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Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Becker County, Minnesota

Part I



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How To Use This Soil Survey

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

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

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

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

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

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

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

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

Major fieldwork for this soil survey was completed in November 1992. Soil names and descriptions were approved in February 1994. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. Assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Soil and Water Conservation Board. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Becker County. It is part of the technical assistance furnished to the Becker County Soil and Water Conservation District.

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

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Cover: An area of Formdale-Langhel-Flom soils.

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Foreword

This soil survey contains information that can be used in land-planning programs in Becker 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 Becker County, Minnesota

By Keith A. Christensen, Natural Resources Conservation Service

Fieldwork by Keith A. Christensen, Malvern N. Jacobsen, Rodney G. Kyar, and Michael L. Lieser, Natural Resources Conservation Service, and Ronald R. Schwartz, Minnesota Agricultural Experiment Station

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; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

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

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

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

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

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

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

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

Soil scientists were denied access to a few tracts of land in the county. These areas are identified with cross-hatching on the map sheets. They were mapped by using knowledge of the surrounding area and aerial photograph interpretation. The delineations of the soils are less accurate on these tracts than in areas where soil scientists had access to the land and could examine the soils.

Survey Procedures

The general procedures followed in making this survey are described in the "National Soil Survey Handbook" (USDA/NRCS) and the "Soil Survey

Manual" (USDA, 1993). Soil survey maps made for conservation planning purposes on individual farms prior to the start of the project and the "Geologic Map of Minnesota" (Hobbs and Goebel, 1982) were among the references used.

Before the fieldwork began, soil scientists studied U.S. Geological Survey topographic maps, at a scale of 1:24,000, to relate land and image features. Sample areas were selected to represent the major landscapes in the county. These areas were investigated more closely than the rest of the county. Traverses were made across the landscape to determine the types of soil occurring on the landscape and the percentages of the different types of soils. In areas of the Formdale-Langhei-Flom association and in other areas where the soil pattern is very complex, traverses were more closely spaced. In areas of the Verndale-Dorset association and in other areas where the soil pattern is relatively simple, traverses were more widely spaced. As the traverses were made, the soil scientists divided the landscape into landforms or landform segments based on use and management of the soils. For example, a hill was separated on the maps from a depression and a gently sloping summit from a very steep back slope of a ridge. In most areas soil examinations along the traverses were made 50 to 100 yards apart, depending on the landscape and the pattern of soils. Extensive notes were taken on the composition of map units in these preliminary study areas. As mapping progressed, these preliminary notes were modified and a final assessment of the composition of the individual map units was made.

Several pedon descriptions were written for each of the soil types mapped in the county. The pedons described as typical were observed and studied in pits that were dug with shovels, spades, or backhoes. Each pedon was separated into different soil horizons, or layers, and the texture, color, reaction, structure, and content of coarse fragments were determined for each layer.

Before the fieldwork began, several different flights of aerial photography were observed to determine which flight was of the highest quality. Approximately 75 percent of the county was soil mapped on U.S. Geological Survey aerial photography flown between the years of 1957 and 1973. The rest of the county was mapped on National High Altitude Photography (NHAP) flown in 1984 and 1985.

During the soil mapping process, preliminary boundaries of slopes and landforms were plotted stereoscopically on aerial photographs. In the field, the soil boundaries were refined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined to a depth of 5 or 6 feet

with the aid of power equipment mounted on pickup trucks or with hand augers where access by motor vehicle was not practical. Traverses across the landscape in areas of cropland typically were spaced about 600 feet apart. Soil borings were typically made every 5 to 10 acres, depending on the complexity of the landscape. In wooded areas, traverses across the landscape typically were spaced about 1,000 feet apart and soil borings were made every 10 to 15 acres, depending on the complexity of the landscape.

Samples for chemical and physical analyses were taken from representative sites of several of the soils in the survey area. The chemical and physical analyses were made by the Soil Survey Laboratory, Department of Soil Science, University of Minnesota. The results of the analyses are stored in a computerized data file at the laboratory. A description of the laboratory procedures and results of the laboratory analyses can be obtained on request from the laboratory. Soil samples were also analyzed in the Detroit Lakes soil survey office. Some of the soil properties determined locally include particle-size analysis, pH, and calcium carbonate content.

General Nature of the Survey Area

Becker County is in west-central Minnesota (fig. I-1). It has a surface area of about 1,440 square miles. The county is 48 miles long from west to east and 30 miles wide from north to south. The county has seven incorporated cities and villages. These are Audubon, Callaway, Detroit Lakes, Frazee, Lake Park, Ogema, White Earth, and Wolf Lake. Detroit Lakes is the county seat. It had a population of 7,174 in 1993. In 1990, the population of Becker County was 27,881.

The county has a land area of approximately 839,700 acres. It has about 84,600 acres of water; this acreage consists of bodies of water that are 40 acres or more in size (USDA, 1982). Approximately 295,000 acres in the county is used as cropland, 80,500 acres as pastureland, and 323,000 acres as woodland. About 141,200 acres consists primarily of wetlands and small bodies of water (less than 40 acres in size), but this acreage also includes roads and urban land.

Approximately 181,600 acres in Becker County is under county, State, or Federal ownership. Federal lands total approximately 49,600 acres. These lands are managed primarily by the U.S. Fish and Wildlife Service. State lands total approximately 56,300 acres and are managed by the Minnesota Department of Natural Resources. County lands total approximately 75,700 acres and are managed by the Becker County Natural Resources Department.

For the purposes of this soil survey, soil scientists

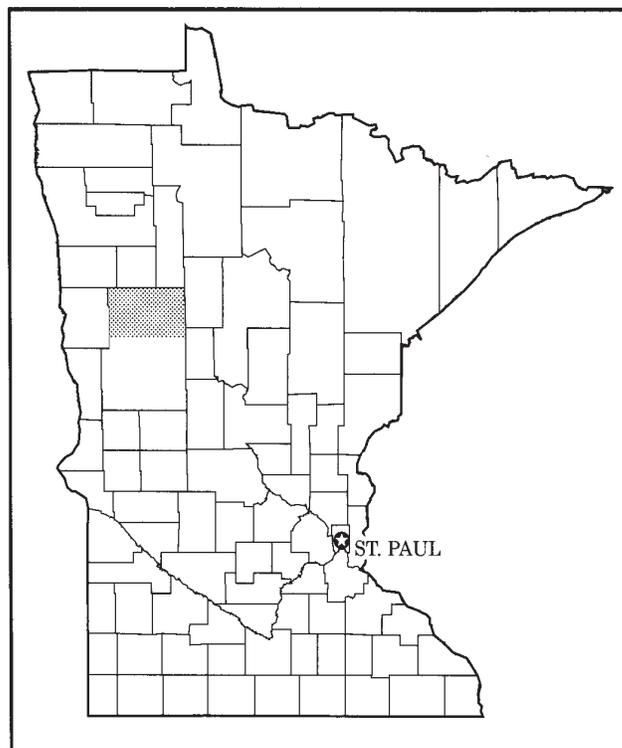


Figure I-1.—Location of Becker County in Minnesota.

identified about 75 different types of soils in Becker County. The soils range widely in texture, natural drainage, and other characteristics. Soils in the western one-third of the county are dark because the original vegetation was mainly tall grass prairie. Soils in the eastern two-thirds of the county are lighter colored because the original vegetation was deciduous and coniferous forest.

History

Becker County was established by an act of the Legislature on March 18, 1858 (Wilcox, 1907). It was named in honor of General George L. Becker of St. Paul. Becker was a lawyer who served as a land commissioner for the old St. Paul and Pacific Railroad. He never actually served in the military. He was elected mayor of St. Paul in 1856 and later served as a congressman and as a State legislator.

For 10 years after the establishment of Becker County, the Chippewa Indians occupied nearly all of the area. The Sioux tribe had about one-half of Cormorant Township and a small part of Lake Park Township. The Treaty of 1867 established a reservation in the northern part of Becker County for the Chippewa Indians. Approximately 200 Chippewa arrived at the reservation

from the Chippewa Agency near Crow Wing on June 14, 1868. The Indians named the place White Earth because of the white clay they found under the black soil. Government loggers clear-cut part of the timber on the east side of White Earth Lake during the winter of 1867-1868 and sawed the logs into lumber to be used by the Indians for building shelters.

Until the 1860's, the only Europeans in the area were trappers and explorers. In 1802, the first non-Indian settlements in Becker County were established. These were two small trading posts that were set up at White Earth and Shell Lake by men employed by the Northwest Fur Company. The trading posts remained but a short time. The first permanent European settler in Becker County was Patrick Quinlan, who established a homestead on May 28, 1868, in the southwest quarter of section 35 in Burlington Township. The site is near the present-day city of Frazee. Quinlan believed that he was settling in Otter Tail County but actually had settled a few hundred feet inside Becker County.

Most of the government surveying was begun in 1870 and was completed by the end of 1872. In the summer of 1870, speculation that the Northern Pacific Railroad would pass through the county brought an influx of settlers. Construction on the railroad began during the fall of 1870 and was completed the following year. Most of the early settlement took place on the prairie soils in the western part of the county. Prior to 1879, there were few settlers in the eastern part of the county. During the summer of 1879, several settlers moved onto the Ponsford Prairie. The eastern townships were more or less settled by 1890, but they were less densely populated than those in the western part because the wooded areas had to be cleared before a crop could be planted.

