	90-100	75-90	60-90	30-40	10-15
	4-8	Loam, silt loam, fine sandy loam	CL, ML	A-4, A-6	0	0-5	95-100	90-100	65-90	50-80	25-40	5-20
	8-18	Clay, silty clay, clay loam	CH, CL	A-7	0	0-5	95-100	90-100	75-95	70-90	45-65	25-40
	18-80	Clay loam, silty clay loam, loam	CL	A-6, A-7	0	0-5	95-100	90-100	75-95	60-90	35-50	15-25

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
718E:												
Naytahwaush-----	0-3	Loam----------	CL, ML	A-6	0	0-5	95-100	90-100	75-90	60-90	30-40	10-15
	3-7	Loam, silt loam, fine sandy loam	CL, ML	A-4, A-6	0	0-5	95-100	90-100	65-90	50-80	25-40	5-20
	7-14	Clay, silty clay, clay loam	CH, CL	A-7	0	0-5	95-100	90-100	75-95	70-90	45-65	25-40
	14-80	Clay loam, silty clay loam, loam	CL	A-6, A-7	0	0-5	95-100	90-100	75-95	60-90	35-50	15-25
733:												
Berner----------	0-32	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	32-36	Sandy loam, fine sandy loam, gravelly sandy loam	SC-SM, SC, SM	A-2, A-4	0	0	90-100	70-100	50-85	10-50	15-25	NP-10
	36-45	Sand, loamy sand, gravelly sand	SM, SP, SP-SM	A-1, A-2, A-3	0	0	90-100	70-100	60-80	0-25	---	NP
	45-80	Loam, clay loam, silt loam	CL, ML	A-4, A-6	0	0	95-100	85-100	60-90	50-80	30-40	10-20
735B:												
Halverson-------	0-10	Loamy fine sand	SM	A-2	0	0-1	100	98-100	85-95	20-40	---	NP
	10-23	Loamy fine sand, fine sand, loamy sand	SC-SM, SM	A-2	0	0-1	100	95-100	80-95	15-40	0-15	NP-5
	23-35	Fine sandy loam, loam, very fine sandy loam	CL	A-4, A-6	0	0-5	95-100	80-95	70-85	50-65	30-40	10-20
	35-55	Fine sandy loam, loam, sandy loam	CL, CL-ML, SC-SM, SC	A-4, A-6	0	0-5	95-100	80-95	65-85	35-60	20-30	5-15
	55-80	Fine sandy loam, loam, sandy loam	CL-ML, ML, SM, SC-SM	A-4, A-6	0	0-5	95-100	80-95	65-85	35-60	20-30	5-10

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
735C:												
Halverson-------	0-10	Loamy fine sand	SM	A-2	0	0-1	100	98-100	85-95	20-40	---	NP
	10-21	Loamy fine sand, fine sand, loamy sand	SC-SM, SM	A-2	0	0-1	100	95-100	80-95	15-40	0-15	NP-5
	21-29	Fine sandy loam, loam, very fine sandy loam	CL	A-4, A-6	0	0-5	95-100	80-95	70-85	50-65	30-40	10-20
	29-80	Fine sandy loam, loam, sandy loam	ML, CL-ML, SC-SM, SM	A-4, A-6	0	0-5	95-100	80-95	65-85	35-60	20-30	5-10
737:												
Mahkonce--------	0-4	Loam----------	CL, ML	A-6, A-7	0	0-5	95-100	90-98	75-95	60-90	35-50	15-25
	4-9	Fine sandy loam, loam, silt loam	CL, ML	A-4, A-6	0	0-5	95-100	90-98	65-90	50-80	30-40	10-20
	9-26	Silty clay, clay	CH	A-7	0	0-5	95-100	90-98	75-95	70-90	50-65	25-40
	26-34	Clay loam, silty clay loam, clay	CH, CL	A-6, A-7	0	0-5	95-100	95-98	75-95	60-90	35-50	15-25
	34-60	Loam, clay loam, silty clay loam	CL	A-6, A-7	0-1	0-5	95-100	90-98	75-95	60-90	35-50	15-25
746:												
Haslie----------	0-12	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	12-30	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	30-80	Coprogenous earth, mucky silt loam	OL	A-5	0	0	100	95-100	85-100	75-96	41-50	2-10
749:												
Colvin----------	0-9	Silt loam------	CL	A-6	0	0	100	95-100	90-100	80-95	30-45	10-25
	9-28	Silt loam, silty clay loam	CL	A-6	0	0	100	95-100	90-100	80-95	30-45	10-25
	28-52	Silt loam, silty clay loam	CL	A-6	0	0	100	95-100	90-100	80-95	30-45	10-25
	52-60	Stratified fine sandy loam to silty clay loam	CL, ML	A-4, A-6	0	0	90-100	90-100	80-95	60-90	25-50	8-30

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
765:												
Smiley----------	0-10	Loam----------	CL-ML, CL, ML	A-4, A-6	0-1	0-2	95-100	85-100	75-95	50-80	15-35	2-12
	10-18	Clay loam, loam, silty clay loam	CL, CL-ML	A-6, A-7	0-1	0-2	95-100	85-100	70-95	50-80	25-50	10-25
	18-61	Loam, fine sandy loam, clay loam	CL, CL-ML, SC-SM, SC	A-4, A-6	0-1	0-2	95-100	85-100	70-95	40-80	25-40	6-18
	61-80	Loam, fine sandy loam, clay loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0-1	0-2	95-100	85-100	70-95	40-80	25-40	6-18
767:												
Auganaush-------	0-4	Loam----------	CL-ML, CL, ML	A-4, A-6	0	0-5	95-100	85-95	85-95	60-90	20-40	5-15
	4-9	Loam, fine sandy loam, silt loam	ML, SC-SM, CL-ML, SM	A-4	0	0-5	95-100	85-95	75-90	40-70	15-30	NP-10
	9-25	Clay, clay loam, silty clay loam	CH, CL, MH	A-7	0	0-5	95-100	85-95	85-95	70-90	45-70	25-45
	25-60	Clay loam, silty clay loam, silty clay	CH, ML, CL	A-6, A-7	0	0-5	95-100	85-95	80-95	60-90	35-55	15-30
	60-80	Loam, clay loam, silty clay loam	CL, ML	A-4, A-7	0	0-5	90-100	85-95	60-90	55-85	30-45	10-20
791:												
Winterfield-----	0-5	Loamy fine sand	SC-SM, SM	A-2-4, A-4	0	0	100	95-100	50-90	15-45	0-25	NP-7
	5-80	Sand, gravelly sand, loamy fine sand	SM, SP-SM, SP	A-2-4, A-1-b, A-3	0	0	85-100	70-100	35-80	0-35	0-14	NP
827B:												
Heimdal---------	0-14	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	14-22	Loam, fine sandy loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	22-33	Fine sandy loam, loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	33-80	Fine sandy loam, loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-3	95-100	85-95	50-80	35-65	15-30	2-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
827B:												
Esmond----------	0-8	Loam----------	ML	A-4	---	0-1	95-100	85-100	85-100	60-90	20-35	NP-10
	8-22	Loam, sandy loam, fine sandy loam	CL, ML, SM, SC	A-4, A-6	---	0-3	90-100	85-100	60-95	35-80	15-30	NP-15
	22-80	Fine sandy loam, loam, sandy loam	CL, ML, SM, SC	A-4, A-6	0-1	0-3	90-100	85-100	60-95	35-80	15-30	NP-12
827C2:												
Heimdal---------	0-9	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	9-30	Loam, fine sandy loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	30-80	Fine sandy loam, loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-3	95-100	85-95	50-80	35-65	15-30	2-12
Esmond----------	0-9	Loam----------	ML	A-4	---	0-1	95-100	85-100	85-100	60-90	20-35	NP-10
	9-18	Loam, sandy loam, fine sandy loam	ML, CL, SC, SM	A-4, A-6	---	0-3	90-100	85-100	60-95	35-80	15-30	NP-15
	18-80	Fine sandy loam, loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-3	90-100	85-100	60-95	35-80	15-30	NP-12
908:												
Bearden---------	0-10	Silty clay loam	CH, CL	A-6, A-7	0	0	100	100	95-100	80-95	25-55	10-30
	10-17	Silt loam, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	17-26	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	26-80	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
Fargo----------	0-10	Silty clay-----	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	10-21	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	21-80	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
935:												
Hegne----------	0-9	Silty clay-----	CH	A-7	0	0	100	100	95-100	90-98	50-70	25-40
	9-15	Silty clay, clay	CH	A-7	0	0	100	100	95-100	95-98	50-70	25-40
	15-24	Clay, silty clay	CH	A-7	0	0	100	100	95-100	95-100	50-70	25-45
	24-80	Clay, silty clay	CH	A-7	0	0	100	100	95-100	95-100	50-70	25-45
Fargo----------	0-10	Silty clay-----	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	10-19	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	19-80	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
967B:												
Waukon----------	0-6	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-16	Clay loam, loam	CL, ML	A-6, A-7	0-1	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	16-80	Loam, clay loam	CL, ML	A-6	0-1	0-3	95-100	90-100	70-95	50-80	30-40	10-20
Langhei---------	0-7	Loam----------	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	19-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
967C2:												
Waukon----------	0-6	Loam----------	CL, ML, CL-ML	A-4, A-6	0-1	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-16	Clay loam, loam	CL, ML	A-6, A-7	0-1	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	16-80	Loam, clay loam	CL, ML	A-6	0-1	0-3	95-100	90-100	70-95	50-80	30-40	10-20
Langhei---------	0-7	Loam----------	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	19-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
979D2:												
Langhei---------	0-7	Loam----------	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	55-80	20-40	5-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
	19-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-90	60-80	20-40	5-25
Waukon----------	0-6	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-3	95-100	90-100	80-95	60-90	20-40	5-20
	6-16	Clay loam, loam	CL, ML	A-6, A-7	0-1	0-3	95-100	90-100	75-95	50-85	30-45	10-20
	16-80	Loam, clay loam	CL, ML	A-6	0-1	0-3	95-100	90-100	70-95	50-80	30-40	10-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1006:												
Fluvaquents-----	0-24	Very fine sandy loam	CL, ML, CL-ML	A-4, A-6	0	0	100	90-100	75-100	45-90	15-40	NP-15
	24-80	Stratified loamy sand to silt loam	ML, CL, SM, SP	A-3, A-1, A-4, A-6	0	0	95-100	70-100	35-95	5-80	0-40	NP-15
Haploborolls----	0-19	Clay loam------	CL	A-6, A-4, A-7	0	0	100	100	90-100	75-100	25-50	7-25
	19-80	Clay loam, silt loam, sandy loam	CL, SC-SM, CL-ML, SC	A-4, A-6	0	0	100	100	60-100	36-90	25-40	5-20
1030:												
Pits, gravel.												
Udipsamments----	0-14	Sand----------	SM, SP-SM	A-2	0	0	95-100	85-100	75-90	10-35	---	NP
	14-60	Sand, fine sand	SP, SP-SM	A-2, A-3	0	0	95-100	85-100	50-75	5-25	---	NP
	60-80	Coarse sand, gravelly coarse sand	SP, GP-GM, SP-SM	A-1, A-2	0	0	75-100	65-85	40-65	1-10	---	NP
1113:												
Haslie----------	0-8	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	8-34	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	34-80	Coprogenous earth, mucky silty clay	OL	A-5	0	0	100	95-100	85-100	75-96	41-50	2-10
Seelyeville-----	0-30	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	30-80	Mucky peat, muck	PT	A-8	0	0	---	---	---	---	---	---
Cathro----------	0-34	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	34-80	Sandy loam, silt loam, clay loam	CL, CL-ML, SC-SM, SC	A-4, A-6	0	0-5	80-100	65-100	60-100	35-90	20-40	4-20
1117:												
Hedman----------	0-11	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-4	95-100	85-98	75-90	50-70	20-35	5-15
	11-20	Fine sandy loam, loam, sandy loam	ML, SC-SM, CL-ML, SM	A-2, A-4	0-1	0-4	95-100	85-98	50-85	35-60	15-30	5-15
	20-80	Loam, fine sandy loam, sandy loam	ML, SC-SM, CL-ML, SM	A-2, A-4	0-1	0-4	95-100	85-98	50-85	35-60	15-30	5-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1119:												
Nielsville------	0-9	Silty clay loam	CL	A-6, A-7	0	0	100	100	95-100	85-95	35-50	15-30
	9-28	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	28-45	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
	45-80	Clay, silty clay	CH	A-7	0	0-1	95-100	90-100	80-100	75-95	50-75	25-50
1121:												
Hedman----------	0-9	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-4	95-100	85-98	75-90	50-70	20-35	5-15
	9-15	Fine sandy loam, loam, sandy loam	CL-ML, SM, ML, SC-SM	A-2, A-4	0-1	0-4	95-100	85-98	50-85	35-60	15-30	5-10
	15-80	Loam, fine sandy loam, sandy loam	CL-ML, SM, ML, SC-SM	A-2, A-4	0-1	0-4	95-100	85-98	50-85	35-60	15-30	5-10
1122:												
Nielsville------	0-11	Silty clay loam	CL	A-6, A-7	0	0	100	100	95-100	85-95	35-50	15-30
	11-33	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	33-44	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
	44-80	Clay, silty clay	CH	A-7	0	0-1	95-100	90-100	80-100	75-95	50-75	25-50
Perella---------	0-9	Silty clay loam	CL	A-6, A-7	0	0	100	95-100	95-100	85-95	25-50	10-30
	9-21	Silt loam, silty clay loam	CL, CL-ML	A-6, A-4, A-7	0	0	100	95-100	95-100	80-100	25-45	5-25
	21-80	Silt loam, silty clay loam	CL, CL-ML	A-6, A-4, A-7	0	0	100	95-100	95-100	80-100	25-50	5-25
1142:												
Hedman----------	0-10	Loam----------	CL, ML, CL-ML	A-4, A-6	0-1	0-4	95-100	85-98	75-90	50-70	20-35	5-15
	10-18	Fine sandy loam, loam, sandy loam	ML, SC-SM, CL-ML, SM	A-2, A-4	0-1	0-4	95-100	85-98	50-85	35-60	15-30	5-15
	18-80	Loam, fine sandy loam, sandy loam	ML, SC-SM, CL-ML, SM	A-2, A-4	0-1	0-4	95-100	85-98	50-85	35-60	15-30	5-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1142:												
Fram----------	0-10	Loam----------	ML	A-4	0	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	10-80	Sandy loam, fine sandy loam, loam	ML, SM	A-4	0	0-1	95-100	90-100	60-100	35-90	20-40	NP-10
1144:												
Strathcona------	0-6	Mucky fine sandy loam	SM	A-4	0	0	100	95-100	65-85	30-50	20-30	5-10
	6-19	Fine sandy loam, sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	65-85	30-50	20-30	5-10
	19-29	Sand, fine sand, loamy fine sand	SM, SP-SM	A-1, A-2	0	0-1	95-100	85-100	60-80	10-30	0-14	NP
	29-80	Fine sandy loam, loam, clay loam	CL, CL-ML	A-4, A-6	0	0-1	95-100	85-98	70-90	50-70	25-40	5-20
Kratka----------	0-14	Mucky fine sandy loam	OL, SP	A-2-4, A-4	0	0	95-100	90-100	50-80	20-50	0-25	NP-5
	14-34	Loamy sand, loamy fine sand, sand	SP-SM	A-2, A-3	0	0	95-100	90-100	50-80	5-10	0-20	NP-5
	34-80	Loam, clay loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-60	20-45	5-20
1152B:												
Sugarbush-------	0-4	Loamy sand-----	SM	A-1-b, A-2-4	0-1	0-10	95-100	90-100	45-70	15-30	---	NP
	4-10	Loamy sand, loamy coarse sand	SM, SP-SM	A-1-b, A-2-4	0-1	0-10	95-100	90-100	40-70	10-25	---	NP
	10-20	Sandy loam, coarse sandy loam	SM	A-2-4	0-1	0-10	95-100	90-100	50-70	25-35	15-20	NP-4
	20-80	Gravelly coarse sand, gravelly sand	SP, SP-SM	A-1-b, A-2-4, A-3	0-1	0-10	55-85	50-75	30-55	2-10	---	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1152C:												
Sugarbush-------	0-5	Loamy sand-----	SM	A-1-b, A-2-4	0-1	0-10	95-100	90-100	45-70	15-30	---	NP
	5-10	Loamy sand, loamy coarse sand	SM, SP-SM	A-1-b, A-2-4	0-1	0-10	95-100	90-100	40-70	10-25	---	NP
	10-18	Sandy loam, coarse sandy loam	SM	A-2-4	0-1	0-10	95-100	90-100	50-70	25-35	15-20	NP-4
	18-80	Gravelly coarse sand, gravelly sand	SP, SP-SM	A-2-4, A-1-b, A-3	0-1	0-10	55-85	50-75	30-55	2-10	---	NP
1152E:												
Sugarbush-------	0-5	Loamy sand-----	SM	A-1-b, A-2-4	0-1	0-10	95-100	90-100	45-70	15-30	---	NP
	5-12	Loamy sand, loamy coarse sand	SM, SP-SM	A-1-b, A-2-4	0-1	0-10	95-100	90-100	40-70	10-25	---	NP
	12-18	Sandy loam, coarse sandy loam	SM	A-2-4	0-1	0-10	95-100	90-100	50-70	25-35	15-20	NP-4
	18-80	Gravelly coarse sand, gravelly sand	SP, SP-SM	A-2-4, A-1-b, A-3	0-1	0-10	55-85	50-75	30-55	2-10	---	NP
1233D:												
Esmond----------	0-7	Loam----------	ML	A-4	---	0-1	95-100	85-100	85-100	60-90	20-35	NP-10
	7-80	Fine sandy loam, loam, sandy loam	CL, ML, SM, SC	A-4, A-6	0-1	0-3	90-100	85-100	60-95	35-80	15-30	NP-12
Heimdal---------	0-8	Loam----------	CL, CL-ML, ML	A-4, A-6	0-1	0-1	95-100	85-95	55-85	50-70	20-35	3-15
	8-15	Loam, fine sandy loam, sandy loam	ML, CL, SC, SM	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	3-15
	15-30	Fine sandy loam, loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-1	95-100	85-95	50-80	35-65	15-30	2-12
	30-80	Fine sandy loam, loam, sandy loam	ML, SC, CL, SM	A-4, A-6	0-1	0-3	95-100	85-95	50-80	35-65	15-30	2-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1264:												
Ulen----------	0-10	Loamy fine sand	SM	A-2, A-4	0	0	100	100	80-100	20-50	0-20	NP-4
	10-20	Loamy fine sand, fine sand	SM	A-2	0	0	95-100	95-100	70-95	12-35	0-14	NP
	20-36	Fine sand------	SM, SP-SM	A-2, A-3	0	0	100	95-100	80-100	5-35	0-14	NP
	36-80	Very fine sandy loam, fine sandy loam	ML, SC-SM, CL-ML, SM	A-4	0	0	100	95-100	70-95	35-60	20-30	5-10
1278:												
Rosewood--------	0-10	Fine sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	100	97-100	65-90	30-50	15-30	NP-10
	10-17	Fine sandy loam, loamy fine sand, sandy loam	SC, SM, SC-SM	A-2, A-4	0	0	100	95-100	60-85	25-45	15-30	NP-10
	17-30	Fine sand, sand	SM, SP-SM	A-1, A-3, A-2	0	0	85-100	75-95	45-75	5-25	5-15	NP
	30-80	Fine sand, sand, coarse sand	SM, SP-SM, SP	A-2, A-1, A-3	0	0	85-100	75-95	40-80	5-35	5-15	NP
Venlo----------	0-15	Fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	100	60-85	30-50	0-25	NP-5
	15-80	Loamy fine sand, loamy sand, fine sand	SM, SP-SM	A-2, A-3	0	0	100	100	50-80	5-35	0-20	NP
1279:												
Vallers---------	0-10	Loam----------	ML, OL	A-4	0	0	95-100	90-100	80-90	50-80	30-40	4-10
	10-22	Clay loam, silty clay loam, loam	CL	A-6	0	0	95-100	90-100	80-95	50-80	30-40	11-20
	22-80	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-95	60-85	20-40	5-20
Hamerly---------	0-9	Loam----------	CL, CL-ML	A-4, A-6	---	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	9-22	Loam, clay loam	CL, CL-ML	A-4, A-6	---	0-5	95-100	85-95	80-95	60-75	20-40	5-20
	22-80	Loam, clay loam	CL, CL-ML	A-4, A-6	---	0-5	95-100	85-95	80-95	60-75	20-40	5-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1280:												
Gunclub---------	0-9	Silty clay loam	CL	A-6, A-7	0	0	100	100	95-100	85-95	35-50	15-30
	9-34	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	34-54	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
	54-80	Clay, silty clay	CH	A-7	0	0-1	95-100	90-100	80-100	75-95	50-75	23-45
1283:												
Reis----------	0-17	Clay----------	CH, CL	A-7	0	0-1	95-100	90-99	80-95	70-95	45-80	20-50
	17-42	Clay, silty clay	CH, MH	A-7	0	0-1	95-100	90-99	80-97	75-90	50-80	20-50
	42-60	Clay, silty clay	CH, MH	A-7	0	0-1	95-100	90-99	80-97	75-90	50-80	20-50
	60-80	Clay, silty clay	CH, MH	A-7	0	0-1	95-100	90-99	80-95	75-90	50-80	20-50
Clearwater------	0-10	Clay----------	CH, CL	A-7	0	0-1	95-100	90-97	80-95	70-95	45-80	20-50
	10-27	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-1	95-100	90-97	80-95	70-95	40-80	20-50
	27-80	Clay, silty clay, silty clay loam	CH, CL	A-7	0	0-1	95-100	90-100	80-97	75-95	40-80	20-50
1297:												
Augsburg--------	0-12	Very fine sandy loam	CL, ML, CL-ML	A-4, A-6	0	0	100	100	95-100	50-90	15-35	NP-10
	12-25	Loam, very fine sandy loam, silt loam	ML	A-4	0	0	100	100	95-100	80-90	15-30	NP-10
	25-54	Loamy very fine sand, very fine sandy loam, loam	ML	A-4	0	0	100	100	95-100	80-90	15-30	NP-10
	54-80	Clay, silty clay, silty clay loam	CH, CL	A-6, A-7	0	0	95-100	95-100	95-100	90-100	35-80	15-45