During the period from 1880 to 1919, the lumber industry swept through the county. Many of the white pine, red pine, and oak trees were cut.

Logging History

Logging in Becker County dates back to the early 1870's, when the pine harvesting began. Red pine and white pine stands were first harvested near Toad Lake and floated down the Toad River to the Otter Tail River to a sawmill in Fergus Falls. The pine harvested near the Shell and Straight Rivers was cut and floated down the Crow Wing River to Little Falls and Minneapolis. The pine that was harvested in Savannah and Two Inlets Townships was floated down the Fish Hook River to a mill in Park Rapids. A large sawmill was constructed at Frazee in 1872 (Vandersluis, 1974). Most of the pine logs in Becker County were sawed at this sawmill until it was closed in 1918. Logs harvested in the northern part of the county were cut and hauled

by horses and an inland railroad to landings on Big Elbow Lake and Many Point Lake. A channel was dug from Big Elbow Lake adjacent to Little Bemidji Lake to Many Point Lake. This channel facilitated log movement down the Otter Tail River. The logs were stockpiled during the winter months on the ice near landings. In spring, after the ice broke up, logs were "boomed" down the lakes and river as the water flow was generally greatest following the snowmelt. Logs were floated down the river during the summer as flowage permitted. Typically, a lumberjack would cut wood during the winter months, float the logs to the sawmills in the spring, and work in the sawmills in the summer and the fall.

By 1919, the virgin pine was essentially harvested and very little remained. It was estimated that Becker County had about 500,000,000 board feet of pine before harvesting began in 1871. A few pine stands were of particularly high quality. One tract of 160 acres yielded 4,800,000 board feet of lumber.

The western and southwestern parts of the county were covered with hardwood forests, except the northwestern one-fourth, which was open prairie. Bur oak was originally very abundant in Becker County. An estimated 125 million board feet of oak timber was in the county (Wilcox, 1907). There were also stands of red oak and a few areas of white oak. The white oak variety was not very abundant. Some of the oak was used for railroad ties or lumber, and some was used for fuel by the railroad and by settlers.

The logging industry played an important role in the development of Becker County. People employed by the logging industry provided a market for agricultural products. Forests presently make up about 39 percent of the land area. Large stands of timber are in the north-central and northeastern parts of the county.

Transportation Facilities

Two railroads serve Becker County. One line runs north and south through Detroit Lakes, Callaway, and Ogema, and the other runs east and west through Frazee, Detroit Lakes, Audubon, and Lake Park.

Most of the major highways are paved. State Highways 34 and 87 run east and west through the eastern two-thirds of the county. State Highway 34 connects Detroit Lakes with Park Rapids. State Highway 87 runs from Frazee to Menahga in Wadena County. U.S. Highway 10 is a four-lane highway that enters the county near Frazee and passes through Detroit Lakes, Audubon, and Lake Park on its way across Becker County. U.S. Highway 59 runs north and south through the county and serves the towns of Detroit Lakes, Callaway, and Ogema.

Physiography and Relief

The main geomorphic areas in Becker County include the Alexandria Moraine Area, the Itaska Moraine Area, the Wadena Drumlin Area, the Pelican River Sand Plain, the Park Rapids Sand Plain, and the Mahnommen Till Plain. Nearly half of the 1,440 square miles of the county consists of terminal moraines—the Alexandria Moraine and the Itaska Moraine. The moraine area is in the central part of the county and extends into the southwest and northeast corners. The vertical relief in the moraine ranges to as much as 200 to 300 feet. In places the moraine is more than 20 miles wide (Anderson).

The Alexandria Moraine runs mainly from north to south in the western part of Becker County and contains the drift of two different ice lobes. The bulk of the moraine was deposited at the terminus of the Wadena Lobe, and its deposits are exposed on the east side of the moraine. The moraine was subsequently overridden from the west by the Des Moines Lobe. Glacial till from the Wadena Lobe typically has a sandy loam texture, and glacial till from the Des Moines Lobe typically has a loam or clay loam texture. A narrow band of glacial till with silty clay loam textures also occurs in the western part of the county. The origin of the very clayey glacial till sediments suggests that ice retreated and then readvanced over lake sediments in the Lake Agassiz basin (Fenton and others, 1983). The Des Moines Lobe contains a higher percentage of shale fragments and is thought to have a more northwesterly source area than the Wadena Lobe (Anderson). Relief is typically rolling to very hilly.

The Itaska Moraine runs mainly from east to west across the northern and central parts of Becker County. The moraine is a deposit of the Wadena Lobe. The Itaska Moraine is characterized by sandy loam glacial till. The glacial till is commonly mixed with pockets of sand and gravel (ice-contact deposits). Relief is typically rolling to very hilly.

The Wadena Drumlin Area is in the southeastern part of Becker County. The Wadena Drumlin Field is the largest drumlin field in Minnesota (Wright, 1962). The drumlins were formed by the Wadena Lobe and consist of sandy loam glacial till. In Becker County the long axis of the drumlins has an east-west orientation (Perkins). Relief is typically undulating to rolling.

The Pelican River Sand Plain is located in the southwestern part of Becker County. The glacial outwash consists of sands and gravels deposited primarily by meltwaters of the Des Moines Lobe. Relief is typically rolling to hilly.

The Park Rapids Sand Plain is located in the eastern part of Becker County. The glacial outwash consists of

sands and gravels deposited by meltwaters of the Wadena Lobe as it stood at the Itaska Moraine (Wright, 1972a). Relief is typically nearly level or undulating.

The Mahnommen Till Plain is located in the northwestern part of Becker County. The till plain consists primarily of glacial till from the Des Moines Lobe, but the glacial till is mantled in some areas by silty glacial lacustrine sediments. These silty sediments indicate ponding at elevations considerably above the level of the Herman Beach of Lake Agassiz (Fenton and others, 1983). As the glacial ice retreated northward, water began to pond in low areas between the moraine and the retreating glacial ice. The present-day South Branch of the Wild Rice River and the Buffalo River are former meltwater channels that eventually drained these ponded meltwaters into Glacial Lake Agassiz. Relief is typically nearly level or undulating.

The highest elevation in Becker County is about 1,850 feet. This elevation is in section 16 of Wolf Lake Township. The lowest elevation, about 1,150 feet, is in section 19 of Walworth Township.

Drainage

Becker County is located on the watershed divide of North America. The western three-fourths of the county are tributary to the Red River of the North, which flows northward into Hudson Bay. The eastern one-fourth of the county is tributary to the Mississippi River, which flows southward into the Gulf of Mexico.

The rugged topography within the Alexandria and Itaska Moraines prevents good natural drainage throughout a substantial portion of the county. Thus, there are more than 300 lakes that are 40 acres or more in size in these areas. Lakes, rivers, streams, and swamps cover approximately one-fourth of the surface area of the county.

Artificial drainage through surface ditches is extensive in the northwestern part of Becker County. Many shallow depressions have been drained with these shallow ditches and are now being used as cropland. Subsurface tile drainage has not been used extensively in Becker County.

Geologic History

Precambrian metamorphic and igneous rocks form the lowermost geologic unit in Becker County. The depth to these rocks generally ranges from 300 to more than 600 feet. Cretaceous sedimentary rocks overlie the Precambrian bedrock in parts of the county. These consist of sandstone and shale.

Glacial drift of Wisconsin Age forms the uppermost geologic unit in Becker County. The glacial drift is among the thickest in Minnesota and ranges from about 300 to 600 feet in thickness. The deposits of several

glaciers are buried beneath the surficial glacial deposits (Clayton and Moran, 1982). Glacial advances by the Wadena Lobe and the Des Moines Lobe deposited the bulk of the surficial deposits in Becker County.

The Wadena Lobe advanced from a northerly direction, crossing the Winnipeg lowlands in southern Manitoba, where it incorporated limestone rocks and deposited loamy materials rich in carbonates (Wright, 1962). Its earliest advance built the Alexandria Moraine and the Wadena Drumlin Field. The Wadena Lobe then retreated northward and readvanced to build the Itaska Moraine about 20,000 years ago (Wright, 1972b). Within the Itaska Moraine are several areas of linear ridges, called "push ridges" or "thrust ridges" (Norton, 1982), which are a series of steeply sloping ridges. Among the more noteworthy areas of push ridges in Becker County are an area west of Flat Lake and an area east of Strawberry Lake.

The most recent glacial advance was that of the Des Moines Lobe, which reached its maximum southerly extent about 14,000 years ago. The Des Moines Lobe advanced from a north-northwesterly direction, crossing Manitoba, where it incorporated limestone rocks. It followed the Red River Valley and incorporated shale-rich materials derived from Cretaceous rocks (Sackreiter). The final retreat of glacial ice from Minnesota is estimated to have occurred about 11,500 years ago.

The most recent deposits are nonglacial in origin and consist of alluvium deposited on flood plains and organic or limnic sediments in lakes and depressions. The accumulation of these organic deposits in depressional areas is estimated to have begun about 4,000 years ago (Norton).