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct	Pct					Pct	
1299:												
Borup----------	0-10	Very fine sandy loam	ML	A-4	0	0	100	100	90-100	60-80	20-30	NP-7
	10-22	Very fine sandy loam, silt loam, sandy clay loam	ML	A-4	0	0	100	100	90-100	60-95	0-30	NP-5
	22-80	Loamy very fine sand, very fine sand, very fine sandy loam	ML	A-4	0	0	100	100	85-100	50-90	0-30	NP-5
1304A:												
Glyndon---------	0-8	Very fine sandy loam	CL-ML, ML	A-4	0	0	100	100	95-100	70-95	20-30	NP-5
	8-35	Silt loam, very fine sandy loam, loam	CL, ML, CL-ML	A-4	0	0	100	100	90-100	85-95	20-30	NP-10
	35-80	Loamy very fine sand, very fine sand, very fine sandy loam	ML, CL, SC, SM	A-4	0	0	100	100	85-100	35-75	10-30	NP-10
1304B:												
Glyndon---------	0-10	Very fine sandy loam	CL-ML, ML	A-4	0	0	100	100	95-100	70-95	20-30	NP-5
	10-32	Silt loam, very fine sandy loam, loam	CL, CL-ML, ML	A-4	0	0	100	100	90-100	85-95	20-30	NP-10
	32-80	Loamy very fine sand, very fine sand, very fine sandy loam	ML, SC, CL, SM	A-4	0	0	100	100	85-100	35-75	10-30	NP-10
1315A:												
Wheatville------	0-9	Very fine sandy loam	ML	A-4	0	0	100	100	95-100	50-100	0-14	NP
	9-31	Very fine sandy loam, silt loam, loamy very fine sand	CL-ML, CL, ML	A-4	0	0	100	100	85-100	80-95	15-35	NP-10
	31-80	Clay, silty clay, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	95-100	90-100	35-80	15-45

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1323B:												
LaDelle---------	0-29	Silt loam------	CL, ML	A-6, A-4, A-7	0	0	100	100	90-100	80-100	30-45	7-20
	29-69	Silt loam, silty clay loam, loam	CL, MH, CH, ML	A-6, A-7	0	0	100	100	90-100	75-100	30-55	10-25
	69-80	Stratified silt loam to clay loam	CH, CL, CL-ML	A-4, A-7, A-6	0	0	100	100	90-100	75-100	25-60	5-30
1325:												
Bowstring-------	0-65	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	65-80	Stratified sand to fine sandy loam	SC-SM, SM, SP-SM	A-2	0	0	100	100	50-85	10-35	15-20	NP-5
Fluvaquents-----	0-16	Very fine sandy loam	CL-ML, CL, ML	A-4, A-6	0	0	100	90-100	75-100	45-90	15-40	NP-15
	16-80	Stratified loamy sand to silt loam	ML, SM, CL, SP	A-1, A-6, A-3, A-4	0	0	95-100	70-100	35-95	5-80	0-40	NP-15
1356:												
Water, miscellaneous.												
1422:												
Northwood-------	0-14	Muck----------	PT	A-8	0	0	---	---	---	---	---	NP
	14-29	Marl----------	MH, OH	A-5, A-8, A-7	0	0	100	100	90-100	80-95	50-90	NP-20
	29-35	Fine sand, coarse sand, loamy fine sand	SM, SP-SM	A-2, A-4	0	0-1	95-100	80-100	70-95	10-40	0-14	NP
	35-80	Loam, clay loam, fine sandy loam	CL, CL-ML, ML	A-4, A-6	0	0-2	95-100	90-100	75-100	50-85	20-40	3-20
1866:												
Colvin----------	0-10	Silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	35-50	15-30
	10-20	Silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	20-80	Loam, silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1866:												
Perella---------	0-16	Silty clay loam	CL, CL-ML	A-4, A-7, A-6	0	0	100	95-100	95-100	85-95	25-50	5-30
	16-23	Silt loam, silty clay loam, silty clay	CH, CL, CL-ML	A-4, A-7, A-6	0	0	100	95-100	95-100	80-100	25-60	5-40
	23-80	Silt loam, silty clay loam	CL, CL-ML	A-6, A-4, A-7	0	0	100	95-100	95-100	80-100	25-45	5-25
1871:												
Fargo----------	0-10	Silty clay-----	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	10-21	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	21-80	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
1874:												
Radium----------	0-14	Loamy sand-----	SM, SP-SM	A-2-4	0	0	95-100	95-100	50-70	5-20	0-15	NP
	14-32	Sand, loamy sand, gravelly loamy coarse sand	SM, SP-SM, SP	A-1, A-2, A-3	0	0-5	75-100	65-95	35-60	3-15	0-15	NP
	32-46	Gravelly sand, gravelly coarse sand, very gravelly coarse sand	SM, GP, SP, SP-SM	A-1	0	0-5	55-85	25-75	15-40	2-10	0-15	NP
	46-80	Sand, coarse sand, loamy sand	SM, SP, SP-SM	A-1, A-2, A-3	0	0-5	75-90	75-90	40-80	2-10	---	NP
1878:												
Hamre----------	0-10	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	10-16	Loam, clay loam, silt loam	CL, CL-ML	A-4, A-6, A-7	0-1	0-3	90-100	80-100	70-100	50-90	25-45	6-20
	16-80	Loam, clay loam, silt loam	CL, CL-ML	A-4, A-6, A-7	0-1	0-3	80-100	75-100	65-95	50-85	25-45	6-20
1879:												
Seelyeville-----	0-12	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	12-80	Mucky peat, muck	PT	A-8	0	0	---	---	---	---	---	---

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1882:												
Rosewood--------	0-13	Fine sandy loam	SC, SM, SC-SM	A-2, A-4	0	0	100	95-100	65-85	30-50	0-30	NP-10
	13-18	Fine sandy loam, loamy fine sand, sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	100	95-100	60-85	25-45	0-30	NP-10
	18-80	Fine sand, sand	SM, SP-SM	A-1, A-2, A-3	0	0	85-100	75-95	45-75	5-25	0-14	NP
Strathcona------	0-14	Fine sandy loam	SC, SM, SC-SM	A-2, A-4	0	0	100	95-100	65-85	30-50	20-30	5-10
	14-26	Loamy fine sand, loamy sand, fine sand	SM, SP-SM	A-2	0	0	95-100	85-100	60-80	10-30	0-14	NP
	26-36	Loamy sand, fine sand, loamy fine sand	SM, SP-SM	A-2	0	0-1	95-100	85-100	60-80	10-30	0-14	NP
	36-80	Fine sandy loam, loam, clay loam	CL, CL-ML	A-4, A-6	0	0-1	95-100	85-100	70-90	50-70	25-40	5-20
Berner----------	0-20	Muck----------	PT	A-8	0	0	---	---	---	---	---	---
	20-26	Sandy loam, fine sandy loam, gravelly sandy loam	SC-SM, SC, SM	A-2-4, A-4	0	0	90-100	70-100	50-85	10-50	15-25	NP-10
	26-40	Sand, fine sand, gravelly sand	SM, SP, SP-SM	A-1, A-3, A-2	0	0	90-100	70-100	60-80	0-25	---	NP
	40-80	Loam, clay loam, silt loam	CL, ML	A-4, A-6	0	0	95-100	85-100	60-90	50-80	30-40	10-20
1916:												
Lindaas---------	0-9	Silty clay loam	CH, CL	A-6, A-7	0	0	100	100	95-100	75-95	40-50	20-30
	9-30	Silty clay, clay	CH	A-7	0	0	100	100	95-100	80-95	55-65	30-40
	30-40	Silt loam, silty clay loam, clay loam	CH, CL	A-6, A-7	0	0	100	100	95-100	75-95	40-55	20-35
	40-80	Silt loam, very fine sandy loam, silty clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	100	100	85-100	55-95	30-50	10-25

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
1963:												
Bearden---------	0-10	Silty clay loam	CH, CL	A-6, A-7	0	0	100	100	95-100	80-95	25-55	10-30
	10-18	Silt loam, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	18-30	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
	30-80	Silt loam, silty clay loam, loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-55	10-30
Colvin----------	0-10	Silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	35-50	15-30
	10-19	Silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	19-80	Loam, silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
1964:												
Colvin----------	0-10	Silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	35-50	15-30
	10-22	Silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	25-50	10-30
	22-80	Loam, silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	10-25
Fargo----------	0-9	Silty clay-----	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	9-30	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	30-80	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50

Physical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Absence of an entry indicates that data were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
20B:												
Chapett----------	0-8	10-20	1.35-1.65	0.6-2	0.13-0.19	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	8-19	18-28	1.30-1.65	0.6-2	0.15-0.19	0.0-2.9	0.5-1.0	.32	.32			
	19-30	10-18	1.40-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
	30-80	10-18	1.65-1.80	0.6-2	0.10-0.16	0.0-2.9	0.0-0.5	.28	.28			
20C2:												
Chapett----------	0-9	10-20	1.35-1.65	0.6-2	0.13-0.19	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	9-21	18-28	1.30-1.65	0.6-2	0.15-0.19	0.0-2.9	0.5-1.0	.32	.32			
	21-33	10-18	1.40-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
	33-80	10-18	1.65-1.80	0.6-2	0.10-0.16	0.0-2.9	0.0-0.5	.28	.28			
20D2:												
Chapett----------	0-12	10-20	1.35-1.65	0.6-2	0.13-0.19	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	12-21	18-28	1.30-1.65	0.6-2	0.15-0.19	0.0-2.9	0.5-1.0	.32	.32			
	21-31	10-18	1.40-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
	31-80	10-18	1.65-1.80	0.6-2	0.10-0.16	0.0-2.9	0.0-0.5	.28	.28			
20E:												
Chapett----------	0-4	10-20	1.35-1.65	0.6-2	0.13-0.19	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	4-15	18-28	1.30-1.65	0.6-2	0.15-0.19	0.0-2.9	0.5-1.0	.32	.32			
	15-50	10-18	1.40-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
	50-80	10-18	1.65-1.80	0.6-2	0.10-0.16	0.0-2.9	0.0-0.5	.28	.28			
38B:												
Waukon----------	0-6	12-27	1.40-1.60	0.6-2	0.20-0.24	3.0-5.9	2.0-6.0	.24	.24	5	6	48
	6-29	18-35	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	29-80	18-30	1.45-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
38C2:												
Waukon----------	0-7	12-27	1.40-1.60	0.6-2	0.20-0.24	3.0-5.9	2.0-6.0	.24	.24	5	6	48
	7-18	18-35	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	18-80	18-30	1.45-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
38D2:												
Waukon----------	0-6	12-27	1.40-1.60	0.6-2	0.20-0.24	3.0-5.9	2.0-6.0	.24	.24	5	6	48
	6-18	18-35	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	18-80	18-30	1.45-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
45B:												
Maddock----------	0-10	2-10	1.20-1.40	2-20	0.10-0.12	0.0-2.9	1.0-2.0	.17	.17	5	2	134
	10-80	2-8	1.30-1.50	2-20	0.05-0.12	0.0-2.9	0.0-0.5	.17	.17			
45C:												
Maddock----------	0-10	2-10	1.20-1.40	2-20	0.10-0.12	0.0-2.9	1.0-2.0	.17	.17	5	2	134
	10-80	2-8	1.30-1.50	2-20	0.05-0.12	0.0-2.9	0.0-0.5	.17	.17			
45E:												
Maddock----------	0-10	2-10	1.20-1.40	2-20	0.10-0.12	0.0-2.9	1.0-2.0	.17	.17	5	2	134
	10-80	2-8	1.30-1.50	2-20	0.05-0.12	0.0-2.9	0.0-0.5	.17	.17			
47:												
Colvin----------	0-9	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	4.0-7.0	.32	.32	5	4L	86
	9-24	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	0.0-5.0	.32	.32			
	24-80	18-34	1.30-1.50	0.2-2	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
57A:												
Fargo----------	0-10	40-60	1.10-1.30	0.06-0.2	0.15-0.18	6.0-8.9	4.0-10	.32	.32	5	4	86
	10-19	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	2.0-7.0	.32	.32			
	19-80	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	1.0-5.0	.32	.32			
59:												
Grimstad----------	0-16	10-18	1.30-1.45	2-6	0.13-0.18	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	16-31	2-15	1.45-1.60	6-20	0.08-0.14	0.0-2.9	1.0-2.0	.20	.20			
	31-80	10-30	1.50-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.37	.37			
65:												
Foxhome----------	0-10	10-20	1.35-1.50	2-6	0.13-0.18	0.0-2.9	3.0-7.0	.20	.20	3	3	86
	10-15	10-25	1.35-1.50	2-20	0.09-0.19	0.0-2.9	1.0-3.0	.17	.24			
	15-23	5-15	1.50-1.70	6-20	0.02-0.07	0.0-2.9	0.5-1.0	.05	.15			
	23-80	12-35	1.40-1.70	0.6-2	0.15-0.22	0.0-2.9	0.0-0.5	.32	.37			
66:												
Flaming----------	0-12	2-10	1.40-1.55	6-20	0.11-0.13	0.0-2.9	2.0-4.0	.17	.17	5	2	134
	12-80	2-10	1.50-1.70	6-20	0.06-0.10	0.0-2.9	0.5-1.0	.17	.17			
67A:												
Bearden----------	0-8	10-26	1.20-1.40	0.6-2	0.20-0.24	3.0-5.9	3.0-7.0	.32	.32	5	4L	86
	8-28	18-34	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	1.0-4.0	.37	.37			
	28-42	18-34	1.30-1.80	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
	42-80	18-34	1.30-1.80	0.06-0.2	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
67B:												
Bearden----------	0-7	10-26	1.20-1.40	0.6-2	0.20-0.24	3.0-5.9	3.0-7.0	.32	.32	5	4L	86
	7-17	18-34	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	1.0-4.0	.37	.37			
	17-30	18-34	1.30-1.80	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
	30-80	18-34	1.30-1.80	0.06-0.2	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
93A:												
Bearden----------	0-10	27-39	1.20-1.40	0.2-0.6	0.17-0.23	3.0-5.9	3.0-7.0	.37	.37	5	4L	86
	10-18	18-34	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	1.0-4.0	.37	.37			
	18-26	18-34	1.30-1.80	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
	26-80	18-34	1.30-1.80	0.06-0.2	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
111:												
Hangaard----------	0-10	8-18	1.25-1.45	2-6	0.10-0.14	0.0-2.9	3.0-8.0	.20	.20	5	3	86
	10-15	5-15	1.50-1.70	6-20	0.07-0.11	0.0-2.9	1.0-3.0	.17	.17			
	15-80	2-10	1.50-1.70	6-40	0.02-0.04	0.0-2.9	0.0-0.5	.10	.15			
184A:												
Hamerly----------	0-9	18-27	1.20-1.60	0.6-2	0.20-0.24	0.0-2.9	4.0-7.0	.28	.28	5	4L	86
	9-20	18-30	1.20-1.60	0.6-2	0.15-0.19	0.0-2.9	0.5-1.0	.28	.32			
	20-80	18-30	1.30-1.60	0.6-2	0.14-0.19	0.0-2.9	0.0-0.5	.37	.37			
185D2:												
Hattie----------	0-8	40-60	1.30-1.40	0.06-0.2	0.16-0.22	6.0-8.9	2.0-5.0	.28	.28	5	4	86
	8-80	40-60	1.30-1.45	0.06-0.2	0.12-0.16	6.0-8.9	0.0-2.0	.32	.32			
236:												
Vallers----------	0-14	18-27	1.20-1.35	0.6-2	0.22-0.24	0.0-2.9	5.0-8.0	.28	.28	5	4L	86
	14-35	18-35	1.40-1.55	0.2-0.6	0.15-0.19	3.0-5.9	1.0-3.0	.28	.28			
	35-80	18-35	1.50-1.70	0.2-0.6	0.17-0.19	0.0-2.9	0.0-0.5	.37	.37			
242B:												
Marquette----------	0-8	1-10	1.40-1.60	6-20	0.10-0.14	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	8-18	5-18	1.50-1.70	2-6	0.10-0.16	0.0-2.9	0.5-1.0	.15	.20			
	18-80	1-5	1.50-1.70	20-20	0.02-0.04	0.0-2.9	0.0-0.5	.05	.15			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
242D:												
Marquette----------	0-7	1-10	1.40-1.60	6-20	0.10-0.14	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	7-16	5-18	1.50-1.70	2-6	0.10-0.16	0.0-2.9	0.5-1.0	.15	.20			
	16-80	1-5	1.50-1.70	20-20	0.02-0.04	0.0-2.9	0.0-0.5	.05	.15			
258B:												
Sandberg----------	0-19	2-10	1.40-1.60	6-20	0.10-0.12	0.0-2.9	1.0-3.0	.15	.15	5	2	134
	19-25	0-10	1.50-1.65	6-20	0.03-0.10	0.0-2.9	0.5-1.0	.05	.10			
	25-38	0-5	1.50-1.65	20-20	0.02-0.06	0.0-2.9	0.5-1.0	.05	.10			
	38-80	0-5	1.50-1.65	20-20	0.02-0.06	0.0-2.9	0.0-0.5	.05	.10			
258C:												
Sandberg----------	0-10	2-10	1.40-1.60	6-20	0.10-0.12	0.0-2.9	1.0-3.0	.15	.15	5	2	134
	10-38	0-10	1.50-1.65	6-20	0.03-0.10	0.0-2.9	0.5-1.0	.05	.10			
	38-59	0-5	1.50-1.65	20-20	0.02-0.06	0.0-2.9	0.5-1.0	.05	.10			
	59-80	0-5	1.50-1.65	20-20	0.02-0.06	0.0-2.9	0.0-0.5	.05	.10			
258E:												
Sandberg----------	0-9	2-10	1.40-1.60	6-20	0.10-0.12	0.0-2.9	1.0-3.0	.15	.15	5	2	134
	9-16	0-10	1.50-1.65	6-20	0.03-0.10	0.0-2.9	0.5-1.0	.05	.10			
	16-41	0-5	1.50-1.65	20-20	0.02-0.06	0.0-2.9	0.5-1.0	.05	.10			
	41-80	0-5	1.50-1.65	20-20	0.02-0.06	0.0-2.9	0.0-0.5	.05	.10			
296:												
Fram----------	0-22	10-18	1.30-1.60	0.6-2	0.20-0.24	0.0-2.9	4.0-9.0	.28	.28	5	4L	86
	22-80	7-18	1.40-1.60	0.6-2	0.13-0.20	0.0-2.9	---	.37	.37			
341B:												
Arvilla----------	0-8	6-18	1.40-1.60	2-6	0.13-0.15	0.0-2.9	1.0-4.0	.20	.20	3	3	86
	8-16	6-18	1.40-1.60	2-6	0.11-0.14	0.0-2.9	1.0-2.0	.20	.20			
	16-80	2-10	1.50-1.70	6-40	0.02-0.05	0.0-2.9	0.0-0.5	.05	.15			
348:												
Borup----------	0-15	15-27	1.20-1.40	2-6	0.20-0.23	0.0-2.9	4.0-8.0	.28	.28	5	4L	86
	15-24	10-18	1.30-1.50	2-6	0.17-0.20	0.0-2.9	---	.28	.28			
	24-80	5-18	1.35-1.65	2-20	0.15-0.19	0.0-2.9	---	.28	.28			
372:												
Hamar----------	0-8	5-10	1.20-1.30	2-20	0.10-0.12	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	8-13	0-7	1.35-1.55	2-20	0.10-0.12	0.0-2.9	0.0-2.0	.17	.17			
	13-80	0-7	1.45-1.65	2-20	0.06-0.08	0.0-2.9	0.0-0.5	.17	.17			
387:												
Roliss----------	0-15	18-27	1.10-1.50	0.2-2	0.17-0.24	3.0-5.9	3.0-8.0	.28	.28	5	6	48
	15-20	18-35	1.30-1.70	0.2-0.6	0.15-0.19	3.0-5.9	1.0-3.0	.28	.28			
	20-47	18-35	1.30-1.70	0.2-2	0.15-0.19	3.0-5.9	0.5-1.0	.28	.28			
	47-80	18-35	1.30-1.70	0.2-2	0.15-0.19	3.0-5.9	0.5-1.0	.28	.28			
412:												
Mavie----------	0-8	8-18	1.35-1.55	2-6	0.13-0.15	0.0-2.9	3.0-6.0	.20	.20	3	3	86
	8-16	10-27	1.35-1.55	0.6-2	0.12-0.19	0.0-2.9	1.0-3.0	.28	.28			
	16-30	2-10	1.40-1.65	6-20	0.03-0.05	0.0-2.9	0.0-0.5	.10	.15			
	30-80	18-35	1.40-1.70	0.2-2	0.15-0.21	0.0-2.9	0.0-0.5	.37	.37			
422A:												
Bygland----------	0-7	27-40	1.20-1.40	0.2-0.6	0.18-0.22	6.0-8.9	4.0-8.0	.28	.28	5	7	38
	7-29	35-60	1.20-1.40	0.06-0.6	0.10-0.19	6.0-8.9	1.0-3.0	.32	.32			
	29-37	18-40	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	0.5-1.0	.43	.43			
	37-80	18-40	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
422B:												
Bygland----------	0-9	27-40	1.20-1.40	0.2-0.6	0.18-0.22	6.0-8.9	4.0-8.0	.28	.28	5	7	38
	9-22	35-60	1.20-1.40	0.06-0.6	0.10-0.19	6.0-8.9	1.0-3.0	.32	.32			
	22-32	18-40	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	0.5-1.0	.43	.43			
	32-80	18-40	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
422C2:												
Bygland----------	0-9	27-40	1.20-1.40	0.2-0.6	0.18-0.22	6.0-8.9	4.0-8.0	.28	.28	5	7	38
	9-20	35-60	1.20-1.40	0.06-0.6	0.10-0.19	6.0-8.9	1.0-3.0	.32	.32			
	20-31	18-40	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	0.5-1.0	.43	.43			
	31-80	18-40	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
426:												
Foldahl----------	0-12	4-9	1.40-1.55	6-20	0.10-0.14	0.0-2.9	1.0-4.0	.20	.20	5	2	134
	12-30	2-10	1.45-1.60	6-20	0.07-0.12	0.0-2.9	0.5-1.0	.20	.20			
	30-44	18-35	1.50-1.65	0.2-2	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
	44-80	18-35	1.50-1.65	0.2-2	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
435:												
Syrene----------	0-11	8-18	1.25-1.45	2-6	0.13-0.18	0.0-2.9	3.0-8.0	.20	.20	3	3	86
	11-18	10-30	1.30-1.50	2-6	0.15-0.19	0.0-2.9	0.0-2.0	.37	.37			
	18-80	2-10	1.50-1.70	6-20	0.02-0.04	0.0-2.9	0.0-0.5	.10	.10			
439:												
Strathcona----------	0-10	12-18	1.25-1.45	2-6	0.14-0.17	0.0-2.9	3.0-6.0	.20	.20	3	3	86
	10-17	10-18	1.30-1.50	2-6	0.14-0.16	0.0-2.9	0.5-1.0	.24	.24			
	17-30	2-8	1.35-1.60	6-20	0.05-0.09	0.0-2.9	0.0-0.5	.10	.10			
	30-80	15-30	1.40-1.60	0.2-2	0.14-0.18	3.0-5.9	0.0-0.5	.32	.32			
450:												
Rauville----------	0-36	27-35	1.10-1.25	0.2-2	0.19-0.22	3.0-5.9	4.0-7.0	.28	.28	5	4L	86
	36-80	20-45	1.10-1.30	0.2-2	0.17-0.20	3.0-5.9	1.0-4.0	.32	.32			
481:												
Kratka----------	0-10	5-15	1.20-1.50	2-6	0.13-0.18	0.0-2.9	2.0-5.0	.20	.20	3	3	86
	10-25	2-10	1.30-1.60	6-20	0.06-0.11	0.0-2.9	0.5-1.0	.17	.17			
	25-80	10-35	1.50-1.80	0.2-2	0.11-0.19	3.0-5.9	0.0-0.5	.37	.37			
494B:												
Darnen----------	0-28	18-27	1.25-1.40	0.6-2	0.18-0.20	0.0-2.9	4.0-8.0	.24	.24	5	6	48
	28-38	18-30	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	1.0-2.0	.28	.28			
	38-60	18-30	1.55-1.65	0.6-2	0.14-0.19	3.0-5.9	0.0-0.5	.32	.32			
506:												
Overly----------	0-18	27-39	1.20-1.40	0.2-0.6	0.17-0.23	3.0-5.9	4.0-8.0	.37	.37	5	7	38
	18-46	18-34	1.20-1.50	0.2-0.6	0.17-0.22	3.0-5.9	0.0-1.0	.43	.43			
	46-80	18-59	1.20-1.60	0.06-0.6	0.13-0.22	3.0-5.9	0.0-1.0	.43	.43			
540:												
Seelyeville----------	0-20	---	0.10-0.25	0.2-6	0.35-0.45	---	25-99	---	---	3	2	134
	20-80	---	0.10-0.25	0.2-6	0.35-0.45	---	25-99	---	---			
543:												
Markey----------	0-32	---	0.15-0.45	0.2-6	0.35-0.45	---	55-85	---	---	4	2	134
	32-80	0-10	1.40-1.65	6-20	0.03-0.08	0.0-2.9	0.0-0.5	.15	.15			
544:												
Cathro----------	0-24	---	0.28-0.45	0.2-6	0.45-0.55	---	60-85	---	---	5	2	134
	24-42	---	0.15-0.30	0.2-6	0.35-0.45	---	60-85	---	---			
	42-80	10-30	1.50-1.70	0.2-2	0.11-0.19	0.0-2.9	1.0-5.0	.20	.24			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
547:												
Deerwood	0-14	0-0	0.10-0.30	0.6-6	0.35-0.45	---	50-90	---	---	5	2	134
	14-35	2-18	1.20-1.70	2-20	0.09-0.17	0.0-2.9	4.0-10	.17	.17			
	35-80	0-10	1.50-1.70	6-20	0.02-0.07	0.0-2.9	0.5-2.0	.17	.17			
563:												
Northwood	0-9	---	0.18-0.25	2-6	0.35-0.45	---	50-85	---	---	5	2	134
	9-16	3-18	1.45-1.65	2-20	0.09-0.17	0.0-2.9	1.0-3.0	.15	.15			
	16-31	1-10	1.55-1.70	6-20	0.06-0.11	0.0-2.9	0.0-0.5	.15	.15			
	31-80	7-30	1.40-1.75	0.6-2	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
565:												
Eckvoll	0-7	5-15	1.30-1.70	6-20	0.10-0.12	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	7-26	2-10	1.30-1.70	6-20	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15			
	26-35	18-35	1.40-1.70	0.2-2	0.16-0.18	3.0-5.9	0.0-0.5	.37	.37			
	35-80	16-32	1.30-1.70	0.2-2	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
573D:												
Serden	0-3	3-8	1.30-1.50	6-20	0.06-0.12	0.0-2.9	0.5-1.0	.15	.15	5	1	250
	3-80	3-8	1.40-1.60	6-20	0.05-0.07	0.0-2.9	0.0-0.5	.15	.15			
582:												
Roliss	0-9	18-27	1.10-1.50	0.6-2	0.17-0.24	3.0-5.9	3.0-7.0	.28	.28	5	4L	86
	9-14	18-35	1.30-1.70	0.2-2	0.15-0.19	3.0-5.9	1.0-3.0	.28	.28			
	14-20	18-35	1.30-1.70	0.2-2	0.15-0.19	3.0-5.9	0.5-1.0	.28	.28			
	20-80	18-35	1.30-1.70	0.2-2	0.15-0.19	3.0-5.9	0.5-1.0	.28	.28			
641:												
Clearwater	0-12	40-60	1.20-1.50	0.06-0.2	0.13-0.17	6.0-8.9	3.0-6.0	.28	.28	5	4	86
	12-26	35-60	1.20-1.50	0.06-0.2	0.15-0.18	6.0-8.9	1.0-3.0	.32	.32			
	26-80	35-60	1.20-1.60	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	.32			
642:												
Clearwater	0-10	10-27	1.30-1.60	0.6-6	0.10-0.16	0.0-2.9	2.0-5.0	.24	.24	5	5	56
	10-20	35-60	1.20-1.50	0.06-0.2	0.15-0.18	6.0-8.9	1.0-3.0	.32	.32			
	20-80	35-60	1.20-1.60	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	.32			
643:												
Huot	0-14	5-15	1.50-1.60	2-6	0.13-0.18	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	14-26	8-15	1.55-1.65	2-6	0.09-0.17	0.0-2.9	0.0-1.0	.20	.20			
	26-34	3-8	1.55-1.70	6-20	0.06-0.11	0.0-2.9	0.0-0.5	.20	.20			
	34-80	35-80	1.35-1.60	0.06-0.2	0.09-0.16	6.0-8.9	0.0-0.5	.32	.32			
645:												
Espelie	0-9	8-18	1.30-1.45	2-6	0.13-0.18	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	9-22	3-10	1.35-1.60	2-20	0.06-0.11	0.0-2.9	0.5-1.0	.17	.17			
	22-80	35-60	1.35-1.60	0.06-0.2	0.09-0.19	6.0-8.9	0.0-0.5	.32	.32			
647:												
Hilaire	0-10	6-15	1.25-1.45	6-20	0.10-0.14	0.0-2.9	1.0-3.0	.15	.15	5	2	134
	10-16	3-10	1.25-1.40	6-20	0.07-0.14	0.0-2.9	1.0-2.0	.15	.15			
	16-25	1-10	1.20-1.40	6-20	0.07-0.12	0.0-2.9	0.0-0.5	.10	.17			
	25-80	35-60	1.35-1.55	0.06-0.2	0.09-0.19	6.0-8.9	0.0-0.5	.32	.32			
650:												
Reiner	0-9	4-15	1.20-1.70	2-6	0.16-0.18	0.0-2.9	4.0-6.0	.20	.24	5	3	86
	9-20	24-35	1.40-1.75	0.6-2	0.15-0.19	3.0-5.9	0.5-2.0	.32	.32			
	20-80	18-30	1.35-1.75	0.6-2	0.14-0.19	0.0-2.9	0.0-0.5	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
651:												
Thiefriver----------	0-12	8-18	1.30-1.45	2-6	0.13-0.18	0.0-2.9	2.0-4.0	.24	.24	5	3	86
	12-23	8-18	1.25-1.40	2-20	0.09-0.17	0.0-2.9	0.0-1.0	.28	.28			
	23-32	2-10	1.25-1.40	6-20	0.06-0.11	0.0-2.9	0.0-0.5	.17	.17			
	32-80	35-70	1.35-1.60	0.06-0.2	0.09-0.19	6.0-8.9	0.0-0.5	.32	.32			
667B:												
Fairdale----------	0-9	18-27	1.20-1.40	0.6-2	0.20-0.24	0.0-2.9	3.0-7.0	.24	.24	5	4L	86
	9-80	18-35	1.20-1.50	0.6-2	0.17-0.23	3.0-5.9	0.0-3.0	.32	.32			
667C2:												
Fairdale----------	0-8	18-27	1.20-1.40	0.6-2	0.20-0.24	0.0-2.9	3.0-7.0	.24	.24	5	4L	86
	8-80	18-35	1.20-1.50	0.6-2	0.17-0.23	3.0-5.9	0.0-3.0	.32	.32			
670:												
Knute----------	0-7	10-18	1.35-1.65	0.6-2	0.13-0.18	0.0-2.9	2.0-4.0	.20	.20	5	3	86
	7-18	18-28	1.30-1.65	0.6-2	0.15-0.19	0.0-2.9	1.0-2.0	.32	.32			
	18-36	10-18	1.40-1.65	0.6-2	0.11-0.19	0.0-2.9	0.5-1.0	.28	.28			
	36-80	10-18	1.45-1.70	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
671:												
Onstad----------	0-10	12-22	1.30-1.50	0.6-2	0.20-0.22	0.0-2.9	4.0-8.0	.24	.24	5	5	56
	10-17	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	1.0-2.0	.28	.28			
	17-47	10-18	1.45-1.65	0.6-2	0.11-0.19	0.0-2.9	0.5-1.0	.28	.28			
	47-80	10-18	1.50-1.80	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
681:												
Brandsvold----------	0-10	10-20	1.30-1.50	0.6-2	0.20-0.22	0.0-2.9	3.0-6.0	.24	.24	5	5	56
	10-19	18-27	1.45-1.65	0.6-2	0.15-0.19	3.0-5.9	0.5-2.0	.28	.28			
	19-36	10-18	1.50-1.65	0.6-2	0.11-0.19	0.0-2.9	0.5-1.0	.28	.28			
	36-80	10-18	1.55-1.70	0.2-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
694D2:												
Zell----------	0-7	10-18	1.15-1.30	0.6-2	0.19-0.22	0.0-2.9	2.0-5.0	.32	.32	5	4L	86
	7-14	10-18	1.25-1.40	0.6-2	0.15-0.20	0.0-2.9	0.0-1.0	.43	.43			
	14-80	5-18	1.25-1.40	0.6-2	0.15-0.20	0.0-2.9	0.0-0.5	.43	.43			
704:												
Wyrene----------	0-21	8-18	1.10-1.40	2-6	0.12-0.20	0.0-2.9	4.0-7.0	.20	.20	4	3	86
	21-80	0-5	1.30-1.60	6-20	0.02-0.07	0.0-2.9	0.0-0.5	.15	.28			
707A:												
Lizzie----------	0-14	18-22	1.20-1.40	0.6-2	0.20-0.24	3.0-5.9	2.0-5.0	.28	.28	5	5	56
	14-24	18-35	1.20-1.40	0.6-2	0.15-0.22	3.0-5.9	0.0-0.5	.37	.37			
	24-36	8-20	1.20-1.40	0.6-2	0.15-0.22	0.0-2.9	0.0-0.5	.32	.32			
	36-80	3-16	1.30-1.65	0.6-6	0.08-0.22	0.0-2.9	0.0-0.5	.32	.32			
712:												
Rosewood----------	0-10	8-18	1.20-1.40	2-6	0.13-0.18	0.0-2.9	4.0-7.0	.24	.24	3	3	86
	10-17	6-18	1.20-1.40	2-6	0.11-0.15	0.0-2.9	1.0-3.0	.24	.24			
	17-30	1-6	1.45-1.65	6-20	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
	30-80	1-6	1.40-1.65	6-20	0.02-0.07	0.0-2.9	0.0-0.5	.15	.15			
713:												
Linveldt----------	0-9	8-15	1.20-1.40	2-6	0.13-0.18	0.0-2.9	2.0-4.0	.28	.28	5	3	86
	9-16	12-18	1.25-1.50	0.6-6	0.12-0.18	0.0-2.9	1.0-3.0	.28	.28			
	16-29	2-10	1.45-1.70	6-20	0.06-0.11	0.0-2.9	0.0-0.5	.17	.17			
	29-80	16-30	1.35-1.70	0.6-2	0.14-0.19	0.0-2.9	0.0-0.5	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
718B:												
Naytahwaush----------	0-7	10-20	1.30-1.55	0.6-2	0.20-0.24	3.0-5.9	3.0-6.0	.28	.28	5	6	48
	7-31	35-60	1.25-1.40	0.06-0.2	0.10-0.19	6.0-8.9	0.5-1.0	.32	.32			
	31-80	22-35	1.30-1.55	0.2-0.6	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
718C:												
Naytahwaush----------	0-4	10-20	1.30-1.55	0.6-2	0.20-0.24	3.0-5.9	3.0-6.0	.28	.28	5	6	48
	4-8	8-15	1.30-1.50	0.2-2	0.16-0.24	3.0-5.9	0.5-1.0	.28	.28			
	8-18	35-60	1.25-1.40	0.06-0.2	0.10-0.19	6.0-8.9	0.5-1.0	.32	.32			
	18-80	22-35	1.30-1.55	0.2-0.6	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
718E:												
Naytahwaush----------	0-3	10-20	1.30-1.55	0.6-2	0.20-0.24	3.0-5.9	3.0-6.0	.28	.28	5	6	48
	3-7	8-15	1.30-1.50	0.2-2	0.16-0.24	3.0-5.9	0.5-1.0	.28	.28			
	7-14	35-60	1.25-1.40	0.06-0.2	0.10-0.19	6.0-8.9	0.5-1.0	.32	.32			
	14-80	22-35	1.30-1.55	0.2-0.6	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