Water Supply

Water supplies are obtained from tapping deposits of Pleistocene glacial outwash. The thickness of the Pleistocene glacial deposits ranges from about 300 to 600 feet. The most widely used aquifers are beds of sand and gravel that are buried within the glacial deposits.

Climate

The three tables at the end of this section give climate data for the survey area as recorded at Detroit Lakes during the period from 1961 to 1990.

In winter, the average temperature is 8.6 degrees F and the average daily minimum temperature is -2 degrees. The lowest temperature on record, which occurred at Detroit Lakes on February 15, 1936, is -46 degrees. In summer, the average temperature is 65.9 degrees and the average daily maximum temperature is 78.6 degrees. The highest temperature, which occurred at Detroit Lakes on July 7, 1936, is 107 degrees.

Growing degree days are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 24.40 inches. Of this, about 16.70 inches, or 68 percent, usually falls in May through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 5.4 inches at Detroit Lakes on August 11, 1909. The heaviest rainfall recorded in a 24-hour period was 7.5 inches on July 15 and 16, 1993, at Callaway. Thunderstorms occur on about 32 days each year, and most occur in July.

The average seasonal snowfall is 42.8 inches. The greatest snow depth at any one time during the period of record was 48 inches on March 18, 1943. On an average, 120 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 14 inches on January 7, 1989.

The average relative humidity in midafternoon is about 61 percent. Humidity is higher at night, and the average at dawn is about 81 percent. The sun shines 67 percent of the time in summer and 50 percent in winter. The prevailing wind is from the north-northwest. Average windspeed is highest, 14 miles per hour, in April.

TEMPERATURE AND PRECIPITATION
(Recorded in the period 1961-90 at Detroit Lakes, Minnesota)

Month	Temperature						Precipitation					
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall	
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--			
	<u>° F</u>	<u>° F</u>	<u>° F</u>	<u>° F</u>	<u>° F</u>	<u>Units</u>	<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>	
January-----	15.5	-6.5	4.5	43	-40	0	0.72	0.26	1.10	2	10.4	
February-----	22.4	-0.9	10.7	48	-38	0	.56	.21	.84	2	5.9	
March-----	35.8	14.1	25.0	63	-28	16	.99	.46	1.45	2	7.3	
April-----	54.3	29.5	41.9	83	3	149	1.78	.66	2.72	4	2.8	
May-----	68.1	41.2	54.7	87	20	458	2.60	1.28	3.75	6	.0	
June-----	75.8	50.7	63.3	92	32	694	4.16	2.24	5.84	7	.0	
July-----	81.0	55.4	68.2	95	37	864	3.78	1.93	5.39	6	.0	
August-----	79.1	53.3	66.2	95	33	806	3.34	1.61	4.83	5	.0	
September---	68.4	43.6	56.0	89	19	478	2.82	1.24	4.18	5	.0	
October-----	56.3	33.6	44.9	81	11	208	2.06	.63	3.22	4	1.2	
November---	36.2	18.9	27.6	62	-13	19	.82	.22	1.30	2	6.2	
December---	20.2	1.3	10.7	46	-34	0	.77	.36	1.12	2	9.0	
Yearly:												
Average---	51.1	27.9	39.5	---	---	---	---	---	---	---	---	
Extreme---	---	---	---	96	-41	---	---	---	---	---	---	
Total-----	---	---	---	---	---	3,694	24.40	19.32	28.50	47	42.8	

* 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 Detroit Lakes, Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 15	May 25	June 7
2 years in 10 later than--	May 10	May 19	June 2
5 years in 10 later than--	Apr. 30	May 10	May 23
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 17	Sept. 12	Aug. 29
2 years in 10 earlier than--	Sept. 23	Sept. 14	Sept. 3
5 years in 10 earlier than--	Oct. 3	Sept. 23	Sept. 12

GROWING SEASON

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

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	<u>Days</u>	<u>Days</u>	<u>Days</u>
9 years in 10	129	116	91
8 years in 10	138	122	98
5 years in 10	154	135	114
2 years in 10	170	148	129
1 year in 10	179	155	136

General Soil Map Units

The general soil map shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in another but in a different pattern.

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

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

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

Nearly Level, Loamy and Silty Soils on Ground Moraines

1. Hamerly-Winger-Vallers Association

Setting

Landform: Moraines

Position on the landform: Hamerly—flats and rises;

Winger and Vallers—rims of depressions and flats (fig. 1-2)

Slope range: 0 to 3 percent

Composition

Percent of survey area: 10.5

Extent of components in the association:

Hamerly and similar soils—42 percent

Winger and similar soils—23 percent

Vallers and similar soils—16 percent

Minor soils—19 percent

Soil Properties and Qualities

Hamerly

Depth class: Very deep

Drainage class: Moderately well drained and somewhat poorly drained

Parent material: Till

Surface texture: Loam

Winger

Depth class: Very deep

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits and till

Surface texture: Silty clay loam

Vallers

Depth class: Very deep

Drainage class: Poorly drained

Parent material: Till

Surface texture: Silty clay loam

Minor Soils

- Barnes and similar soils
- Langhei and similar soils
- McIntosh and similar soils
- The depressional Colvin soils and similar soils
- Cathro and similar soils
- Quam and similar soils
- Seelyeville and similar soils

Nearly Level to Moderately Steep, Loamy, Silty, and Organic Soils on Lateral Moraines

2. Formdale-Langhei-Flom Association

Setting

Landform: Moraines

Position on the landform: Formdale and Langhei—back slopes and shoulders; Flom—flats and drainageways (fig. 1-3)

Slope range: 0 to 30 percent

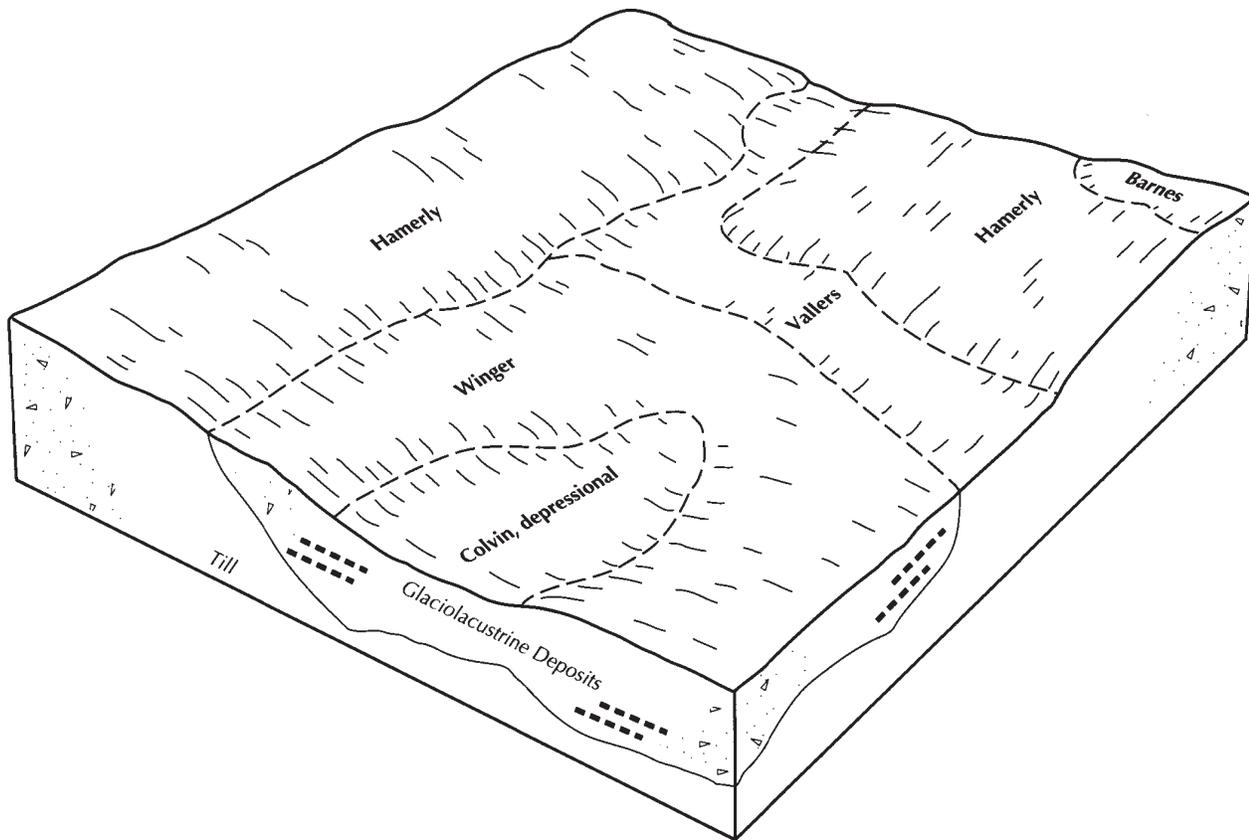


Figure 1-2.—Typical pattern of soils and parent material in the Hamerly-Winger-Vallers association.