733:												
Berner----------	0-32	---	0.15-0.40	0.2-6	0.35-0.48	---	80-95	---	---	2	2	134
	32-36	5-15	1.45-1.65	2-6	0.10-0.17	0.0-2.9	2.0-5.0	.17	.24			
	36-45	0-5	1.50-1.75	6-20	0.05-0.10	0.0-2.9	0.0-0.5	.05	.15			
	45-80	18-30	1.45-1.65	0.2-2	0.14-0.22	3.0-5.9	0.0-0.5	.32	.37			
735B:												
Halverson----------	0-10	2-10	1.50-1.60	2-6	0.08-0.12	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	10-23	2-10	1.55-1.70	6-20	0.06-0.11	0.0-2.9	0.5-1.0	.17	.17			
	23-35	18-27	1.45-1.65	0.6-2	0.15-0.19	3.0-5.9	0.5-1.0	.28	.28			
	35-55	10-18	1.50-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	.28			
	55-80	10-18	1.65-1.80	0.2-0.6	0.04-0.10	0.0-2.9	0.0-0.5	.28	.28			
735C:												
Halverson----------	0-10	2-10	1.50-1.60	2-6	0.08-0.12	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	10-21	2-10	1.55-1.70	6-20	0.06-0.11	0.0-2.9	0.5-1.0	.17	.17			
	21-29	18-27	1.45-1.65	0.6-2	0.15-0.19	3.0-5.9	0.5-1.0	.28	.28			
	29-80	10-18	1.65-1.80	0.2-0.6	0.04-0.10	0.0-2.9	0.0-0.5	.28	.28			
737:												
Mahkonce----------	0-4	22-35	1.30-1.55	0.2-0.6	0.17-0.22	3.0-5.9	3.0-6.0	.32	.32	5	6	48
	4-9	16-26	1.30-1.55	0.2-0.6	0.16-0.22	3.0-5.9	1.0-3.0	.32	.32			
	9-26	35-60	1.25-1.40	0.06-0.2	0.13-0.19	6.0-8.9	0.0-0.5	.24	.24			
	26-34	30-45	1.30-1.55	0.2-0.6	0.13-0.19	3.0-5.9	0.0-0.5	.32	.32			
	34-60	25-35	1.30-1.55	0.2-0.6	0.13-0.19	3.0-5.9	0.0-0.5	.32	.32			
746:												
Haslie----------	0-12	---	0.10-0.30	0.6-6	0.35-0.48	---	60-90	---	---	1	2	134
	12-30	---	0.10-0.30	0.6-6	0.35-0.48	---	60-90	---	---			
	30-80	18-35	0.10-1.25	0.06-0.6	0.18-0.24	3.0-5.9	6.0-20	.28	.28			
749:												
Colvin----------	0-9	20-32	1.20-1.50	0.6-2	0.20-0.22	3.0-5.9	4.0-8.0	.32	.32	5	4L	86
	9-28	18-32	1.20-1.50	0.2-2	0.18-0.21	3.0-5.9	1.0-3.0	.37	.37			
	28-52	18-32	1.20-1.50	0.2-2	0.17-0.20	3.0-5.9	0.5-1.0	.37	.37			
	52-60	15-35	1.30-1.50	0.2-2	0.17-0.20	3.0-5.9	0.5-1.0	.32	.32			
765:												
Smiley----------	0-10	8-20	1.20-1.50	0.6-2	0.20-0.24	0.0-2.9	2.0-5.0	.24	.24	5	5	56
	10-18	18-35	1.35-1.60	0.6-2	0.15-0.19	3.0-5.9	0.5-2.0	.24	.24			
	18-61	16-32	1.40-1.70	0.6-2	0.14-0.19	0.0-2.9	0.0-0.5	.24	.24			
	61-80	16-32	1.40-1.70	0.6-2	0.14-0.19	0.0-2.9	0.0-0.5	.24	.24			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
767:												
Auganaush	0-4	12-27	1.35-1.55	0.6-2	0.20-0.24	0.0-2.9	3.0-8.0	.32	.32	5	6	48
	4-9	5-18	1.40-1.60	0.6-2	0.16-0.24	0.0-2.9	1.0-3.0	.24	.24			
	9-25	35-60	1.25-1.50	0.06-0.6	0.10-0.19	6.0-8.9	0.0-0.5	.28	.28			
	25-60	30-45	1.30-1.55	0.06-0.6	0.14-0.19	3.0-5.9	0.0-0.5	.32	.32			
	60-80	18-35	1.25-1.50	0.2-2	0.16-0.19	3.0-5.9	0.0-0.5	.37	.37			
791:												
Winterfield	0-5	0-15	0.90-1.50	2-20	0.10-0.12	0.0-2.9	2.0-4.0	.17	.17	5	2	134
	5-80	0-10	1.55-1.65	6-20	0.04-0.10	0.0-2.9	0.0-0.5	.10	.17			
827B:												
Heimdal	0-14	10-20	1.30-1.60	0.6-2	0.20-0.22	0.0-2.9	3.0-6.0	.24	.24	5	5	56
	14-22	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	0.5-1.0	.32	.32			
	22-33	10-18	1.45-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.32	.32			
	33-80	7-18	1.65-1.80	0.6-2	0.11-0.16	0.0-2.9	0.0-0.5	.32	.32			
Esmond	0-8	10-18	1.30-1.60	0.6-2	0.20-0.22	0.0-2.9	1.0-4.0	.28	.28	5	4L	86
	8-22	7-18	1.40-1.60	0.6-2	0.14-0.22	0.0-2.9	0.5-1.0	.28	.28			
	22-80	7-18	1.50-1.80	0.6-2	0.11-0.16	0.0-2.9	0.0-0.5	.28	.28			
827C2:												
Heimdal	0-9	10-20	1.30-1.60	0.6-2	0.20-0.22	0.0-2.9	3.0-6.0	.24	.24	5	5	56
	9-30	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	0.5-1.0	.32	.32			
	30-80	7-18	1.65-1.80	0.6-2	0.11-0.16	0.0-2.9	0.0-0.5	.32	.32			
Esmond	0-9	10-18	1.30-1.60	0.6-2	0.20-0.22	0.0-2.9	1.0-4.0	.28	.28	5	4L	86
	9-18	7-18	1.40-1.60	0.6-2	0.14-0.22	0.0-2.9	0.5-1.0	.28	.28			
	18-80	7-18	1.50-1.80	0.6-2	0.11-0.16	0.0-2.9	0.0-0.5	.28	.28			
908:												
Bearden	0-10	27-39	1.20-1.40	0.2-0.6	0.17-0.23	3.0-5.9	3.0-7.0	.37	.37	5	4L	86
	10-17	18-34	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	1.0-4.0	.37	.37			
	17-26	18-34	1.30-1.80	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
	26-80	18-34	1.30-1.80	0.06-0.2	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
Fargo	0-10	40-60	1.10-1.30	0.06-0.2	0.15-0.18	6.0-8.9	4.0-10	.32	.32	5	4	86
	10-21	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	2.0-7.0	.32	.32			
	21-80	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	1.0-5.0	.32	.32			
935:												
Hegne	0-9	40-60	1.20-1.35	0.06-0.2	0.14-0.17	6.0-8.9	3.0-7.0	.32	.32	5	4	86
	9-15	40-60	1.25-1.40	0.06-0.2	0.13-0.16	6.0-8.9	1.0-3.0	.32	.32			
	15-24	40-60	1.25-1.40	0.06-0.2	0.09-0.16	6.0-8.9	0.0-0.5	.32	.32			
	24-80	40-60	1.25-1.55	0-0.2	0.08-0.14	6.0-8.9	0.0-0.5	.32	.32			
Fargo	0-10	40-60	1.10-1.30	0.06-0.2	0.15-0.18	6.0-8.9	4.0-10	.32	.32	5	4	86
	10-19	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	2.0-7.0	.32	.32			
	19-80	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	1.0-5.0	.32	.32			
967B:												
Waukon	0-6	12-27	1.40-1.60	0.6-2	0.20-0.24	3.0-5.9	2.0-6.0	.24	.24	5	6	48
	6-16	18-35	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	16-80	18-30	1.45-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
Langhei	0-7	18-27	1.40-1.50	0.6-2	0.17-0.22	0.0-2.9	0.5-3.0	.32	.32	5	4L	86
	7-19	18-32	1.50-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
	19-80	18-32	1.50-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
967C2:												
Waukon----------	0-6	12-27	1.40-1.60	0.6-2	0.20-0.24	3.0-5.9	2.0-6.0	.24	.24	5	6	48
	6-16	18-35	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	16-80	18-30	1.45-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
Langhei----------	0-7	18-27	1.40-1.50	0.6-2	0.17-0.22	0.0-2.9	0.5-3.0	.32	.32	5	4L	86
	7-19	18-32	1.50-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
	19-80	18-32	1.50-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
979D2:												
Langhei----------	0-7	18-27	1.40-1.50	0.6-2	0.17-0.22	0.0-2.9	0.5-3.0	.32	.32	5	4L	86
	7-19	18-32	1.50-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
	19-80	18-32	1.50-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
Waukon----------	0-6	12-27	1.40-1.60	0.6-2	0.20-0.24	3.0-5.9	2.0-6.0	.24	.24	5	6	48
	6-16	18-35	1.40-1.60	0.6-2	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	16-80	18-30	1.45-1.65	0.6-2	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
1006:												
Fluvaquents----------	0-24	6-27	1.20-1.50	0.6-2	0.18-0.24	0.0-2.9	3.0-10	.28	.28	5	5	56
	24-80	1-27	1.40-1.65	0.6-20	0.04-0.20	0.0-2.9	0.5-3.0	.17	.20			
Haploborolls----------	0-19	20-35	1.24-1.32	0.6-2	0.17-0.22	3.0-5.9	1.0-3.0	.28	.28	5	6	48
	19-80	15-30	1.24-1.32	0.6-2	0.14-0.20	0.0-2.9	0.0-0.5	.28	.28			
1030:												
Pits, gravel.												
Udipsamments----------	0-14	1-15	1.50-1.70	2-20	0.05-0.10	0.0-2.9	0.0-0.5	.15	.15	5	2	220
	14-60	1-10	1.50-1.70	6-20	0.05-0.08	0.0-2.9	0.0-0.0	.10	.10			
	60-80	1-10	1.50-1.70	20-20	0.03-0.05	0.0-2.9	0.0-0.0	.05	.10			
1113:												
Haslie----------	0-8	---	0.10-0.30	0.6-6	0.35-0.48	---	60-90	---	---	1	8	---
	8-34	---	0.10-0.30	0.6-6	0.35-0.48	---	60-90	---	---			
	34-80	18-35	0.10-1.25	0.06-0.6	0.18-0.24	3.0-5.9	6.0-20	.28	.28			
Seelyeville----------	0-30	---	0.10-0.25	0.2-6	0.35-0.45	---	25-99	---	---	3	8	---
	30-80	---	0.10-0.25	0.2-6	0.35-0.45	---	25-99	---	---			
Cathro----------	0-34	0-0	0.28-0.45	0.2-6	0.45-0.55	---	60-85	---	---	2	8	---
	34-80	10-30	1.50-1.70	0.2-2	0.11-0.22	0.0-2.9	1.0-5.0	---	---			
1117:												
Hedman----------	0-11	12-18	1.30-1.50	0.6-2	0.20-0.22	0.0-2.9	4.0-8.0	.24	---	5	4L	86
	11-20	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	1.0-3.0	.28	---			
	20-80	10-18	1.45-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	---			
1119:												
Nielsville----------	0-9	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	4.0-7.0	.28	.28	5	4L	86
	9-28	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	0.0-5.0	.32	.32			
	28-45	18-34	1.30-1.50	0.2-0.6	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			
	45-80	40-70	1.40-1.55	0.01-0.06	0.09-0.16	6.0-8.9	0.0-0.5	.28	.28			
1121:												
Hedman----------	0-9	12-18	1.30-1.50	0.6-2	0.20-0.22	0.0-2.9	5.0-9.0	.24	---	5	4L	86
	9-15	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	0.1-3.0	.28	---			
	15-80	10-18	1.45-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	---			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
1122:												
Nielsville----------	0-11	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	4.0-7.0	.28	.28	5	4L	86
	11-33	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	0.0-5.0	.32	.32			
	33-44	18-34	1.30-1.50	0.2-0.6	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			
	44-80	40-70	1.40-1.55	0.01-0.06	0.09-0.16	6.0-8.9	0.0-0.5	.28	.28			
Perella----------	0-9	27-39	1.20-1.40	0.2-2	0.18-0.23	3.0-5.9	4.0-8.0	.28	.28	5	7	38
	9-21	18-34	1.30-1.50	0.2-2	0.15-0.22	3.0-5.9	3.0-5.0	.28	.28			
	21-80	18-34	1.30-1.60	0.2-2	0.16-0.22	3.0-5.9	0.0-2.0	.28	.28			
1142:												
Hedman----------	0-10	12-18	1.30-1.50	0.6-2	0.20-0.22	0.0-2.9	4.0-8.0	.24	---	5	4L	86
	10-18	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	1.0-3.0	.28	---			
	18-80	10-18	1.45-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.28	---			
Fram----------	0-10	10-18	1.30-1.60	0.6-2	0.20-0.24	0.0-2.9	4.0-9.0	.28	.28	5	4L	86
	10-80	7-18	1.40-1.60	0.6-2	0.13-0.20	0.0-2.9	---	.37	.37			
1144:												
Strathcona----------	0-6	12-18	1.20-1.40	2-6	0.14-0.17	0.0-2.9	10-20	.20	.20	3	3	86
	6-19	10-18	1.30-1.50	2-6	0.14-0.16	0.0-2.9	0.5-2.0	.24	.24			
	19-29	2-8	1.35-1.60	6-20	0.05-0.09	0.0-2.9	0.0-0.5	.10	.10			
	29-80	15-30	1.40-1.60	0.2-2	0.14-0.18	3.0-5.9	0.0-0.5	.32	.32			
Kratka----------	0-14	5-15	1.20-1.50	2-20	0.14-0.18	0.0-2.9	5.0-25	.20	.20	5	2	134
	14-34	2-10	1.30-1.60	6-20	0.06-0.11	0.0-2.9	0.5-1.0	.17	.17			
	34-80	10-35	1.50-1.80	0.2-2	0.11-0.19	3.0-5.9	0.0-0.5	.32	.32			
1152B:												
Sugarbush----------	0-4	3-10	1.35-1.55	6-20	0.10-0.12	0.0-2.9	0.5-1.0	.17	.17	4	2	134
	4-10	2-10	1.40-1.60	6-20	0.09-0.11	0.0-2.9	0.5-1.0	.17	.17			
	10-20	10-18	1.40-1.60	2-6	0.12-0.15	0.0-2.9	0.0-0.5	.24	.24			
	20-80	1-5	1.60-1.80	20-40	0.02-0.06	0.0-2.9	0.0-0.5	.10	.15			
1152C:												
Sugarbush----------	0-5	3-10	1.35-1.55	6-20	0.10-0.12	0.0-2.9	0.5-1.0	.17	.17	4	2	134
	5-10	2-10	1.40-1.60	6-20	0.09-0.11	0.0-2.9	0.5-1.0	.17	.17			
	10-18	10-18	1.40-1.60	2-6	0.12-0.15	0.0-2.9	0.0-0.5	.24	.24			
	18-80	1-5	1.60-1.80	20-40	0.02-0.06	0.0-2.9	0.0-0.5	.10	.15			
1152E:												
Sugarbush----------	0-5	3-10	1.35-1.55	6-20	0.10-0.12	0.0-2.9	0.5-1.0	.17	.17	4	2	134
	5-12	2-10	1.40-1.60	6-20	0.09-0.11	0.0-2.9	0.5-1.0	.17	.17			
	12-18	10-18	1.40-1.60	2-6	0.12-0.15	0.0-2.9	0.0-0.5	.24	.24			
	18-80	1-5	1.60-1.80	20-40	0.02-0.06	0.0-2.9	0.0-0.5	.10	.15			
1233D:												
Esmond----------	0-7	10-18	1.30-1.60	0.6-2	0.20-0.22	0.0-2.9	1.0-4.0	.28	.28	5	4L	86
	7-80	7-18	1.50-1.80	0.6-2	0.11-0.16	0.0-2.9	0.0-0.5	.28	.28			
Heimdal----------	0-8	10-20	1.30-1.60	0.6-2	0.20-0.22	0.0-2.9	3.0-6.0	.24	.24	5	5	56
	8-15	10-18	1.35-1.65	0.6-2	0.12-0.19	0.0-2.9	0.5-1.0	.32	.32			
	15-30	10-18	1.45-1.65	0.6-2	0.11-0.19	0.0-2.9	0.0-0.5	.32	.32			
	30-80	7-18	1.65-1.80	0.6-2	0.11-0.16	0.0-2.9	0.0-0.5	.32	.32			
1264:												
Ulen----------	0-10	5-12	1.35-1.60	6-20	0.10-0.13	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	10-20	5-12	1.45-1.65	6-20	0.06-0.10	0.0-2.9	0.0-1.0	.17	.17			
	20-36	1-7	1.50-1.70	6-20	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15			
	36-80	10-18	1.20-1.50	6-20	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
1278:												
Rosewood	0-10	8-18	1.20-1.40	2-6	0.13-0.18	0.0-2.9	4.0-7.0	.24	.24	3	3	86
	10-17	6-18	1.20-1.40	2-6	0.11-0.15	0.0-2.9	1.0-3.0	.24	.24			
	17-30	1-6	1.45-1.65	6-20	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
	30-80	1-6	1.40-1.65	6-20	0.02-0.07	0.0-2.9	0.0-0.5	.15	.15			
Venlo	0-15	5-10	1.20-1.30	6-20	0.13-0.18	0.0-2.9	2.0-5.0	.20	.20	5	3	86
	15-80	0-7	1.40-1.70	6-20	0.05-0.12	0.0-2.9	0.0-0.5	.15	.15			
1279:												
Vallers	0-10	18-27	1.20-1.35	0.6-2	0.22-0.24	0.0-2.9	5.0-8.0	.28	.28	5	4L	86
	10-22	18-35	1.40-1.55	0.2-0.6	0.15-0.19	3.0-5.9	1.0-3.0	.28	.28			
	22-80	18-35	1.50-1.70	0.2-0.6	0.17-0.19	0.0-2.9	0.0-0.5	.37	.37			
Hamerly	0-9	18-27	1.20-1.60	0.6-2	0.20-0.24	0.0-2.9	4.0-7.0	.28	.28	5	4L	86
	9-22	18-30	1.20-1.60	0.6-2	0.15-0.19	0.0-2.9	0.5-1.0	.28	.32			
	22-80	18-30	1.30-1.60	0.6-2	0.14-0.19	0.0-2.9	0.0-0.5	.37	.37			
1280:												
Gunclub	0-9	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	3.0-7.0	.28	.28	5	4L	86
	9-34	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	1.0-4.0	.32	.32			
	34-54	18-34	1.30-1.50	0.2-0.6	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			
	54-80	40-70	1.35-1.55	0-0.06	0.09-0.16	6.0-8.9	0.0-0.5	.28	.28			
1283:												
Reis	0-17	40-60	1.20-1.50	0.06-0.2	0.15-0.19	6.0-8.9	4.0-8.0	.28	.28	5	4	86
	17-42	40-70	1.20-1.50	0.06-0.2	0.13-0.16	6.0-8.9	1.0-2.0	.24	.24			
	42-60	40-70	1.30-1.60	0.06-0.2	0.13-0.16	6.0-8.9	0.0-0.5	.24	.24			
	60-80	40-70	1.40-1.70	0.06-0.2	0.08-0.14	6.0-8.9	0.0-0.5	.28	.28			
Clearwater	0-10	40-60	1.20-1.50	0.06-0.2	0.13-0.17	6.0-8.9	3.0-6.0	.28	.28	5	4	86
	10-27	35-60	1.20-1.50	0.06-0.2	0.15-0.18	6.0-8.9	1.0-3.0	.32	.32			
	27-80	35-60	1.20-1.60	0.06-0.2	0.15-0.18	6.0-8.9	0.0-0.5	.32	.32			
1297:												
Augsburg	0-12	10-20	1.20-1.40	2-6	0.20-0.23	0.0-2.9	4.0-6.0	.28	.28	5	3	86
	12-25	5-18	1.30-1.50	2-6	0.20-0.23	0.0-2.9	1.0-3.0	.28	.28			
	25-54	5-18	1.40-1.60	2-6	0.17-0.22	0.0-2.9	0.5-1.0	.28	.28			
	54-80	35-80	1.15-1.50	0.06-0.2	0.10-0.14	6.0-8.9	0.0-0.5	.28	.28			
1299:												
Borup	0-10	10-20	1.30-1.50	2-6	0.20-0.22	0.0-2.9	4.0-8.0	.28	.28	5	3	86
	10-22	10-18	1.30-1.50	2-6	0.17-0.20	0.0-2.9	1.0-3.0	.32	.32			
	22-80	5-18	1.35-1.65	2-20	0.15-0.19	0.0-2.9	0.0-0.5	.24	.24			
1304A:												
Glyndon	0-8	15-20	1.20-1.40	0.6-2	0.20-0.23	0.0-2.9	3.0-7.0	.28	.28	5	3	86
	8-35	10-18	1.30-1.50	0.6-6	0.17-0.20	0.0-2.9	1.0-2.0	.43	.43			
	35-80	5-18	1.35-1.65	2-6	0.15-0.19	0.0-2.9	0.0-0.5	.43	.43			
1304B:												
Glyndon	0-10	15-20	1.20-1.40	0.6-2	0.20-0.23	0.0-2.9	3.0-7.0	.28	.28	5	3	86
	10-32	10-18	1.30-1.50	0.6-6	0.17-0.20	0.0-2.9	1.0-2.0	.43	.43			
	32-80	5-18	1.35-1.65	2-6	0.15-0.19	0.0-2.9	0.0-0.5	.43	.43			
1315A:												
Wheatville	0-9	5-18	1.30-1.50	2-6	0.16-0.20	0.0-2.9	3.0-6.0	.28	.28	5	3	86
	9-31	5-18	1.35-1.55	2-6	0.15-0.21	0.0-2.9	0.5-1.0	.28	.28			
	31-80	35-80	1.15-1.50	0.06-0.2	0.10-0.14	6.0-8.9	0.0-0.5	.28	.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
1323B:												
LaDelle	0-29	20-27	1.15-1.30	0.6-2	0.20-0.22	0.0-2.9	3.0-7.0	.28	.28	5	6	48
	29-69	25-35	1.20-1.35	0.6-2	0.18-0.22	3.0-5.9	0.5-2.0	.32	.32			
	69-80	25-50	1.30-1.40	0.2-2	0.12-0.22	3.0-5.9	0.0-0.5	.28	.28			
1325:												
Bowstring	0-65	0-5	0.15-0.30	0.2-6	0.35-0.45	---	40-90	---	---	3	8	---
	65-80	1-12	1.40-1.60	0.6-20	0.08-0.14	0.0-2.9	2.0-10	---	---			
Fluvaquents	0-16	6-27	1.20-1.50	0.6-2	0.18-0.24	0.0-2.9	3.0-10	.28	.28	5	5	56
	16-80	1-27	1.40-1.65	0.6-20	0.04-0.20	0.0-2.9	0.5-3.0	.17	.20			
1422:												
Northwood	0-14	---	0.18-0.25	2-6	0.35-0.45	---	50-85	---	---	3	2	134
	14-29	5-15	1.10-1.35	0.06-0.6	0.18-0.22	0.0-2.9	0.5-2.0	---	---			
	29-35	1-10	1.55-1.60	2-6	0.06-0.11	0.0-2.9	0.0-0.5	.15	.15			
	35-80	7-30	1.40-1.75	0.6-2	0.14-0.19	3.0-5.9	0.0-0.5	.37	.37			
1866:												
Colvin	0-10	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	4.0-7.0	.32	.32	5	4L	86
	10-20	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	0.0-5.0	.32	.32			
	20-80	18-34	1.30-1.50	0.2-2	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			
Perella	0-16	20-39	1.20-1.40	0.2-2	0.18-0.23	3.0-5.9	4.0-8.0	.28	.28	5	7	38
	16-23	18-34	1.30-1.50	0.06-2	0.15-0.22	3.0-5.9	---	.28	.28			
	23-80	18-34	1.30-1.60	0.2-2	0.16-0.22	3.0-5.9	---	.28	.28			
1871:												
Fargo	0-10	40-65	1.00-1.20	0.06-0.2	0.15-0.18	6.0-8.9	4.0-8.0	.32	.32	5	4	86
	10-21	40-65	1.15-1.50	0.06-0.2	0.14-0.17	6.0-8.9	3.0-7.0	.32	.32			
	21-80	40-65	1.15-1.50	0.06-0.2	0.14-0.17	6.0-8.9	1.0-5.0	.32	.32			
1874:												
Radium	0-14	1-8	1.55-1.75	6-20	0.06-0.12	0.0-2.9	1.0-3.0	.17	.17	5	2	134
	14-32	1-8	1.55-1.75	6-20	0.03-0.08	0.0-2.9	0.0-0.5	.10	.10			
	32-46	1-8	1.55-1.75	20-40	0.02-0.05	0.0-2.9	0.0-0.5	.05	.17			
	46-80	1-5	1.55-1.75	6-20	0.03-0.09	0.0-2.9	0.0-0.5	.10	.17			
1878:												
Hamre	0-10	---	0.18-0.22	0.2-2	0.35-0.48	0.0-2.9	85-95	---	---	5	2	134
	10-16	18-35	1.30-1.70	0.2-2	0.17-0.19	3.0-5.9	4.0-10	.32	.32			
	16-80	18-35	1.40-1.70	0.2-2	0.17-0.19	3.0-5.9	0.5-2.0	.32	.32			
1879:												
Seelyeville	0-12	---	0.10-0.25	0.2-6	0.35-0.45	---	25-99	---	---	3	2	134
	12-80	---	0.10-0.25	0.2-6	0.35-0.45	---	25-99	---	---			
1882:												
Rosewood	0-13	8-18	1.20-1.40	2-6	0.13-0.18	0.0-2.9	4.0-7.0	.24	.24	3	3	86
	13-18	6-18	1.20-1.40	2-6	0.11-0.15	0.0-2.9	1.0-3.0	.24	.24			
	18-80	1-6	1.45-1.65	6-20	0.05-0.08	0.0-2.9	0.0-0.5	.20	.24			
Strathcona	0-14	12-20	1.25-1.45	2-6	0.14-0.17	0.0-2.9	4.0-8.0	.20	.20	3	3	86
	14-26	2-8	1.35-1.50	6-20	0.05-0.11	0.0-2.9	0.5-2.0	.10	.10			
	26-36	2-8	1.35-1.60	6-20	0.05-0.09	0.0-2.9	0.0-0.5	.10	.10			
	36-80	15-30	1.40-1.60	0.2-2	0.14-0.18	3.0-5.9	0.0-0.5	.32	.32			
Berner	0-20	---	0.15-0.40	0.2-6	0.35-0.48	---	80-95	---	---	2	2	134
	20-26	5-15	1.45-1.65	2-6	0.10-0.17	0.0-2.9	2.0-5.0	.17	.24			
	26-40	0-5	1.50-1.75	6-20	0.05-0.10	0.0-2.9	0.0-0.5	.05	.15			
	40-80	18-30	1.45-1.65	0.2-2	0.14-0.22	3.0-5.9	0.0-0.5	.32	.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
1916:												
Lindaas----------	0-9	27-34	1.05-1.30	0.2-6	0.18-0.23	3.0-5.9	4.0-7.0	.28	.28	5	7	38
	9-30	40-50	1.20-1.40	0.06-0.2	0.14-0.17	9.0-25.0	0.0-4.0	.32	.32			
	30-40	25-40	1.20-1.50	0.2-2	0.15-0.22	6.0-8.9	0.0-2.0	.43	.43			
	40-80	20-35	1.30-1.50	0.2-2	0.08-0.22	3.0-5.9	0.0-1.0	.43	.43			
1963:												
Bearden----------	0-10	27-39	1.20-1.40	0.2-0.6	0.17-0.23	3.0-5.9	3.0-7.0	.37	.37	5	4L	86
	10-18	18-34	1.30-1.50	0.2-0.6	0.16-0.22	3.0-5.9	1.0-4.0	.37	.37			
	18-30	18-34	1.30-1.80	0.2-0.6	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
	30-80	18-34	1.30-1.80	0.06-0.2	0.16-0.22	3.0-5.9	0.0-0.5	.43	.43			
Colvin----------	0-10	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	4.0-7.0	.32	.32	5	4L	86
	10-19	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	0.0-5.0	.32	.32			
	19-80	18-34	1.30-1.50	0.2-2	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			
1964:												
Colvin----------	0-10	27-34	1.20-1.50	0.2-0.6	0.20-0.22	3.0-5.9	4.0-7.0	.32	.32	5	4L	86
	10-22	18-34	1.20-1.50	0.2-0.6	0.16-0.20	3.0-5.9	0.0-5.0	.32	.32			
	22-80	18-34	1.30-1.50	0.2-2	0.15-0.20	3.0-5.9	0.0-1.0	.32	.32			
Fargo----------	0-9	40-60	1.10-1.30	0.06-0.2	0.15-0.18	6.0-8.9	4.0-10	.32	.32	5	4	86
	9-30	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	2.0-7.0	.32	.32			
	30-80	40-60	1.20-1.50	0.06-0.2	0.14-0.17	6.0-8.9	1.0-5.0	.32	.32			

Chemical Properties of the Soils

(Absence of an entry indicates that data were not estimated.)

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
20B:							
Chapett	0-8	8.0-20	6.1-7.3	0	0	0	0
	8-19	8.0-19	6.1-7.3	0	0	0	0
	19-30	4.0-12	7.4-8.4	15-30	0	0	0
	30-80	4.0-12	7.4-8.4	10-12	0	0	0
20C2:							
Chapett	0-9	8.0-20	6.1-7.3	0	0	0	0
	9-21	8.0-19	6.1-7.3	0	0	0	0
	21-33	4.0-12	7.4-8.4	15-30	0	0	0
	33-80	4.0-12	7.4-8.4	10-12	0	0	0
20D2:							
Chapett	0-12	8.0-20	6.1-7.3	0	0	0	0
	12-21	8.0-19	6.1-7.3	0	0	0	0
	21-31	4.0-12	7.4-8.4	15-30	0	0	0
	31-80	4.0-12	7.4-8.4	10-12	0	0	0
20E:							
Chapett	0-4	8.0-20	6.1-7.3	0	0	0	0
	4-15	8.0-19	6.1-7.3	0	0	0	0
	15-50	4.0-12	7.4-8.4	15-30	0	0	0
	50-80	4.0-12	7.4-8.4	10-12	0	0	0
38B:							
Waukon	0-6	9.0-28	6.1-7.3	0	0	0	0
	6-29	7.0-21	6.1-8.4	0-30	0	0	0
	29-80	7.0-18	7.4-8.4	5-30	0	0	0
38C2:							
Waukon	0-7	9.0-28	6.1-7.3	0	0	0	0
	7-18	7.0-21	6.1-8.4	0-30	0	0	0
	18-80	7.0-18	7.4-8.4	5-30	0	0	0
38D2:							
Waukon	0-6	9.0-28	6.1-7.3	0	0	0	0
	6-18	7.0-21	6.1-8.4	0-30	0	0	0
	18-80	7.0-18	7.4-8.4	5-30	0	0	0
45B:							
Maddock	0-10	3.0-10	6.6-7.8	0-3	0	0.0-2.0	0
	10-80	1.0-8.0	6.6-8.4	0-10	0	0.0-2.0	0
45C:							
Maddock	0-10	3.0-10	6.6-7.8	0-3	0	0.0-2.0	0
	10-80	1.0-8.0	6.6-8.4	0-10	0	0.0-2.0	0
45E:							
Maddock	0-10	3.0-10	6.6-7.8	0-3	0	0.0-2.0	0
	10-80	1.0-8.0	6.6-8.4	0-10	0	0.0-2.0	0
47:							
Colvin	0-9	25-40	6.6-8.4	0-10	0-1	0	0-2
	9-24	15-25	7.4-8.4	15-40	0-1	0	0-3
	24-80	10-20	7.4-8.4	5-20	0-5	0	0-10