Composition

Percent of survey area: 9.5

Extent of components in the association:

Formdale soils—41 percent

Langhei soils—20 percent

Flom and similar soils—15 percent

Minor soils—24 percent

Soil Properties and Qualities

Formdale

Depth class: Very deep

Drainage class: Well drained

Parent material: Till

Surface texture: Clay loam

Slope class: Gently sloping to moderately steep

Langhei

Depth class: Very deep

Drainage class: Well drained

Parent material: Till

Surface texture: Clay loam

Slope class: Gently sloping to moderately steep

Flom

Depth class: Very deep

Drainage class: Poorly drained

Parent material: Till

Surface texture: Silty clay loam

Slope class: Nearly level

Minor Soils

- Hamerly and similar soils
- Aazdahl and similar soils
- Vallers and similar soils
- Cathro and similar soils
- Seelyeville and similar soils
- Quam and similar soils

3. Barnes-Langhei-Vallers Association

Setting

Landform: Moraines

Position on the landform: Barnes and Langhei—back slopes and shoulders; Vallers—rims of depressions and flats

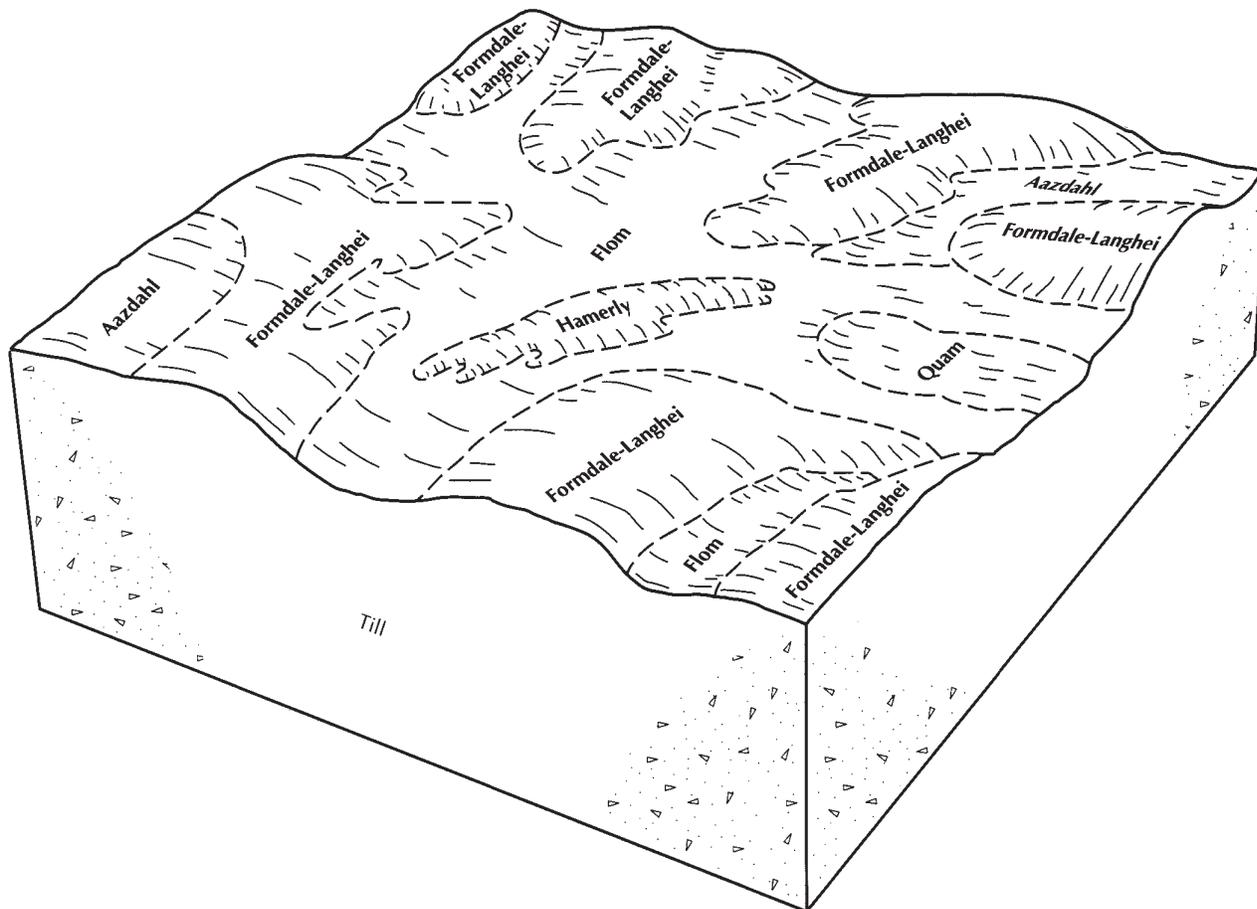


Figure I-3.—Typical pattern of soils and parent material in the Formdale-Langhei-Flom association.

Slope range: 0 to 30 percent

Composition

Percent of survey area: 2.5

Extent of components in the association:

- Barnes soils—43 percent
- Langhei soils—24 percent
- Vallers and similar soils—14 percent
- Minor soils—19 percent

Soil Properties and Qualities

Barnes

Depth class: Very deep
Drainage class: Well drained
Parent material: Till
Surface texture: Loam
Slope class: Gently sloping to moderately steep

Langhei

Depth class: Very deep

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Slope class: Gently sloping to moderately steep

Vallers

Depth class: Very deep
Drainage class: Poorly drained
Parent material: Till
Surface texture: Silty clay loam
Slope class: Nearly level

Minor Soils

- Hamerly and similar soils
- Flom and similar soils
- Quam and similar soils
- Cathro and similar soils
- Seelyeville and similar soils

4. Waukon-Forman-Cathro Association

Setting

Landform: Moraines

Position on the landform: Waukon and Forman—back slopes and shoulders; Cathro—depressions

Slope range: 0 to 30 percent

Composition

Percent of survey area: 4

Extent of components in the association:

Waukon and similar soils—49 percent

Forman soils—21 percent

Seelyeville and similar soils—12 percent

Minor soils—18 percent

Soil Properties and Qualities

Waukon

Depth class: Very deep

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Slope class: Gently sloping to moderately steep

Forman

Depth class: Very deep

Drainage class: Well drained

Parent material: Till

Surface texture: Clay loam

Slope class: Gently sloping to moderately steep

Cathro

Depth class: Very deep

Drainage class: Very poorly drained

Parent material: Organic materials

Surface texture: Muck

Slope class: Nearly level

Minor Soils

- Chapett and similar soils
- Beltrami and similar soils
- Flom and similar soils
- Quam and similar soils
- Seelyeville and similar soils

5. Nebish-Seelyeville Association

Setting

Landform: Moraines

Position on the landform: Nebish—back slopes and shoulders; Seelyeville—depressions

Slope range: 0 to 30 percent

Composition

Percent of survey area: 5

Extent of components in the association:

Nebish soils—59 percent

Seelyeville and similar soils—23 percent

Minor soils—18 percent

Soil Properties and Qualities

Nebish

Depth class: Very deep

Drainage class: Well drained

Parent material: Till

Surface texture: Loam

Slope class: Gently sloping to moderately steep

Seelyeville

Depth class: Very deep

Drainage class: Very poorly drained

Parent material: Organic materials

Surface texture: Muck

Slope class: Nearly level

Minor Soils

- Beltrami and similar soils
- Dalbo and similar soils
- Smiley and similar soils
- Cathro and similar soils
- Rifle and similar soils

6. Birchlake-Audubon-Foxlake Association

Setting

Landform: Moraines

Position on the landform: Birchlake and Audubon—back slopes, shoulders, and rises; Foxlake—flats and drainageways

Slope range: 0 to 30 percent

Composition

Percent of survey area: 3.5

Extent of components in the association:

Birchlake and similar soils—31 percent

Audubon and similar soils—31 percent

Foxlake and similar soils—14 percent

Minor soils—24 percent

Soil Properties and Qualities

Birchlake

Depth class: Very deep

Drainage class: Moderately well drained

Parent material: Till

Surface texture: Silty clay loam

Slope class: Nearly level to moderately steep

Audubon

Depth class: Very deep

Drainage class: Moderately well drained

Parent material: Till
Surface texture: Silty clay loam
Slope class: Nearly level to moderately steep

Foxlake

Depth class: Very deep
Drainage class: Poorly drained
Parent material: Till
Surface texture: Silty clay loam
Slope class: Nearly level

Minor Soils

- Bygland and similar soils
- Lindaas and similar soils
- Dovray and similar soils
- Cathro and similar soils
- Seelyeville and similar soils

7. Naytahwaush-Seelyeville Association

Setting

Landform: Moraines
Position on the landform: Naytahwaush—back slopes and shoulders; Seelyeville—depressions
Slope range: 0 to 30 percent

Composition

Percent of survey area: 0.5
Extent of components in the association:
 Naytahwaush soils—50 percent
 Seelyeville and similar soils—25 percent
 Minor soils—25 percent

Soil Properties and Qualities

Naytahwaush

Depth class: Very deep
Drainage class: Well drained
Parent material: Till
Surface texture: Loam
Slope class: Gently sloping to moderately steep

Seelyeville

Depth class: Very deep
Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck
Slope class: Nearly level

Minor Soils

- Dalbo and similar soils
- Auganaush and similar soils
- Lindaas and similar soils
- Dovray and similar soils
- Cathro and similar soils
- Rifle and similar soils

Nearly Level to Moderately Steep, Dense, Loamy Soils on Drumlins

8. Blowers-Paddock-Rockwood Association

Setting

Landform: Drumlins
Position on the landform: Blowers—back slopes and shoulders; Paddock—flats, foot slopes, and toe slopes; Rockwood—back slopes and shoulders (fig. 1-4)
Slope range: 0 to 20 percent

Composition

Percent of survey area: 4.5
Extent of components in the association:
 Blowers soils—39 percent
 Paddock soils—29 percent
 Rockwood soils—21 percent
 Minor soils—11 percent

Soil Properties and Qualities

Blowers

Depth class: Very deep
Potential rooting depth: Moderately deep to dense till
Drainage class: Moderately well drained
Parent material: Till
Surface texture: Sandy loam
Slope class: Gently sloping

Paddock

Depth class: Very deep
Potential rooting depth: Deep to dense till
Drainage class: Poorly drained
Parent material: Till
Surface texture: Loam
Slope class: Nearly level

Rockwood

Depth class: Very deep
Potential rooting depth: Moderately deep to dense till
Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam
Slope class: Gently sloping to moderately steep

Minor Soils

- Rosy and similar soils
- Hillview and similar soils
- Cathro and similar soils
- Seelyeville and similar soils

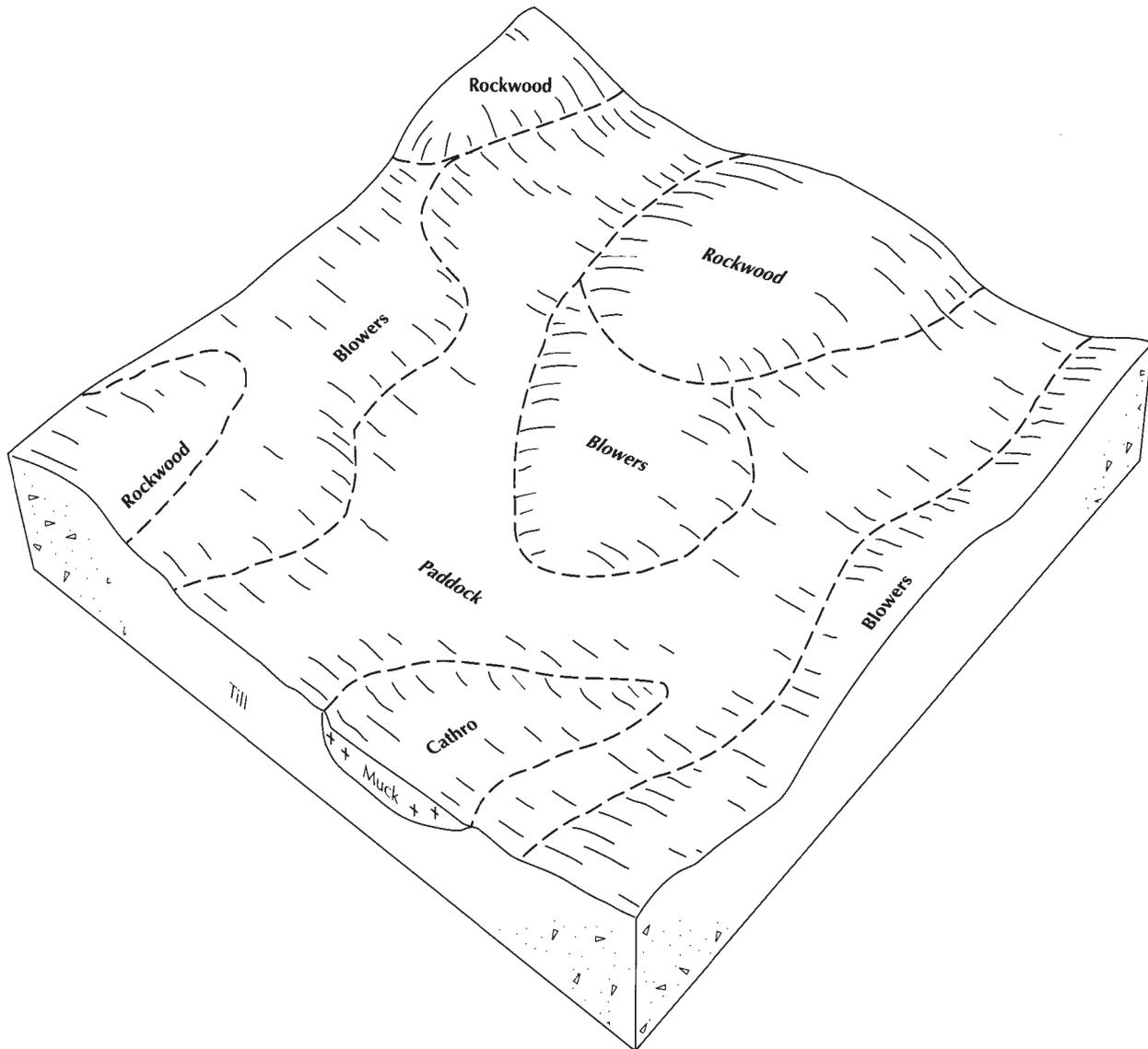


Figure I-4.—Typical pattern of soils and parent material in the Blowers-Paddock-Rockwood association.

Nearly Level to Steep, Loamy, Sandy, and Organic Soils on End Moraines and Ground Moraines

9. Snellman-Rifle-Sugarbush Association

Setting

Landform: Moraines

Position on the landform: Snellman and Sugarbush—back slopes and shoulders; Rifle—depressions

Slope range: 0 to 35 percent

Composition

Percent of survey area: 25.5

Extent of components in the association:

Snellman soils—49 percent

Rifle and similar soils—23 percent

Sugarbush soils—13 percent

Minor soils—15 percent

Soil Properties and Qualities

Snellman

Depth class: Very deep

Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam
Slope class: Gently sloping to steep

Rifle

Depth class: Very deep
Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Mucky peat
Slope class: Nearly level

Sugarbush

Depth class: Very deep
Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam
Slope class: Gently sloping to steep

Minor Soils

- Two Inlets and similar soils
- Nebish and similar soils
- Wykeham and similar soils
- Dalbo and similar soils
- Smiley and similar soils
- Cathro and similar soils
- Seelyeville and similar soils

10. Sol-Lupton-Sugarbush Association**Setting**

Landform: Moraines
Position on the landform: Sol and Sugarbush—back slopes and shoulders; Lupton—depressions
Slope range: 0 to 30 percent

Composition

Percent of survey area: 3.5
Extent of components in the association:
 Sol soils—47 percent
 Lupton and similar soils—23 percent
 Sugarbush soils—13 percent
 Minor soils—17 percent

Soil Properties and Qualities**Sol**

Depth class: Very deep
Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam
Slope class: Gently sloping to moderately steep

Lupton

Depth class: Very deep
Drainage class: Very poorly drained
Parent material: Organic materials

Surface texture: Muck
Slope class: Nearly level

Sugarbush

Depth class: Very deep
Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam
Slope class: Gently sloping to moderately steep

Minor Soils

- Two Inlets and similar soils
- Balmlake and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Cathro and similar soils
- Seelyeville and similar soils

11. Eagleview-Seelyeville-Snellman Association**Setting**

Landform: Moraines
Position on the landform: Eagleview and Snellman—back slopes and shoulders; Seelyeville—depressions
Slope range: 0 to 30 percent

Composition

Percent of survey area: 1.5
Extent of components in the association:
 Eagleview and similar soils—41 percent
 Seelyeville and similar soils—25 percent
 Snellman and similar soils—17 percent
 Minor soils—17 percent

Soil Properties and Qualities**Eagleview**

Depth class: Very deep
Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand
Slope class: Gently sloping to moderately steep

Seelyeville

Depth class: Very deep
Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck
Slope class: Nearly level

Snellman

Depth class: Very deep
Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam

Slope class: Gently sloping to moderately steep

Minor Soils

- Nebish and similar soils
- Beltrami and similar soils
- Friendship and similar soils
- Karlstad and similar soils
- Egglake and similar soils
- Meehan and similar soils
- Cathro and similar soils
- Rifle and similar soils

Nearly Level to Steep, Loamy and Sandy Soils on Outwash Plains and Valley Trains

12. Arvilla-Sandberg Association

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders (fig. 1-5)

Slope range: 2 to 35 percent

Composition

Percent of survey area: 3

Extent of components in the association:

- Arvilla and similar soils—42 percent
- Sandberg and similar soils—29 percent
- Minor soils—29 percent

Soil Properties and Qualities

Arvilla

Depth class: Very deep

Drainage class: Somewhat excessively drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Slope class: Gently sloping to moderately steep

Sandberg

Depth class: Very deep

Drainage class: Excessively drained

Parent material: Glacial outwash

Surface texture: Coarse sandy loam

Slope class: Gently sloping to moderately steep

Minor Soils

- Corliss and similar soils
- Sverdrup and similar soils
- Fordville and similar soils
- Osakis and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros and similar soils