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
57A:							
Fargo	0-10	30-60	6.6-7.8	0-10	0	0.0-2.0	0
	10-19	25-50	6.6-8.4	0-15	0	0.0-2.0	0
	19-80	20-45	7.9-8.4	5-15	0-3	0.0-2.0	0
59:							
Grimstad	0-16	10-18	7.4-8.4	5-15	0	0	0
	16-31	2.0-12	7.4-9.0	5-20	0-3	0	0
	31-80	4.0-16	7.4-9.0	15-35	0-3	0	0
65:							
Foxhome	0-10	10-24	6.6-7.8	0	0	0	0
	10-15	6.0-18	6.6-7.8	0-10	0	0	0
	15-23	2.0-10	7.4-8.4	5-15	0	0	0
	23-80	6.0-18	7.4-8.4	15-30	0	0	0
66:							
Flaming	0-12	4.0-13	5.6-7.3	0	0	0	0
	12-80	1.0-6.0	5.6-8.4	0-15	0	0	0
67A:							
Bearden	0-8	10-25	7.4-8.4	1-10	0	0.0-4.0	0
	8-28	10-25	7.4-8.4	10-20	0-2	0.0-4.0	0-1
	28-42	10-20	7.4-8.4	15-35	0-3	0.0-4.0	0-1
	42-80	10-20	7.4-8.4	10-25	0-3	0.0-4.0	0-2
67B:							
Bearden	0-7	10-25	7.4-8.4	1-10	0	0.0-4.0	0
	7-17	10-25	7.4-8.4	10-20	0-2	0.0-4.0	0-1
	17-30	10-20	7.4-8.4	15-35	0-3	0.0-4.0	0-1
	30-80	10-20	7.4-8.4	10-25	0-3	0.0-4.0	0-2
93A:							
Bearden	0-10	15-30	7.4-8.4	1-10	0	0.0-4.0	0
	10-18	10-25	7.4-8.4	10-20	0-2	0.0-4.0	0-1
	18-26	10-20	7.4-8.4	15-35	0-3	0.0-4.0	0-1
	26-80	10-20	7.4-8.4	10-25	0-3	0.0-4.0	0-2
111:							
Hangaard	0-10	10-26	6.6-7.8	0	0	0	0
	10-15	4.0-14	6.6-7.8	0-5	0	0	0
	15-80	2.0-6.0	7.4-8.4	5-15	0	0	0
184A:							
Hamerly	0-9	15-30	6.6-8.4	0-15	---	---	---
	9-20	8.0-20	7.4-8.4	15-30	---	---	---
	20-80	7.0-19	7.4-8.4	10-25	---	---	---
185D2:							
Hattie	0-8	28-58	7.4-8.4	5-30	0	0	0
	8-80	24-52	7.4-8.4	5-30	0	0	0
236:							
Vallers	0-14	20-32	7.4-8.4	12-25	0	0.0-4.0	0
	14-35	10-18	7.4-8.4	20-35	0-2	0.0-4.0	0
	35-80	8.0-16	7.4-8.4	12-25	0-2	0.0-4.0	0
242B:							
Marquette	0-8	2.0-12	5.6-7.3	0	0	0	0
	8-18	3.0-12	6.6-8.4	0	0	0	0
	18-80	1.0-4.0	7.4-8.4	5-20	0	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
242D:							
Marquette	0-7	2.0-12	5.6-7.3	0	0	0	0
	7-16	3.0-12	6.6-8.4	0	0	0	0
	16-80	1.0-4.0	7.4-8.4	5-20	0	0	0
258B:							
Sandberg	0-19	2.0-12	5.6-7.8	0-5	0	0	0
	19-25	1.0-6.0	6.1-7.8	0-5	0	0	0
	25-38	1.0-6.0	7.4-8.4	10-25	0	0	0
	38-80	1.0-4.0	7.4-8.4	5-10	0	0	0
258C:							
Sandberg	0-10	2.0-12	5.6-7.8	0-5	0	0	0
	10-38	1.0-6.0	6.1-7.8	0-5	0	0	0
	38-59	1.0-6.0	7.4-8.4	10-25	0	0	0
	59-80	1.0-4.0	7.4-8.4	5-10	0	0	0
258E:							
Sandberg	0-9	2.0-12	5.6-7.8	0-5	0	0	0
	9-16	1.0-6.0	6.1-7.8	0-5	0	0	0
	16-41	1.0-6.0	7.4-8.4	10-25	0	0	0
	41-80	1.0-4.0	7.4-8.4	5-10	0	0	0
296:							
Fram	0-22	14-25	7.4-8.4	0-25	0	0	0
	22-80	5.0-10	7.4-8.4	15-30	0-3	0	0
341B:							
Arvilla	0-8	5.0-20	6.1-8.4	0	0	0	0
	8-16	5.0-15	6.6-8.4	0	0	0	0
	16-80	1.0-5.0	7.4-8.4	1-5	0	0	0
348:							
Borup	0-15	---	7.4-8.4	---	---	0.0-4.0	---
	15-24	---	7.4-8.4	---	---	0.0-4.0	---
	24-80	---	7.4-8.4	---	---	2.0-4.0	---
372:							
Hamar	0-8	7.0-12	6.1-7.8	0	0	0.0-2.0	0
	8-13	3.0-9.0	6.6-8.4	0-1	0	0.0-2.0	0
	13-80	3.0-9.0	7.4-8.4	0-2	0	0.0-2.0	0
387:							
Roliss	0-15	15-28	6.6-8.4	5-10	---	---	---
	15-20	10-18	7.4-8.4	5-15	0-3	---	---
	20-47	8.0-16	7.4-8.4	20-35	0-3	---	---
	47-80	8.0-16	7.4-8.4	12-25	0-3	---	---
412:							
Mavie	0-8	10-22	7.4-8.4	5-20	---	---	---
	8-16	6.0-20	7.9-8.4	15-40	---	---	---
	16-30	1.0-6.0	7.4-8.4	10-25	---	---	---
	30-80	9.0-18	7.4-8.4	10-30	0-3	---	---
422A:							
Bygland	0-7	20-40	6.1-7.3	0	0	0	0
	7-29	15-30	6.1-7.8	0-5	0	0	0
	29-37	10-25	7.4-8.4	10-20	0-2	0	0
	37-80	10-20	7.4-8.4	5-15	0-3	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
422B:							
Bygland	0-9	20-40	6.1-7.3	0	0	0	0
	9-22	15-30	6.1-7.8	0-5	0	0	0
	22-32	10-25	7.4-8.4	10-20	0-2	0	0
	32-80	10-20	7.4-8.4	5-15	0-3	0	0
422C2:							
Bygland	0-9	20-40	6.1-7.3	0	0	0	0
	9-20	15-30	6.1-7.8	0-5	0	0	0
	20-31	10-25	7.4-8.4	10-20	0-2	0	0
	31-80	10-20	7.4-8.4	5-15	0-3	0	0
426:							
Foldahl	0-12	4.0-14	6.1-7.8	0	0	0	0
	12-30	2.0-8.0	6.6-7.8	0-10	0	0	0
	30-44	6.0-18	7.4-8.4	15-30	0	0	0
	44-80	6.0-18	7.4-8.4	10-20	0	0	0
435:							
Syrene	0-11	10-25	7.4-8.4	5-30	0	0	0
	11-18	10-35	7.9-8.4	15-35	0	0	0
	18-80	1.0-10	7.4-8.4	10-30	0	0	0
439:							
Strathcona	0-10	10-25	7.4-8.4	5-15	0	0	0
	10-17	5.0-15	7.4-8.4	15-30	0	0	0
	17-30	2.0-8.0	7.4-8.4	5-15	0	0	0
	30-80	10-20	7.4-8.4	20-45	0	0	0
450:							
Rauville	0-36	25-31	7.4-8.4	5-15	0	0.0-2.0	1-2
	36-80	20-29	7.4-8.4	10-20	0-1	0.0-4.0	1-3
481:							
Kratka	0-10	6.0-20	5.6-7.8	0-15	0	0	0
	10-25	1.0-8.0	5.6-7.8	0-15	0	0	0
	25-80	4.0-21	6.1-8.4	0-30	0	0	0
494B:							
Darnen	0-28	15-30	6.6-7.8	0	0	0	0
	28-38	10-20	6.1-7.8	0-5	0	0	0
	38-60	10-15	7.4-8.4	5-20	0	0	0
506:							
Overly	0-18	20-40	6.6-7.8	0	0	0	0
	18-46	15-30	6.6-8.4	0-10	0-2	0.0-2.0	0
	46-80	15-30	7.9-8.4	10-20	0-2	0.0-4.0	0
540:							
Seelyeville	0-20	140-200	4.5-7.3	0	0	0	0
	20-80	140-200	4.5-7.3	0	0	0	0
543:							
Markey	0-32	110-170	4.5-7.8	0-5	0	0	0
	32-80	1.0-3.0	5.6-8.4	0-5	0	0	0
544:							
Cathro	0-24	120-170	4.5-7.8	0	0	0	0
	24-42	120-170	4.5-7.8	0	0	0	0
	42-80	5.0-25	6.6-8.4	5-25	0	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
547:							
Deerwood----------	0-14	90-190	5.6-7.8	0-5	0	0	0
	14-35	8.0-30	6.1-8.4	0-15	0	0	0
	35-80	1.0-10	7.4-8.4	10-20	0	0	0
563:							
Northwood----------	0-9	100-170	5.1-7.8	0	0	0	0
	9-16	5.0-15	5.6-7.8	0-15	0	0	0
	16-31	1.0-10	5.6-8.4	5-30	0	0	0
	31-80	5.0-25	7.4-8.4	5-30	0	0	0
565:							
Eckvoll----------	0-7	3.0-14	6.1-7.3	0	0	0	0
	7-26	1.0-7.0	6.1-7.3	0	0	0	0
	26-35	8.0-18	6.6-7.8	0	0	0	0
	35-80	6.0-16	7.4-8.4	10-30	0	0	0
573D:							
Serden----------	0-3	3.0-5.0	6.1-7.3	0	0	0	0
	3-80	2.0-3.0	6.6-7.8	0-3	0	0	0
582:							
Roliss----------	0-9	15-28	6.6-7.8	5-10	0	0	0
	9-14	10-18	7.4-8.4	5-15	0-1	0	0
	14-20	8.0-16	7.4-8.4	20-35	0-1	0	0
	20-80	8.0-16	7.4-8.4	12-25	0-1	0	0
641:							
Clearwater----------	0-12	26-42	6.6-7.8	0-5	0	0	0
	12-26	18-36	7.4-8.4	5-25	0	0	0
	26-80	18-30	7.4-8.4	5-25	0	0	0
642:							
Clearwater----------	0-10	8.0-24	6.6-7.8	0-5	0	0	0
	10-20	18-36	7.4-8.4	5-25	0	0	0
	20-80	18-30	7.4-8.4	5-25	0	0	0
643:							
Huot----------	0-14	5.0-20	7.4-8.4	5-30	0	0	0
	14-26	5.0-25	7.4-8.4	5-35	0	0	0
	26-34	2.0-20	7.4-8.4	5-30	0	0	0
	34-80	20-75	7.4-8.4	5-30	0	0	0
645:							
Espelie----------	0-9	8.0-18	6.6-7.3	0	0	0	0
	9-22	2.0-8.0	6.6-7.8	0-15	0	0	0
	22-80	16-30	7.4-8.4	10-30	0-3	0	0
647:							
Hilaire----------	0-10	5.0-14	6.6-7.3	0-10	0	0	0
	10-16	3.0-10	6.6-7.8	0-10	0	0	0
	16-25	1.0-6.0	6.6-7.8	0-15	0	0	0
	25-80	16-30	7.4-8.4	10-30	0	0	0
650:							
Reiner----------	0-9	15-20	6.6-7.3	0	0	0.0-2.0	0
	9-20	30-40	6.6-7.3	0-10	0	0.0-2.0	0
	20-80	10-25	7.4-8.4	20-30	0	0.0-2.0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
651:							
Thiefriver----------	0-12	8.0-17	7.4-8.4	5-15	0	0	0
	12-23	4.0-11	7.4-8.4	10-25	0	0	0
	23-32	1.0-6.0	7.4-8.4	5-10	0	0	0
	32-80	24-50	7.4-8.4	5-15	0	0	0
667B:							
Fairdale----------	0-9	15-30	7.4-7.8	3-10	0	0	0
	9-80	10-20	7.4-8.4	5-35	0	0.0-2.0	0
667C2:							
Fairdale----------	0-8	15-30	7.4-7.8	3-10	0	0	0
	8-80	10-20	7.4-8.4	5-35	0	0.0-2.0	0
670:							
Knute----------	0-7	8.0-18	6.1-7.3	0	0	0	0
	7-18	8.0-19	6.1-7.8	0	0	0	0
	18-36	4.0-12	7.4-8.4	20-30	0	0	0
	36-80	4.0-12	7.4-8.4	15-25	0	0	0
671:							
Onstad----------	0-10	9.0-18	6.1-7.3	0	0	0	0
	10-17	9.0-13	6.1-7.8	0	0	0	0
	17-47	5.0-10	7.4-8.4	20-30	0	0	0
	47-80	5.0-10	7.4-8.4	15-25	0	0	0
681:							
Brandsvold----------	0-10	7.0-15	6.1-7.3	0	0	0	0
	10-19	9.0-13	6.1-7.8	0	0	0	0
	19-36	5.0-10	7.4-8.4	20-30	0	0	0
	36-80	5.0-10	7.4-8.4	15-25	0	0	0
694D2:							
Zell----------	0-7	15-25	6.6-8.4	0-5	0	0.0-2.0	0
	7-14	10-20	7.4-8.4	15-30	0	0.0-2.0	0
	14-80	10-20	7.4-8.4	10-25	0-1	0.0-2.0	0-3
704:							
Wyrene----------	0-21	18-30	6.6-8.4	15-30	0	0	0
	21-80	0.0-3.0	7.4-8.4	10-25	0	0	0
707A:							
Lizzie----------	0-14	9.0-23	6.1-7.3	0	0	0	0
	14-24	8.0-22	6.1-7.3	0	0	0	0
	24-36	6.0-13	7.4-8.4	12-35	0	0	0
	36-80	2.0-10	7.4-8.4	12-35	0	0	0
712:							
Rosewood----------	0-10	8.0-24	7.4-8.4	5-20	0	0	0
	10-17	5.0-15	7.4-8.4	15-30	0	0	0
	17-30	1.0-4.0	7.4-8.4	5-25	0	0	0
	30-80	1.0-5.0	7.4-8.4	5-25	0	0	0
713:							
Linveldt----------	0-9	8.0-16	6.6-7.8	0	0	0	0
	9-16	8.0-16	6.6-7.8	0	0	0	0
	16-29	2.0-6.0	7.4-8.4	0-15	0	0	0
	29-80	8.0-16	7.4-8.4	15-25	0	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
718B:							
Naytahwaush----------	0-7	15-28	5.6-7.3	0	0	0	0
	7-31	15-26	5.6-7.3	0-5	0	0	0
	31-80	9.0-22	7.4-8.4	15-25	0	0	0
718C:							
Naytahwaush----------	0-4	15-28	5.6-7.3	0	0	0	0
	4-8	6.0-18	5.6-7.3	0	0	0	0
	8-18	15-26	5.6-7.3	0-5	0	0	0
	18-80	9.0-22	7.4-8.4	15-25	0	0	0
718E:							
Naytahwaush----------	0-3	15-28	5.6-7.3	0	0	0	0
	3-7	6.0-18	5.6-7.3	0	0	0	0
	7-14	15-26	5.6-7.3	0-5	0	0	0
	14-80	9.0-22	7.4-8.4	15-25	0	0	0
733:							
Berner----------	0-32	115-160	5.6-7.3	0	0	0	0
	32-36	5.0-15	6.1-7.3	0	0	0	0
	36-45	2.0-8.0	6.1-7.8	0-5	0	0	0
	45-80	10-20	7.4-8.4	15-35	0	0	0
735B:							
Halverson----------	0-10	4.0-8.0	5.6-7.3	0	0	0	0
	10-23	3.0-5.0	5.6-7.3	0	0	0	0
	23-35	9.0-13	6.1-7.8	0	0	0	0
	35-55	5.0-10	7.4-8.4	15-35	0	0	0
	55-80	5.0-10	7.4-8.4	15-25	0	0	0
735C:							
Halverson----------	0-10	4.0-8.0	5.6-7.3	0	0	0	0
	10-21	3.0-5.0	5.6-7.3	0	0	0	0
	21-29	9.0-13	6.1-7.8	0	0	0	0
	29-80	5.0-10	7.4-8.4	15-25	0	0	0
737:							
Mahkonce----------	0-4	15-30	5.6-7.3	0	0	0	0
	4-9	10-25	5.6-7.3	0	0	0	0
	9-26	25-30	6.1-7.3	0	0	0	0
	26-34	10-20	6.1-7.8	5-15	0	0	0
	34-60	10-20	7.4-8.4	15-30	0	0	0
746:							
Haslie----------	0-12	140-180	5.6-7.8	---	---	---	---
	12-30	140-190	5.6-7.8	---	---	---	---
	30-80	10-45	7.4-8.4	20-80	---	---	---
749:							
Colvin----------	0-9	20-30	7.4-8.4	5-15	0	0	0
	9-28	10-25	7.4-8.4	15-40	0	0	0
	28-52	10-18	7.4-8.4	15-30	0	0	0
	52-60	8.0-18	7.4-8.4	10-25	0	0	0
765:							
Smiley----------	0-10	7.0-22	6.6-7.8	0-15	0	0	0
	10-18	8.0-25	6.6-8.4	0-30	0	0	0
	18-61	8.0-25	7.9-8.4	10-30	0	0	0
	61-80	5.0-20	7.4-8.4	5-25	0	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
767:							
Auganaush	0-4	15-30	5.6-7.3	0	0	0	0
	4-9	5.0-15	5.6-7.3	0	0	0	0
	9-25	15-30	5.6-7.3	0	0	0	0
	25-60	15-25	7.4-8.4	15-30	0	0	0
	60-80	10-30	7.4-8.4	15-30	0	0	0
791:							
Winterfield	0-5	2.0-15	5.6-7.8	0-5	0	0	0
	5-80	1.0-5.0	5.6-8.4	0-5	0	0	0
827B:							
Heimdal	0-14	10-24	6.1-7.3	0	0	0	0
	14-22	5.0-12	6.1-7.8	0-10	0	0	0
	22-33	5.0-12	7.4-8.4	20-30	0	0	0
	33-80	4.0-10	7.4-8.4	15-25	0	0	0
Esmond	0-8	7.0-23	7.4-8.4	0-5	0	0	0
	8-22	4.0-20	7.4-8.4	20-30	0	0	0
	22-80	4.0-20	7.4-8.4	15-25	0	0	0
827C2:							
Heimdal	0-9	10-24	6.1-7.3	0	0	0	0
	9-30	5.0-12	6.1-7.8	0-10	0	0	0
	30-80	4.0-10	7.4-8.4	15-25	0	0	0
Esmond	0-9	7.0-23	7.4-8.4	0-5	0	0	0
	9-18	4.0-20	7.4-8.4	20-30	0	0	0
	18-80	4.0-20	7.4-8.4	15-25	0	0	0
908:							
Bearden	0-10	15-30	7.4-8.4	1-10	0	0.0-4.0	0
	10-17	10-25	7.4-8.4	10-20	0-2	0.0-4.0	0-1
	17-26	10-20	7.4-8.4	15-35	0-3	0.0-4.0	0-1
	26-80	10-20	7.4-8.4	10-25	0-3	0.0-4.0	0-2
Fargo	0-10	30-60	6.6-7.8	0-10	0	0.0-2.0	0
	10-21	25-50	6.6-8.4	0-15	0	0.0-2.0	0
	21-80	20-45	7.9-8.4	5-15	0-3	0.0-2.0	0
935:							
Hegne	0-9	26-44	7.4-8.4	10-20	0	0	0
	9-15	18-36	7.4-8.4	15-30	0	0.0-4.0	0
	15-24	18-32	7.4-8.4	15-30	0-3	0.0-4.0	0
	24-80	18-32	7.4-8.4	10-20	0-3	0.0-4.0	0
Fargo	0-10	30-60	6.6-7.8	0-10	0	0.0-2.0	0
	10-19	25-50	6.6-8.4	0-15	0	0.0-2.0	0
	19-80	20-45	7.9-8.4	5-15	0-3	0.0-2.0	0
967B:							
Waukon	0-6	9.0-28	6.1-7.3	0	0	0	0
	6-16	7.0-21	6.1-8.4	0-30	0	0	0
	16-80	7.0-18	7.4-8.4	5-30	0	0	0
Langhei	0-7	10-30	6.6-8.4	0-30	0	0	0
	7-19	10-25	7.9-8.4	20-35	0	0	0
	19-80	10-25	7.4-8.4	15-30	0	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
967C2:							
Waukon	0-6	9.0-28	6.1-7.3	0	0	0	0
	6-16	7.0-21	6.1-8.4	0-30	0	0	0
	16-80	7.0-18	7.4-8.4	5-30	0	0	0
Langhei	0-7	10-30	6.6-8.4	0-30	0	0	0
	7-19	10-25	7.9-8.4	20-35	0	0	0
	19-80	10-25	7.4-8.4	15-30	0	0	0
979D2:							
Langhei	0-7	10-30	6.6-8.4	0-30	0	0	0
	7-19	10-25	7.9-8.4	20-35	0	0	0
	19-80	10-25	7.4-8.4	15-30	0	0	0
Waukon	0-6	9.0-28	6.1-7.3	0	0	0	0
	6-16	7.0-21	6.1-8.4	0-30	0	0	0
	16-80	7.0-18	7.4-8.4	5-30	0	0	0
1006:							
Fluvaquents	0-24	10-35	5.6-7.8	0-15	0	0	0
	24-80	5.0-30	5.6-7.8	0-15	0	0	0
Haploborolls	0-19	12-24	6.6-7.8	0	0	0	0
	19-80	8.0-16	7.4-8.4	0	0	0	0
1030:							
Pits, gravel.							
Udipsamments	0-14	1.0-5.0	6.6-7.3	0	0	0	0
	14-60	1.0-3.0	6.6-7.3	0	0	0	0
	60-80	1.0-3.0	7.4-8.4	0-5	0	0	0
1113:							
Haslie	0-8	140-180	5.6-7.8	0	0	0	0
	8-34	140-190	5.6-7.8	0	0	0	0
	34-80	10-45	7.4-8.4	60-80	0	0	0
Seelyeville	0-30	140-200	4.5-7.3	0	0	0	0
	30-80	140-200	4.5-7.3	0	0	0	0
Cathro	0-34	150-230	4.5-7.8	0	0	0	0
	34-80	2.0-20	5.6-8.4	5-25	0	0	0
1117:							
Hedman	0-11	14-25	6.6-7.8	0-25	0	0	0
	11-20	6.0-15	7.4-8.4	15-30	0-3	0	0
	20-80	5.0-10	7.4-8.4	10-25	0-3	0	0
1119:							
Nielsville	0-9	25-40	7.4-8.4	1-10	0-1	0.0-4.0	0-2
	9-28	15-25	7.4-8.4	15-30	0-1	0.0-4.0	0-3
	28-45	10-20	7.4-8.4	10-30	0-5	0.0-4.0	0-10
	45-80	25-50	7.4-8.4	5-30	0-1	0.0-4.0	0-2
1121:							
Hedman	0-9	16-28	6.6-7.8	10-25	0	0	0
	9-15	6.0-16	7.4-8.4	15-30	0-3	0	0
	15-80	5.0-10	7.4-8.4	10-25	0-3	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
1122:							
Nielsville----------	0-11	25-40	7.4-8.4	1-10	0-1	0.0-4.0	0-2
	11-33	15-25	7.4-8.4	15-30	0-1	0.0-4.0	0-3
	33-44	10-20	7.4-8.4	10-30	0-5	0.0-4.0	0-10
	44-80	25-50	7.4-8.4	5-30	0-1	0.0-4.0	0-2
Perella----------	0-9	---	6.6-7.8	---	---	0	---
	9-21	---	6.6-7.8	---	---	0	---
	21-80	---	7.4-8.4	---	---	0	---
1142:							
Hedman----------	0-10	14-25	6.6-7.8	0-25	0	0	0
	10-18	6.0-15	7.4-8.4	15-30	0-3	0	0
	18-80	5.0-10	7.4-8.4	10-25	0-3	0	0
Fram----------	0-10	14-25	7.4-8.4	0-25	0	0	0
	10-80	5.0-10	7.4-8.4	15-30	0-3	0	0
1144:							
Strathcona----------	0-6	25-51	7.4-8.4	5-15	0	0	0
	6-19	5.0-15	7.4-8.4	15-30	0	0	0
	19-29	2.0-8.0	7.4-8.4	5-15	0	0	0
	29-80	10-20	7.4-8.4	20-45	0	0	0
Kratka----------	0-14	6.0-30	6.6-7.8	0-10	0	0	0
	14-34	1.0-8.0	6.6-7.8	0-15	0	0	0
	34-80	4.0-21	6.1-8.4	0-30	0	0	0
1152B:							
Sugarbush----------	0-4	2.0-8.0	5.6-7.3	0	0	0	0
	4-10	2.0-8.0	5.6-7.3	0	0	0	0
	10-20	5.0-10	5.6-7.3	0	0	0	0
	20-80	1.0-5.0	5.6-8.4	0-15	0	0	0
1152C:							
Sugarbush----------	0-5	2.0-8.0	5.6-7.3	0	0	0	0
	5-10	2.0-8.0	5.6-7.3	0	0	0	0
	10-18	5.0-10	5.6-7.3	0	0	0	0
	18-80	1.0-5.0	5.6-8.4	0-15	0	0	0
1152E:							
Sugarbush----------	0-5	2.0-8.0	5.6-7.3	0	0	0	0
	5-12	2.0-8.0	5.6-7.3	0	0	0	0
	12-18	5.0-10	5.6-7.3	0	0	0	0
	18-80	1.0-5.0	5.6-8.4	0-15	0	0	0
1233D:							
Esmond----------	0-7	7.0-23	7.4-8.4	0-5	0	0	0
	7-80	4.0-20	7.4-8.4	15-25	0	0	0
Heimdal----------	0-8	10-24	6.1-7.3	0	0	0	0
	8-15	5.0-12	6.1-7.8	0-10	0	0	0
	15-30	5.0-12	7.4-8.4	20-30	0	0	0
	30-80	4.0-10	7.4-8.4	15-25	0	0	0
1264:							
Ulen----------	0-10	5.0-15	7.4-8.4	5-30	0	0.0-4.0	0
	10-20	0.0-10	7.9-8.4	5-30	0	0.0-4.0	0
	20-36	0.0-10	7.4-8.4	5-30	0	0.0-4.0	0
	36-80	5.0-15	7.4-8.4	5-30	0	0.0-4.0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
1278:							
Rosewood----------	0-10	8.0-24	7.4-8.4	5-20	0	0	0
	10-17	5.0-15	7.4-8.4	15-30	0	0	0
	17-30	1.0-4.0	7.4-8.4	5-25	0	0	0
	30-80	1.0-5.0	7.4-8.4	5-25	0	0	0
Venlo----------	0-15	5.0-15	6.1-7.3	0	0	0	0
	15-80	1.0-5.0	6.6-8.4	1-15	0	0	0
1279:							
Vallers----------	0-10	20-32	7.4-8.4	12-25	0	0.0-4.0	0
	10-22	10-18	7.4-8.4	20-35	0-2	0.0-4.0	0
	22-80	8.0-16	7.4-8.4	12-25	0-2	0.0-4.0	0
Hamerly----------	0-9	15-30	6.6-8.4	0-15	---	---	---
	9-22	8.0-20	7.4-8.4	15-30	---	---	---
	22-80	7.0-19	7.4-8.4	10-25	---	---	---
1280:							
Gunclub----------	0-9	25-40	7.4-8.4	1-10	0-1	0.0-4.0	0-2
	9-34	15-25	7.4-8.4	15-30	0-1	0.0-4.0	0-3
	34-54	10-20	7.4-8.4	10-30	0-5	0.0-4.0	0-10
	54-80	25-50	7.4-8.4	5-30	0-1	0.0-4.0	0-2
1283:							
Reis----------	0-17	26-42	7.4-8.4	10-20	0	0	0
	17-42	18-45	7.4-8.4	15-30	0	0	0
	42-60	18-30	7.4-8.4	5-25	0	0	0
	60-80	10-20	7.4-8.4	3-15	0-3	0.0-2.0	0
Clearwater----------	0-10	26-42	6.6-7.8	0-5	0	0	0
	10-27	18-36	7.4-8.4	5-25	0	0	0
	27-80	18-30	7.4-8.4	5-25	0	0	0
1297:							
Augsburg----------	0-12	10-25	7.4-8.4	5-30	0	0.0-2.0	0
	12-25	1.0-15	7.4-8.4	25-40	0-3	0.0-2.0	0
	25-54	1.0-15	7.4-8.4	30-35	0-3	2.0-4.0	0
	54-80	20-65	7.4-8.4	10-30	0	0.0-4.0	0
1299:							
Borup----------	0-10	8.0-18	7.4-8.4	10-25	0	0.0-4.0	0
	10-22	6.0-15	7.4-8.4	15-40	0	0.0-4.0	0
	22-80	3.0-10	7.4-8.4	10-30	0	0.0-4.0	0
1304A:							
Glyndon----------	0-8	12-24	7.4-8.4	15-25	0	0.0-4.0	0
	8-35	6.0-14	7.4-8.4	20-40	0	0.0-4.0	0
	35-80	2.0-10	7.4-8.4	15-35	0	0.0-4.0	0
1304B:							
Glyndon----------	0-10	12-24	7.4-8.4	15-25	0	0.0-4.0	0
	10-32	6.0-14	7.4-8.4	20-40	0	0.0-4.0	0
	32-80	2.0-10	7.4-8.4	15-35	0	0.0-4.0	0
1315A:							
Wheatville----------	0-9	10-30	7.4-8.4	5-30	0	0.0-4.0	0
	9-31	5.0-15	7.4-8.4	15-40	0	0.0-4.0	0
	31-80	20-65	7.4-7.8	10-30	0	0.0-4.0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
1323B:							
LaDelle----------	0-29	20-25	6.1-7.8	0	0	0.0-2.0	0
	29-69	20-30	7.4-8.4	4-15	0	0.0-4.0	0
	69-80	15-25	7.4-8.4	4-15	0-2	0.0-4.0	0-1
1325:							
Bowstring----------	0-65	80-190	5.6-8.4	0-25	0	0	0
	65-80	10-40	5.6-8.4	0-25	0	0	0
Fluvaquents----------	0-16	10-35	5.6-7.8	0-15	0	0	0
	16-80	5.0-30	5.6-7.8	0-15	0	0	0
1356:							
Water, miscellaneous.							
1422:							
Northwood----------	0-14	140-180	6.6-7.8	0-10	0	0	0
	14-29	5.0-10	7.4-8.4	40-90	0	0	0
	29-35	2.0-7.0	6.6-7.8	0-5	0	0	0
	35-80	4.0-18	7.4-8.4	5-15	0	0	0
1866:							
Colvin----------	0-10	25-40	6.6-8.4	0-10	0-1	0	0-2
	10-20	15-25	7.4-9.0	15-40	0-1	0	0-3
	20-80	10-20	7.4-8.4	5-20	0-5	0	0-10
Perella----------	0-16	---	6.6-7.8	---	---	0	---
	16-23	---	6.6-7.8	---	---	0	---
	23-80	---	7.4-8.4	---	---	0	---
1871:							
Fargo----------	0-10	30-60	6.6-7.8	0-10	0	0	0
	10-21	25-50	6.6-8.4	0-15	0	0	0
	21-80	20-45	7.9-8.4	5-15	0-3	0	0
1874:							
Radium----------	0-14	3.0-12	6.1-7.8	0-5	0	0	0
	14-32	2.0-8.0	6.6-8.4	2-10	0	0	0
	32-46	1.0-5.0	7.4-8.4	5-15	0	0	0
	46-80	1.0-5.0	7.4-8.4	5-15	0	0	0
1878:							
Hamre----------	0-10	160-200	5.1-7.8	0-5	0	0	0
	10-16	16-28	5.1-7.8	0-10	0	0	0
	16-80	10-22	7.4-8.4	5-30	0	0	0
1879:							
Seelyeville----------	0-12	140-200	7.4-8.4	5-15	0	0	0
	12-80	140-200	7.4-8.4	5-15	0	0	0
1882:							
Rosewood----------	0-13	8.0-24	7.9-8.4	5-15	0	0	0
	13-18	5.0-15	7.9-8.4	15-30	0	0	0
	18-80	1.0-4.0	7.4-8.4	5-20	0	0	0
Strathcona----------	0-14	15-35	7.4-8.4	5-15	0	0	0
	14-26	2.0-8.0	7.4-8.4	15-30	0	0	0
	26-36	2.0-8.0	7.4-8.4	5-15	0	0	0
	36-80	10-20	7.4-8.4	20-45	0	0	0