13. Verndale-Dorset-Corliss Association

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes, shoulders, and flats

Slope range: 0 to 35 percent

Composition

Percent of survey area: 10.5

Extent of components in the association:

- Verndale and similar soils—28 percent
- Dorset soils—25 percent
- Corliss and similar soils—16 percent
- Minor soils—31 percent

Soil Properties and Qualities

Verndale

Depth class: Very deep

Drainage class: Somewhat excessively drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Slope class: Nearly level to strongly sloping

Dorset

Depth class: Very deep

Drainage class: Well drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Slope class: Nearly level to moderately steep

Corliss

Depth class: Very deep

Drainage class: Excessively drained

Parent material: Glacial outwash

Surface texture: Loamy coarse sand

Slope class: Gently sloping to steep

Minor Soils

- Abbeylake and similar soils
- Lida and similar soils
- Fordville and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros and similar soils
- Seelyeville and similar soils

14. Sugarbush-Graycalm-Two Inlets Association

Setting

Landform: Outwash plains and valley trains

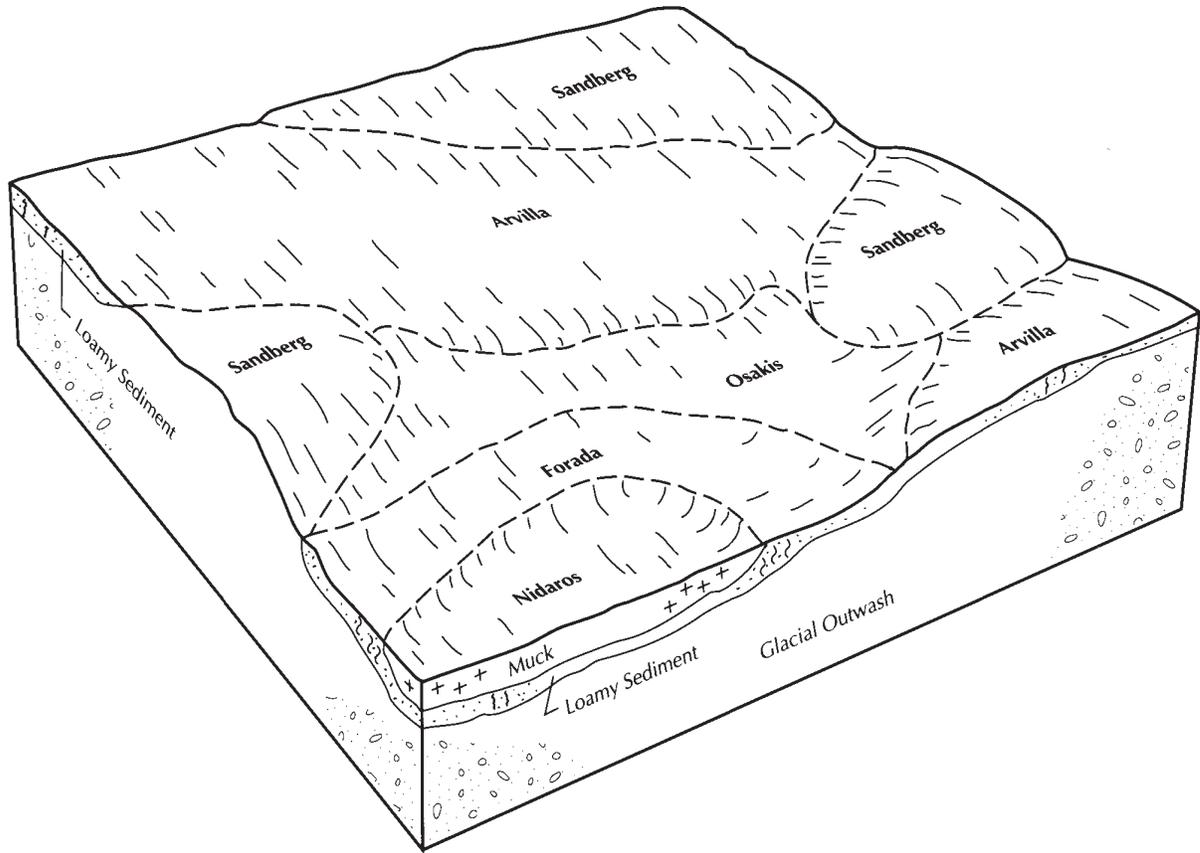


Figure I-5.—Typical pattern of soils and parent material in the Arvilla-Sandberg association.

Position on the landform: Back slopes, shoulders, and flats

Slope range: 1 to 30 percent

Composition

Percent of survey area: 16

Extent of components in the association:

- Sugarbush and similar soils—29 percent
- Graycalm soil and similar soils—23 percent
- Two Inlets soils—17 percent
- Minor soils—31 percent

Soil Properties and Qualities

Sugarbush

Depth class: Very deep
Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam
Slope class: Gently sloping to moderately steep

Graycalm

Depth class: Very deep

Drainage class: Somewhat excessively drained

Parent material: Glacial outwash

Surface texture: Loamy sand

Slope class: Gently sloping to moderately steep

Two Inlets

Depth class: Very deep
Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Loamy coarse sand
Slope class: Gently sloping to moderately steep

Minor Soils

- Menahga and similar soils
- Eagleview and similar soils
- Bootlake and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- Meehan and similar soils
- The depressional Forada soils and similar soils
- Nidaros and similar soils
- Seelyeville and similar soils

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Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification (Jenny, 1941). 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.

Formation of the Soils

A soil is a three-dimensional natural body consisting of mineral and organic material that can support plant growth. The nature of any soil at a given site is the result of the interaction of five general factors—the composition of the parent material; the climate under which the soil material has accumulated; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material. Differences among the soils are caused by variations in one or more of these factors. Horizons or distinct layers were formed in the soils of Becker County by many processes, including accumulation of organic matter, leaching of carbonates and salts, formation and transfer of clay, and oxidation or reduction of iron. The following paragraphs relate the factors of soil formation to the soils in the survey area.

Climate

The climate in Becker County has significantly affected the soil-forming processes. Climatic factors, such as precipitation and temperature, have influenced the plant and animal communities and the physical and chemical weathering of the parent material.

During the glacial period, the advancing glaciers spread over the county and buried the existing boreal forests and the existing soils. The cold temperatures reduced the rate of chemical reactions in the parent materials being deposited by the glacier. The postglacial climate progressively warmed and then stabilized about 5,000 years ago. The warming climate is evidenced by successive vegetation types. The initial postglacial vegetation was spruce forest. The spruce

forest was replaced by pine and deciduous forest. The deciduous forest was replaced by prairie in the northwestern part of the county when the climate stabilized. Becker County currently has a cool, subhumid, continental climate characterized by cold winters and hot summers.

Climate influences soil formation mainly through the effects of precipitation and temperature. Water dissolves soluble materials, such as carbonates, and transfers them either upward or downward within the soil profile. Water is also needed to transfer clay particles to the lower layers of the soil profile.

Temperature affects the rate at which chemical and physical weathering proceed. Freezing of the soil during the winter essentially stops the soil-forming processes. Alternate freezing and thawing in the spring and fall play a part in the development of soil structure and the weathering of soil particles. Chemical reactions occur more rapidly during the summer, when soil temperatures are higher.

The microclimate in a given area can affect soil formation. Quam soils, which are in depressions or low areas, receive runoff from the higher adjacent slopes. The runoff creates a wet microclimate that results in prolonged saturation. This saturation results in the reduction of iron, which causes grayish colors in the subsoil. Sloping soils, such as Formdale soils, formed under a drier microclimate because some of the precipitation is lost through runoff. These soils have better internal drainage than the Quam soils. The resulting oxidation of iron causes a yellowish brown subsoil.

Living Organisms

All forms of life, both in and on the soil, influence the chemical and biological processes of soil formation. Bacteria, earthworms, and other forms of animal life aid in the weathering of materials and the decomposition of organic matter. Plants, including fungi, influence formation by returning decaying plant residue to the soil and aiding in decomposition. Plant roots loosen the soil and bring minerals up from the parent material. The vegetation influences the soil structure and the

movement of nutrients up and down through the soil. Earthworms, insects, and small burrowing animals mix the soil and create small channels that influence soil aeration and the percolation of water. Earthworms help to incorporate crop residue and leaf litter into the soil.

Two types of vegetation, prairie and forest, have strongly influenced the formation of the soils in Becker County. Prairie vegetation occupied about one-fourth of the area at the time the county was settled, mainly in the northwestern part of the county (Marshner, 1974). Soils that formed under prairie vegetation have a thicker, darker surface layer than soils that formed under forest vegetation. Fire has had some effect on limiting tree growth in this area. Soils that formed under forest vegetation characteristically have a thinner, lighter colored surface layer than soils that formed under prairie vegetation and have an accumulation of clay in the subsoil.

Human activities have significantly influenced soil formation. Native forests have been cleared and developed for farming and other uses. Cultivation has accelerated the rate of erosion of the surface layer in the more sloping areas. The surface layer of some of the well drained soils has become browner as a result of mixing with the subsoil and reduction of the content of organic matter. Cultivation has affected soil structure and compaction and has reduced the content of organic matter. Fertilizer applications have increased the fertility of many soils. The drainage of wet soils has prevented further accumulations of organic and limnic sediments in many depressions.

Topography

The topography of the land has an influence on soil-forming processes. As the degree of slope increases, the potential for runoff increases. Steeply sloping soils receive less water for percolation through the soil profile because more water runs off these soils than soils in more gently sloping positions. As the runoff rate increases, the potential for erosion increases. The surface soil becomes thinner in areas upslope but becomes thicker on foot slopes because of erosional processes.

Slope aspect influences soil moisture and soil temperature. Soils on south- and west-facing slopes receive more sunlight and thus are warmer and drier than soils on north- and east-facing slopes.

Position on the landscape influences the natural drainage characteristics of a soil. Soils high on the landscape typically are not saturated with water in the soil profile. Soils low on the landscape may have a seasonal high water table and be saturated with water for extended periods of time. Soils in depressions commonly are ponded and remain saturated year-round

unless they are artificially drained.

Soil color is influenced by the oxidation status of the soil. Yellow and brown colors are common under well drained conditions. Subdued colors, such as grays and blues, are common under poorly drained conditions.

Relief varies greatly in Becker County. On the ground moraine in the northwestern part of the county and on the Ponsford Prairie outwash plain in the eastern part of the county, the slopes are nearly level to gently undulating. Relief is more pronounced throughout the rest of the county, especially in areas of the Alexandria and Itaska end moraines where slopes are very steep. More information about relief is given in the section "General Nature of the Survey Area."

Parent Material

The landscape of Becker County was shaped by the Ice Age, when a series of glaciers spread over the county and deposited glacial drift. Glacial drift is a general term that applies to all rock material, including clay, silt, sand, gravel, and boulders, that has been transported by the glacier and deposited by melting ice or by meltwater flowing from the ice. The pattern of soils is complex because more than one glacial lobe is exposed at the surface in Becker County. The lobes came from different source areas, and they brought with them materials of different physical and chemical properties. The debris remaining after the glaciers had melted provided the parent material in which most of the soils in Becker County formed.

Till is material that was deposited directly by glacial ice with little or no water action. It typically has particles that vary in size, including sand, silt, clay, and larger particles, such as gravel, cobbles, and boulders. The till was deposited in moraines whose topography ranges from nearly level plains (ground moraines) to steeply sloping hills (end moraines or terminal moraines). Approximately 50 percent of the soils in Becker County formed in till sediments. The till soils in the western one-half of the county were deposited by the Des Moines Lobe and typically contain more than 18 percent clay in the parent material. Formdale, Barnes, Langhei, Forman, Waukon, and Nebish soils are examples of soils that formed in Des Moines Lobe till deposits. The till soils in the eastern one-half of the county were deposited by the Wadena Lobe and typically contain less than 18 percent clay in the parent material. Snellman, Rockwood, Chapett, Blowers, and Wykeham soils are examples of soils that formed in Wadena Lobe till deposits.

Glacial outwash resulted when, as the glacial ice melted during warm seasons, meltwater flowed from the margins of the ice sheet and was redeposited as a partly sorted mixture of sand and gravel. The size of the

rock particles that can be carried suspended in water depends on the speed of the moving water. As the water velocity decreases, the finer particles are able to settle out instead of being carried in suspension. In some areas the sands and gravels have a mantle of loamy sediments that may be 2 or more feet thick. Approximately 25 percent of the soils in Becker County formed in glacial outwash sediments. Arvilla, Dorset, Verndale, Sugarbush, and Bootlake soils are examples of soils that formed in glacial outwash sediments.

Waters flowing from a melting glacier commonly were blocked by ice or glacial debris and formed lakes and ponds. These waters were laden with silts and clays, which settled out as the flow ceased, forming lacustrine deposits. Approximately 10 percent of the soils in Becker County formed in glacial lacustrine sediments. The lacustrine sediments occur locally within the Itaska and Alexandria Moraines and on the till plain in the northwestern part of the county. Dalbo, Bygland, and Lindaas soils formed in glacial lacustrine sediments.

To a minor extent, other kinds of parent material also occurred in Becker County. Alluvium is material that was deposited by water on the flood plains along streams, generally after the glacial period. Soils that formed in alluvium are typically stratified with gravel, sand, silt, and clay. The texture of the soil material varies, depending on the velocity of the floodwater, the duration of the flooding, and the distance from the streambed. Lamoure and Fordum soils formed in alluvium.

Colluvium is soil material deposited by water or wind at the base of slopes, in drainageways, and in depressions on the uplands. These sediments are typically silty or loamy. Lakepark and Darnen soils are examples of soils that formed in colluvium. Less than 1 percent of the soils formed in alluvial or colluvial sediments.

Organic soils formed in decomposed plant material that accumulated from vegetation growing in marshes and depressions. Some of the deeper ice-block depressions within the moraines initially were filled with limnic sediments (primarily coprogenous earth) until the water became shallow enough to support herbaceous vegetation. Such plants as cattails, sedges, reeds, grasses, and some shrubs thrive in this environment. The high water table reduces the rate of decomposition; therefore, plant materials accumulate faster than they can decompose.

Approximately 15 percent of the soils in Becker County formed in limnic or organic sediments. The thickness of organic material ranges from a few inches to more than 10 feet. Sapric organic materials are highly decomposed and commonly are black. Hemic organic materials are less decomposed and commonly

are reddish brown. The organic materials in the western one-third of the county are primarily sapric, and those in the eastern two-thirds of the county are mixed sapric and hemic.

Near the town of Ogema is an extensive area of fens, which receive a substantial amount of their water from ground water (springs). The ground water rises to the surface because of hydrostatic pressure. The peat in these fens typically is highly calcareous because the ground water contains a high amount of calcium.

Time

The length of time that the parent material has been exposed to the soil-forming processes influences the nature of the soil that forms. The soils in Becker County are geologically young because the last glacial period ended between 10,000 and 20,000 years ago. Young soils generally are more fertile than older soils because leaching and other soil-forming processes have not altered the parent material as much.

Even though the soils are geologically young, enough time has elapsed for the parent material to weather into soils that have distinct horizons. In many of the forested soils, including Nebish, Snellman, and Rockwood soils, carbonates have been leached to a depth of 2 to 4 feet, clay has been translocated from the surface and subsurface layers to the subsoil, and organic matter has accumulated in the surface layer.

The youngest soils in Becker County, such as Lamoure and Fordum soils, formed in recent alluvium. These soils may be stratified and have weakly expressed horizons because the soil-forming processes are interrupted with each new deposition.

Processes of Soil Formation

Soils form through complex processes that are grouped into four general categories. These are additions, removals, transfers, and transformations. These processes affect soil formation in differing degrees.

The accumulation of organic matter in the A horizon of the mineral soils in the county is an example of an addition. This accumulation is the main reason for the dark color of the A horizon. The leaching of lime from the upper 2 to 4 feet in many of the soils in the county is an example of removal. The parent material of these soils was initially limy throughout, but the lime has been leached from the upper part of the profile by percolating water. The translocation of clay from the A and E horizons to the B horizon in many of the forested soils in the county is an example of a transfer. The A and E horizons are zones of eluviation, or loss. The B horizon is a zone of illuviation, or gain. The B horizon has more clay than the parent material initially had. Thin clay films

are in pores and on faces of peds in the B horizon. An example of a transformation is the reduction of iron. This process takes place under wet, saturated conditions in which there is no oxygen. Gleying, or the reduction of iron, is evident in Flom, Winger, and Colvin soils, which have a dominantly gray subsoil. Reduced iron is soluble, but it commonly has been moved short distances in the soils. Part of this iron can be reoxidized and segregated in the form of stains or concretions.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and

base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Endoaquolls (*Endo*, meaning within, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Endoaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, frigid Typic Endoaquolls.