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	meq/100g	pH	Pct	Pct	mmhos/cm	
1882:							
Berner----------	0-20	115-160	5.6-7.3	---	---	---	---
	20-26	5.0-15	6.1-7.3	---	---	---	---
	26-40	2.0-8.0	6.1-7.8	0-5	---	---	---
	40-80	10-20	7.4-8.4	15-35	---	---	---
1916:							
Lindaas----------	0-9	20-35	6.6-7.3	0	0	0	0
	9-30	20-40	6.6-7.8	0	0	0	0-1
	30-40	10-30	7.4-8.4	0-5	0-1	0	0-2
	40-80	10-25	7.4-8.4	5-10	0-1	0	0-2
1963:							
Bearden----------	0-10	15-30	7.4-8.4	1-10	0	0.0-4.0	0
	10-18	10-25	7.4-8.4	10-20	0-2	0.0-4.0	0-1
	18-30	10-20	7.4-8.4	15-35	0-3	0.0-4.0	0-1
	30-80	10-20	7.4-8.4	10-25	0-3	0.0-4.0	0-2
Colvin----------	0-10	25-40	6.6-8.4	0-10	0-1	0	0-2
	10-19	15-25	7.4-8.4	15-40	0-1	0	0-3
	19-80	10-20	7.4-8.4	5-20	0-5	0	0-10
1964:							
Colvin----------	0-10	25-40	6.6-8.4	0-10	0-1	0	0-2
	10-22	15-25	7.4-8.4	15-40	0-1	0	0-3
	22-80	10-20	7.4-8.4	5-20	0-5	0	0-10
Fargo----------	0-9	30-60	6.6-7.8	0-10	0	0.0-2.0	0
	9-30	25-50	6.6-8.4	0-15	0	0.0-2.0	0
	30-80	20-45	7.9-8.4	5-15	0-3	0.0-2.0	0

Water Features

(See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Map symbol and soil name	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table and ponding: Water table depth	High water table and ponding: Kind of water table	High water table and ponding: Months	High water table and ponding: Ponding duration	High water table and ponding: Maximum ponding depth
					Ft				Ft
20B, 20C2, 20D2, 20E:									
Chapett	B	None	---	---	>6.0	---	---	---	---
38B, 38C2, 38D2:									
Waukon	B	None	---	---	>6.0	---	---	---	---
45B, 45C, 45E:									
Maddock	A	None	---	---	>6.0	---	---	---	---
47:									
Colvin	C/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
57A:									
Fargo	D	None	---	---	0.5-1.5	Apparent	Mar-Jul	---	---
59:									
Grimstad	B	None	---	---	1.5-4.0	Apparent	Apr-Jul	---	---
65:									
Foxhome	B	None	---	---	2.5-4.0	Apparent	Oct-Jun	---	---
66:									
Flaming	A	None	---	---	2.5-4.0	Apparent	Nov-Jun	---	---
67A, 67B, 93A:									
Bearden	C	None	---	---	1.5-4.0	Apparent	Apr-Jun	---	---
111:									
Hangaard	A/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
184A:									
Hamerly	C	None	---	---	1.5-4.0	Apparent	Apr-Jun	---	---
185D2:									
Hattie	C	None	---	---	>6.0	---	---	---	---
236:									
Vallers	C	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
242B, 242D:									
Marquette	A	None	---	---	>6.0	---	---	---	---
258B, 258C, 258E:									
Sandberg	A	None	---	---	>6.0	---	---	---	---
296:									
Fram	B	None	---	---	1.5-5.0	Apparent	Sep-Jun	---	---
341B:									
Arvilla	B	None	---	---	>6.0	---	---	---	---
348:									
Borup	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Long	1.0
372:									
Hamar	A/D	None	---	---	1.0-1.5	Apparent	Oct-Jun	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table and ponding: Water table depth	High water table and ponding: Kind of water table	High water table and ponding: Months	High water table and ponding: Ponding duration	High water table and ponding: Maximum ponding depth
					Ft				Ft
387:									
Roliss	B/D	None	---	---	0.0-1.0	Apparent	Mar-Jul	Long	1.0
412:									
Mavie	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
422A, 422B, 422C2:									
Bygland	C	None	---	---	2.5-4.0	Apparent	Apr-Jun	---	---
426:									
Foldahl	B	None	---	---	2.5-3.5	Apparent	Nov-Jun	---	---
435:									
Syrene	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
439:									
Strathcona	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
450:									
Rauville	D	Frequent	Long	Mar-Oct	0.0-0.5	Apparent	Jan-Dec	---	---
481:									
Kratka	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
494B:									
Darnen	B	None	---	---	>6.0	---	---	---	---
506:									
Overly	C	None	---	---	3.0-5.0	Apparent	Apr-Jun	---	---
540:									
Seelyeville	A/D	None	---	---	0.0-0.5	Apparent	Oct-Jun	Long	1.0
543:									
Markey	A/D	None	---	---	0.0-1.0	Apparent	Nov-Jun	Long	1.0
544:									
Cathro	A/D	None	---	---	0.0-0.5	Apparent	Oct-Jun	Long	1.0
547:									
Deerwood	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Long	1.0
563:									
Northwood	B/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Long	1.0
565:									
Eckvoll	B	None	---	---	2.5-3.5	Apparent	Mar-Jun	---	---
573D:									
Serden	A	None	---	---	>6.0	---	---	---	---
582:									
Roliss	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
641, 642:									
Clearwater	D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
643:									
Huot	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table and ponding: Water table depth	High water table and ponding: Kind of water table	High water table and ponding: Months	High water table and ponding: Ponding duration	High water table and ponding: Maximum ponding depth
					Ft				Ft
645:									
Espelie	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
647:									
Hilaire	B	None	---	---	2.5-4.0	Apparent	Apr-Jun	---	---
650:									
Reiner	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---
651:									
Thiefriver	B/D	None	---	---	0.5-1.5	Apparent	Mar-Jun	---	---
667B, 667C2:									
Fairdale	B	Occasional	Brief	Mar-Jun	3.0-5.0	Apparent	Apr-Jun	---	---
670:									
Knute	B	None	---	---	2.5-3.5	Apparent	Mar-Jun	---	---
671:									
Onstad	B	None	---	---	2.5-4.0	Apparent	Mar-Jul	---	---
681:									
Brandsvold	C/D	None	---	---	0.5-1.5	Apparent	Oct-Jul	---	---
694D2:									
Zell	B	None	---	---	>6.0	---	---	---	---
704:									
Wyrene	B	None	---	---	1.5-3.5	Apparent	Mar-Jun	---	---
707A:									
Lizzie	B	None	---	---	>6.0	---	---	---	---
712:									
Rosewood	A/D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
713:									
Linveldt	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---
718B, 718C, 718E:									
Naytahwaush	B	None	---	---	>6.0	---	---	---	---
733:									
Berner	A/D	None	---	---	0.0-0.5	Apparent	Nov-Jun	Long	1.0
735B, 735C:									
Halverson	B	None	---	---	>6.0	---	---	---	---
737:									
Mahkonce	C	None	---	---	2.5-4.0	Apparent	Mar-May	---	---
746:									
Haslie	A/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Long	1.0
749:									
Colvin	C/D	Occasional	Brief	Mar-Jun	0.0-1.0	Apparent	Mar-Jun	---	---
765:									
Smiley	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
767:									
Auganaush	C	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table and ponding: Water table depth	High water table and ponding: Kind of water table	High water table and ponding: Months	High water table and ponding: Ponding duration	High water table and ponding: Maximum ponding depth
					Ft				Ft
791:									
Winterfield	A/D	Occasional	Brief	Nov-May	0.5-3.0	Apparent	Nov-May	---	---
827B, 827C2:									
Heimdal	B	None	---	---	>6.0	---	---	---	---
Esmond	B	None	---	---	>6.0	---	---	---	---
908:									
Bearden	C	None	---	---	1.5-4.0	Apparent	Apr-Jun	---	---
Fargo	D	None	---	---	0.5-1.5	Apparent	Mar-Jul	---	---
935:									
Hegne	D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
Fargo	D	None	---	---	0.5-1.5	Apparent	Mar-Jul	---	---
967B, 967C2:									
Waukon	B	None	---	---	>6.0	---	---	---	---
Langhei	B	None	---	---	>6.0	---	---	---	---
979D2:									
Langhei	B	None	---	---	>6.0	---	---	---	---
Waukon	B	None	---	---	>6.0	---	---	---	---
1006:									
Fluvaquents	D	Frequent	Long	Mar-Oct	0.0-1.0	Apparent	Apr-Oct	Long	1.0
Haploborolls	C	Rare	---	---	>6.0	---	---	---	---
1030:									
Pits, gravel.									
Udipsamments	A	None	---	---	>6.0	---	---	---	---
1113:									
Haslie	D	None	---	---	0.0-0.0	Apparent	Jan-Dec	Very long	3.0
Seelyeville	D	None	---	---	0.0-0.0	Apparent	Jan-Dec	Very long	3.0
Cathro	D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Very long	4.0
1117:									
Hedman	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
1119:									
Nielsville	C/D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
1121:									
Hedman	B/D	None	---	---	0.0-0.5	Apparent	Apr-Jun	Long	1.0
1122:									
Nielsville	C/D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
Perella	B/D	None	---	---	0.5-1.5	Apparent	Mar-Jul	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table and ponding: Water table depth	High water table and ponding: Kind of water table	High water table and ponding: Months	High water table and ponding: Ponding duration	High water table and ponding: Maximum ponding depth
					Ft				Ft
1142:									
Hedman	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
Fram	B	None	---	---	1.5-5.0	Apparent	Sep-Jun	---	---
1144:									
Strathcona	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Long	1.0
Kratka	B/D	None	---	---	0.0-0.5	Apparent	Mar-Aug	Long	1.0
1152B, 1152C, 1152E:									
Sugarbush	B	None	---	---	>6.0	---	---	---	---
1233D:									
Esmond	B	None	---	---	>6.0	---	---	---	---
Heimdal	B	None	---	---	>6.0	---	---	---	---
1264:									
Ulen	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---
1278:									
Rosewood	A/D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
Venlo	A/D	None	---	---	0.0-1.0	Apparent	Nov-Jul	Long	1.0
1279:									
Vallers	C	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
Hamerly	C	None	---	---	1.5-4.0	Apparent	Apr-Jun	---	---
1280:									
Gunclub	C/D	None	---	---	1.5-2.5	Apparent	Apr-Jun	---	---
1283:									
Reis	D	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
Clearwater	D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
1297:									
Augsburg	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
1299:									
Borup	B/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
1304A, 1304B:									
Glyndon	B	None	---	---	2.5-4.0	Apparent	Apr-Jun	---	---
1315A:									
Wheatville	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---
1323B:									
LaDelle	B	Occasional	Brief	Apr-Jun	3.5-5.0	Apparent	Oct-Jun	---	---
1325:									
Bowstring	A/D	Frequent	Long	Mar-Jun	0.0-0.5	Apparent	Oct-Jun	Long	1.0
Fluvaquents	D	Frequent	Long	Mar-Oct	0.0-1.0	Apparent	Apr-Oct	Long	1.0
1356:									
Water, miscellaneous.									

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table and ponding: Water table depth	High water table and ponding: Kind of water table	High water table and ponding: Months	High water table and ponding: Ponding duration	High water table and ponding: Maximum ponding depth
					Ft				Ft
1422:									
Northwood	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Long	1.0
1866:									
Colvin	C/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
Perella	B	None	---	---	0.5-1.5	Apparent	Apr-Jun	---	---
1871:									
Fargo	D	None	---	---	0.0-1.0	Apparent	Nov-Jul	Long	0.5
1874:									
Radium	A	None	---	---	2.5-4.0	Apparent	Apr-Oct	---	---
1878:									
Hamre	C/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Long	1.0
1879:									
Seelyeville	A/D	None	---	---	0.0-0.5	Apparent	Oct-Jun	Long	1.0
1882:									
Rosewood	D	None	---	---	0.0-1.0	Apparent	Jan-Dec	---	---
Strathcona	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	---	---
Berner	A/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	---	---
1916:									
Lindaas	C/D	None	---	---	0.0-1.5	Apparent	Mar-Jun	Long	1.0
1963:									
Bearden	C	None	---	---	1.5-4.0	Apparent	Apr-Jun	---	---
Colvin	C/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
1964:									
Colvin	C/D	None	---	---	0.5-1.5	Apparent	Apr-Jul	---	---
Fargo	D	None	---	---	0.5-1.5	Apparent	Mar-Jul	---	---

Soil Features

(See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Map symbol and soil name	Subsidence Initial	Subsidence Total	Potential for frost action	Risk of corrosion Uncoated steel	Risk of corrosion Concrete
	In	In			
20B:					
Chapett	0	---	Moderate	Low	Low.
20C2:					
Chapett	0	---	Moderate	Low	Low.
20D2:					
Chapett	0	---	Moderate	Low	Low.
20E:					
Chapett	0	---	Moderate	Low	Low.
38B:					
Waukon	0	---	Moderate	Low	Low.
38C2:					
Waukon	0	---	Moderate	Low	Low.
38D2:					
Waukon	0	---	Moderate	Low	Low.
45B:					
Maddock	0	---	Low	Low	Low.
45C:					
Maddock	0	---	Low	Low	Low.
45E:					
Maddock	0	---	Low	Low	Low.
47:					
Colvin	0	---	High	High	Low.
57A:					
Fargo	0	---	High	High	Low.
59:					
Grimstad	0	---	Moderate	Moderate	Low.
65:					
Foxhome	0	---	High	Moderate	Low.
66:					
Flaming	0	---	Moderate	Low	Low.
67A:					
Bearden	0	---	High	High	Low.
67B:					
Bearden	0	---	High	High	Low.
93A:					
Bearden	0	---	High	High	Low.
111:					
Hangaard	0	---	Moderate	High	Low.

Soil Features--Continued

Map symbol and soil name	Subsidence Initial	Subsidence Total	Potential for frost action	Risk of corrosion Uncoated steel	Risk of corrosion Concrete
	In	In			
184A:					
Hamerly	0	---	High	High	Low.
185D2:					
Hattie	0	---	Moderate	High	Low.
236:					
Vallers	0	---	High	High	Low.
242B:					
Marquette	0	---	Low	Low	Low.
242D:					
Marquette	0	---	Low	Low	Low.
258B:					
Sandberg	0	---	Low	Moderate	Low.
258C:					
Sandberg	0	---	Low	Moderate	Low.
258E:					
Sandberg	0	---	Low	Moderate	Low.
296:					
Fram	0	---	High	High	Low.
341B:					
Arvilla	0	---	Low	Moderate	Low.
348:					
Borup	0	---	High	High	Low.
372:					
Hamar	0	---	Moderate	High	Low.
387:					
Roliss	0	---	High	High	Low.
412:					
Mavie	0	---	High	High	Low.
422A:					
Bygland	0	---	High	High	Low.
422B:					
Bygland	0	---	High	High	Low.
422C2:					
Bygland	0	---	High	High	Low.
426:					
Foldahl	0	---	High	Moderate	Low.
435:					
Syrene	0	---	Moderate	High	Low.
439:					
Strathcona	0	---	High	High	Low.

Soil Features--Continued

Map symbol and soil name	Subsidence: Initial	Subsidence: Total	Potential for frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
	In	In			
450:					
Rauville	0	---	High	High	Moderate.
481:					
Kratka	0	---	Moderate	High	Low.
494B:					
Darnen	0	---	Moderate	High	Low.
506:					
Overly	0	---	High	High	Low.
540:					
Seelyeville	0	50-55	High	High	Moderate.
543:					
Markey	0	25-30	High	High	Low.
544:					
Cathro	0	19-22	High	High	Low.
547:					
Deerwood	0	5-10	Moderate	High	Low.
563:					
Northwood	0-3	8-10	High	High	Low.
565:					
Eckvoll	0	---	High	Moderate	Low.
573D:					
Serden	0	---	Low	Moderate	Low.
582:					
Roliss	0	---	High	High	Low.
641:					
Clearwater	0	---	High	High	Low.
642:					
Clearwater	0	---	High	High	Low.
643:					
Huot	0	---	High	High	Low.
645:					
Espelie	0	---	High	High	Low.
647:					
Hilaire	0	---	High	Moderate	Low.
650:					
Reiner	0	---	High	Moderate	Low.
651:					
Thiefriver	0	---	High	High	Low.
667B:					
Fairdale	0	---	Moderate	Moderate	Low.
667C2:					
Fairdale	0	---	Moderate	Moderate	Low.

Soil Features--Continued

Map symbol and soil name	Subsidence Initial	Subsidence Total	Potential for frost action	Risk of corrosion Uncoated steel	Risk of corrosion Concrete
	In	In			
670:					
Knute	0	---	Moderate	Moderate	Low.
671:					
Onstad	0	---	Moderate	Moderate	Low.
681:					
Brandsvold	0	---	High	High	Low.
694D2:					
Zell	0	---	High	High	Moderate.
704:					
Wyrene	0	---	Moderate	High	Low.
707A:					
Lizzie	0	---	High	Low	Low.
712:					
Rosewood	0	---	Moderate	High	Low.
713:					
Linveldt	0	---	High	Moderate	Low.
718B:					
Naytahwaush	0	---	Moderate	Moderate	Low.
718C:					
Naytahwaush	0	---	Moderate	Moderate	Low.
718E:					
Naytahwaush	0	---	Moderate	Moderate	Low.
733:					
Berner	0	19-22	High	High	Moderate.
735B:					
Halverson	0	---	Low	High	Low.
735C:					
Halverson	0	---	Low	High	Low.
737:					
Mahkonce	0	---	High	High	Low.
746:					
Haslie	0	0	High	High	Moderate.
749:					
Colvin	0	---	High	High	Low.
765:					
Smiley	0	---	High	High	Low.
767:					
Auganaush	0	---	High	High	Moderate.
791:					
Winterfield	0	---	Moderate	Low	Low.

Soil Features--Continued

Map symbol and soil name	Subsidence: Initial	Subsidence: Total	Potential for frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
	In	In			
827B:					
Heimdal	0	---	Moderate	High	Low.
Esmond	0	---	Moderate	High	Low.
827C2:					
Heimdal	0	---	Moderate	High	Low.
Esmond	0	---	Moderate	High	Low.
908:					
Bearden	0	---	High	High	Low.
Fargo	0	---	High	High	Low.
935:					
Hegne	0	---	Moderate	High	Low.
Fargo	0	---	High	High	Low.
967B:					
Waukon	0	---	Moderate	Low	Low.
Langhei	0	---	Moderate	Low	Low.
967C2:					
Waukon	0	---	Moderate	Low	Low.
Langhei	0	---	Moderate	Low	Low.
979D2:					
Langhei	0	---	Moderate	Low	Low.
Waukon	0	---	Moderate	Low	Low.
1006:					
Fluvaquents	0	---	High	High	Low.
Haploborolls	0	---	Moderate	Moderate	Low.
1030:					
Pits, gravel.					
Udipsamments	0	---	Low	Low	Low.
1113:					
Haslie	0	30-45	High	High	Moderate.
Seelyeville	0	---	High	High	Moderate.
Cathro	0	---	High	High	Low.
1117:					
Hedman	0	---	High	High	Low.
1119:					
Nielsville	0	---	High	High	Low.
1121:					
Hedman	0	---	High	High	Low.

Soil Features--Continued

Map symbol and soil name	Subsidence Initial	Subsidence Total	Potential for frost action	Risk of corrosion Uncoated steel	Risk of corrosion Concrete
	In	In			
1122:					
Nielsville	0	---	High	High	Low.
Perella	0	---	High	High	Low.
1142:					
Hedman	0	---	High	High	Low.
Fram	0	---	High	High	Low.
1144:					
Strathcona	0	---	High	High	Low.
Kratka	0	---	Moderate	High	Low.
1152B:					
Sugarbush	0	---	Low	Low	Low.
1152C:					
Sugarbush	0	---	Low	Low	Low.
1152E:					
Sugarbush	0	---	Low	Low	Low.
1233D:					
Esmond	0	---	Moderate	High	Low.
Heimdal	0	---	Moderate	High	Low.
1264:					
Ulen	0	---	Moderate	Low	Low.
1278:					
Rosewood	0	---	Moderate	High	Low.
Venlo	0	---	Moderate	High	Low.
1279:					
Vallers	0	---	High	High	Low.
Hamerly	0	---	High	High	Low.
1280:					
Gunclub	0	---	High	High	Low.
1283:					
Reis	0	---	High	High	Low.
Clearwater	0	---	High	High	Low.
1297:					
Augsburg	0	---	High	High	Low.
1299:					
Borup	0	---	High	High	Low.
1304A:					
Glyndon	0	---	High	High	Low.
1304B:					
Glyndon	0	---	High	High	Low.

Soil Features--Continued

Map symbol and soil name	Subsidence Initial	Subsidence Total	Potential for frost action	Risk of corrosion Uncoated steel	Risk of corrosion Concrete
	In	In			
1315A:					
Wheatville	0	---	High	High	Low.
1323B:					
LaDelle	0	---	High	High	Low.
1325:					
Bowstring	0-12	12-45	High	High	Low.
Fluvaquents	0	---	High	High	Low.
1356:					
Water, miscellaneous.					
1422:					
Northwood	0-3	6-10	High	High	Low.
1866:					
Colvin	0	---	High	High	Low.
Perella	0	---	High	High	Low.
1871:					
Fargo	0	---	High	High	Low.
1874:					
Radium	0	---	Low	Moderate	Low.
1878:					
Hamre	0	---	High	High	Low.
1879:					
Seelyeville	0	50-55	High	High	Low.
1882:					
Rosewood	0	---	High	High	Low.
Strathcona	0	---	High	High	Low.
Berner	0	19-22	High	High	Moderate.
1916:					
Lindaas	0	---	High	High	Low.
1963:					
Bearden	0	---	High	High	Low.
Colvin	0	---	High	High	Low.
1964:					
Colvin	0	---	High	High	Low.
Fargo	0	---	High	High	Low.

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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.

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

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

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

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.

Beach deposits. Material, such as sand and gravel, that is generally laid down parallel to an active or relict shoreline of a postglacial or glacial lake.

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.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

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.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clayey. In this survey, clayey textures include clay, silty clay, and sandy clay.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

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 has 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 has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has 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.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

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 effects of 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. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which

classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

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.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Depth, soil. Generally, 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.

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 wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Eolian deposits. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

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. Synonym: scarp.

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.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Footslope. The position that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

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 has 15 to 35 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 the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is

an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Head slope. A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-chroma zones. In a soil profile, zones having chroma of 3 or more. Typical 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 15 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. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

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 potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

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

Interfluve. An elevated area between two drainageways that sheds water to those drainageways.

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.

Irrigation. Application of water to soils to assist in production of crops.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Kame moraine. An end moraine that contains numerous kames. A group of kames along the front of a stagnant glacier, commonly comprising the slumped remnants of a formerly continuous outwash plain built up over the foot of rapidly wasting or stagnant ice.

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.

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.

Loamy. In this survey, loamy textures include loam, sandy loam, sandy clay loam, clay loam, and silt loam that contains more than 20 percent sand.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-chroma zones. In a soil profile, zones having chroma of 2 or less. Typical 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.

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 earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, and recessional.

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 of 6.6 to 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.

Nose slope. A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent.

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. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The 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 or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as “permeability.” Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 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 flooding.

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.

Pitted outwash plain. An outwash plain marked by many irregular depressions, such as kettles, shallow pits, and potholes, which formed by melting of incorporated ice masses. Common in Wisconsin and Minnesota.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

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.

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.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

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:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
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 generally is 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.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

Sandy. In this survey, sandy soils include coarse sand, sand, fine sand, very fine sand, loamy coarse sand, loamy sand, loamy fine sand, and loamy very fine sand and the gravelly analogs of these textures.

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.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. 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 position that forms the uppermost inclined surface near the top of a hillslope. It is a transition 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.

Side slope. A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel.

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.

Silty. In this survey, silty textures include silt, silty clay loam, silt loam (containing 20 percent or less sand), and very fine sandy loam.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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. In this survey, the slope classes are as follows:

Level	0 to 1 percent
Nearly level	0 to 2 percent
	0 to 3 percent
	1 to 3 percent
Gently sloping	1 to 4 percent
	1 to 6 percent
	2 to 6 percent
Undulating	1 to 8 percent
	2 to 8 percent
Sloping	6 to 12 percent
	6 to 15 percent
Rolling	8 to 15 percent
Moderately steep	6 to 18 percent
	6 to 20 percent
	12 to 20 percent
Hilly	6 to 30 percent
Steep	12 to 30 percent
	15 to 30 percent
	20 to 40 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

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.

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 material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stagnation moraine. A body of drift released by the melting of a glacier that ceased flowing. Commonly (but not always) occurs near ice margins; composed of till, ice-contact stratified drift, and small areas of glacial lake sediment. Typical landforms are knob-and-kettle topography, locally including ice-walled lake plains.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded 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 erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsidence. The potential decrease in surface elevation as a result of the drainage of wet soils that have organic layers or semifluid mineral layers. Subsidence as a result of drainage is attributed to (1) shrinkage from drying, (2) consolidation because of the loss of ground-water buoyancy, (3) compaction from tillage or manipulation, (4) wind erosion, (5) burning, and (6) biochemical oxidation.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

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 caused by uneven glacial deposition.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is 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 that is 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 soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer 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 ovendry 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.