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

CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aazdahl-----	Aquic Haploborolls, fine-loamy, mixed
Abbeylake-----	Typic Udipsamments, mixed, frigid
Arvilla-----	Udic Haploborolls, sandy, mixed
Audubon-----	Vertic Haploborolls, fine, montmorillonitic
Auganaush-----	Mollic Albaqualfs, fine, montmorillonitic, frigid
Balmlake-----	Typic Eutroboralfs, coarse-loamy, mixed
Barnes-----	Udic Haploborolls, fine-loamy, mixed
Beltrami-----	Aquic Eutroboralfs, fine-loamy, mixed
Birchlake-----	Aquic Argiborolls, fine, montmorillonitic
Blowers-----	Glossaquic Eutroboralfs, coarse-loamy, mixed
Bootlake-----	Typic Eutroboralfs, coarse-loamy, mixed
Boyerlake-----	Vertic Eutrochrepts, fine, montmorillonitic, frigid
Buse-----	Typic Calciborolls, fine-loamy, mixed
Bygland-----	Aquertic Argiborolls, fine, montmorillonitic
Cathro-----	Terric Borosaprists, loamy, mixed, euic
Chapett-----	Boralfic Udic Argiborolls, fine-loamy, mixed
Colvin-----	Typic Calciaquolls, fine-silty, frigid
Corliss-----	Typic Udipsamments, mixed, frigid
Dalbo-----	Vertic Eutroboralfs, fine, montmorillonitic
Darnen-----	Pachic Udic Haploborolls, fine-loamy, mixed
Dorset-----	Udic Argiborolls, coarse-loamy, mixed
Dovray-----	Cumulic Vertic Epiaquolls, fine, montmorillonitic, frigid
Eagleview-----	Argic Udipsamments, mixed, frigid
Egeland-----	Udic Haploborolls, coarse-loamy, mixed
Egglake-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Epoufette-----	Mollic Endoaqualfs, coarse-loamy, mixed, frigid
Flom-----	Typic Endoaquolls, fine-loamy, mixed, frigid
Forada-----	Typic Endoaquolls, coarse-loamy, mixed, frigid
Fordville-----	Pachic Udic Haploborolls, fine-loamy over sandy or sandy-skeletal, mixed
Forman-----	Udic Argiborolls, fine-loamy, mixed
Formdale-----	Udic Haploborolls, fine-loamy, mixed
Foxlake-----	Vertic Epiaquolls, fine, montmorillonitic, frigid
Friendship-----	Typic Udipsamments, mixed, frigid
Gonvick-----	Aquic Argiborolls, fine-loamy, mixed
Graycalm-----	Argic Udipsamments, mixed, frigid
Hamerly-----	Aeric Calciaquolls, fine-loamy, frigid
Hamre-----	Histic Humaquepts, fine-loamy, mixed, nonacid, frigid
Hangaard-----	Typic Endoaquolls, sandy, mixed, frigid
Haslie-----	Limnic Borosaprists, coprogenous, euic
Hillview-----	Mollic Endoaqualfs, coarse-loamy, mixed, frigid
Karlstad-----	Aquic Eutroboralfs, coarse-loamy, mixed
Lakepark-----	Cumulic Endoaquolls, fine-loamy, mixed, frigid
Lamoure-----	Cumulic Endoaquolls, fine-silty, mixed (calcareous), frigid
Langhei-----	Typic Eutrochrepts, fine-loamy, mixed, frigid
Lida-----	Mollic Eutroboralfs, coarse-loamy, mixed
Lindaas-----	Typic Argiaquolls, fine, montmorillonitic, frigid
Lupton-----	Typic Borosaprists, euic
McIntosh-----	Aeric Calciaquolls, fine-silty, frigid
Meehan-----	Aquic Udipsamments, mixed, frigid
Menahga-----	Typic Udipsamments, mixed, frigid
Mooselake-----	Typic Borohemists, euic
Naytahwaush-----	Mollic Eutroboralfs, fine, montmorillonitic
Nebish-----	Typic Eutroboralfs, fine-loamy, mixed
Nidaros-----	Terric Borosaprists, loamy, mixed, euic
Nymore-----	Typic Udipsamments, mixed, frigid
Osakis-----	Aquic Haploborolls, sandy, mixed
Oylen-----	Aquic Argiborolls, coarse-loamy, mixed
Paddock-----	Udollic Epiaqualfs, coarse-loamy, mixed, frigid
Quam-----	Cumulic Endoaquolls, fine-silty, mixed, frigid
Rifle-----	Typic Borohemists, euic
Rockwell-----	Typic Calciaquolls, coarse-loamy, frigid
Rockwood-----	Mollic Eutroboralfs, coarse-loamy, mixed
Rosy-----	Glossaquic Eutroboralfs, coarse-loamy, mixed
Runeberg-----	Typic Endoaquolls, coarse-loamy, mixed, frigid

CLASSIFICATION OF THE SOILS--Continued

Soil name	Family or higher taxonomic class
Rushlake-----	Aquic Udipsamments, mixed, frigid
Sandberg-----	Udorthentic Haploborolls, sandy, mixed
Sedgenville-----	Fluvaquentic Endoaquolls, coarse-loamy, mixed, frigid
Seelyeville-----	Typic Borosaprists, euic
Smiley-----	Typic Argiaquolls, fine-loamy, mixed, frigid
Snellman-----	Typic Eutroboralfs, fine-loamy, mixed
Sol-----	Glossic Eutroboralfs, fine-loamy, mixed
Sugarbush-----	Typic Eutroboralfs, coarse-loamy, mixed
Sverdrup-----	Udic Haploborolls, sandy, mixed
Sybil-----	Mollic Eutroboralfs, sandy, mixed
Two Inlets-----	Psammentic Eutroboralfs, sandy, mixed
Udipsamments-----	Udipsamments
Udorthents-----	Udorthents
Urness-----	Mollic Fluvaquents, fine-silty, mixed (calcareous), frigid
Vallers-----	Typic Calciaquolls, fine-loamy, frigid
Verndale-----	Udic Argiborolls, coarse-loamy, mixed
Waukon-----	Mollic Eutroboralfs, fine-loamy, mixed
Winger-----	Typic Calciaquolls, fine-silty, frigid
Wolverton-----	Aquic Calciborolls, coarse-loamy, mixed
Wykeham-----	Aquic Eutroboralfs, fine-loamy, mixed
Wyndmere-----	Aeric Calciaquolls, coarse-loamy, frigid

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
20B	Chapett fine sandy loam, 2 to 8 percent slopes-----	1,730	0.2
20C2	Chapett fine sandy loam, 8 to 15 percent slopes, eroded-----	1,880	0.2
20E	Chapett fine sandy loam, 15 to 30 percent slopes-----	680	*
26	Aazdahl clay loam-----	3,110	0.3
33B	Barnes loam, 2 to 6 percent slopes-----	1,740	0.2
36	Flom silty clay loam-----	5,620	0.6
38B	Waukon loam, 2 to 8 percent slopes-----	6,730	0.7
38C	Waukon loam, 8 to 15 percent slopes-----	5,710	0.6
38E	Waukon loam, 15 to 30 percent slopes-----	2,300	0.3
40B	Nebish loam, 2 to 8 percent slopes-----	8,280	0.9
40C	Nebish loam, 8 to 15 percent slopes-----	9,650	1.0
40E	Nebish loam, 15 to 30 percent slopes-----	3,470	0.4
47	Colvin silty clay loam-----	940	0.1
63	Rockwell loam-----	2,390	0.2
108	McIntosh silt loam-----	3,820	0.4
111	Hangaard sandy loam-----	1,090	0.1
121	Wykeham fine sandy loam-----	3,820	0.4
125	Beltrami loam-----	4,380	0.5
133A	Dalbo silt loam, 0 to 2 percent slopes-----	3,620	0.4
133B	Dalbo silt loam, 2 to 8 percent slopes-----	3,280	0.4
133C	Dalbo silt loam, 8 to 15 percent slopes-----	1,330	0.2
133E	Dalbo silt loam, 15 to 30 percent slopes-----	280	*
137	Dovray silty clay-----	800	*
141B	Egeland fine sandy loam, 1 to 6 percent slopes-----	980	0.1
141C	Egeland fine sandy loam, 6 to 12 percent slopes-----	310	*
168B	Forman clay loam, 2 to 6 percent slopes-----	2,770	0.3
168C2	Forman clay loam, 6 to 12 percent slopes, eroded-----	3,110	0.3
168D2	Forman clay loam, 12 to 20 percent slopes, eroded-----	1,310	0.2
168E	Forman clay loam, 20 to 30 percent slopes-----	250	*
171B	Formdale clay loam, 2 to 5 percent slopes-----	8,580	0.9
180	Gonvick loam-----	810	*
184	Hamerly loam-----	10,330	1.1
191	Epoufette sandy loam-----	3,070	0.3
202	Meehan loamy sand-----	1,140	0.1
207D	Nymore loamy sand, 12 to 20 percent slopes-----	690	*
267B	Snellman sandy loam, 2 to 8 percent slopes-----	13,680	1.5
267C	Snellman sandy loam, 8 to 15 percent slopes-----	28,960	3.1
267E	Snellman sandy loam, 15 to 30 percent slopes-----	11,280	1.2
315A	Bootlake sandy loam, 0 to 2 percent slopes-----	370	*
315B	Bootlake sandy loam, 2 to 5 percent slopes-----	640	*
332B	Sugarbush sandy loam, 1 to 8 percent slopes-----	1,820	0.2
335	Urness mucky silt loam-----	3,760	0.4
339	Fordville loam-----	1,480	0.2
344	Quam silty clay loam-----	3,730	0.4
351	Colvin silty clay loam, depressiona-----	1,090	0.1
375	Forada loam-----	3,360	0.4
398	Winger silty clay loam, depressiona-----	2,380	0.2
406A	Dorset sandy loam, 0 to 2 percent slopes-----	3,610	0.4
406B	Dorset sandy loam, 2 to 6 percent slopes-----	8,730	0.9
413	Osakis sandy loam-----	560	*
418	Lamoure silty clay loam, occasionally flooded-----	1,510	0.2
422B	Bygland silty clay loam, 1 to 6 percent slopes-----	1,420	0.2
422C	Bygland silty clay loam, 6 to 15 percent slopes-----	290	*
503B	Balmlake fine sandy loam, 1 to 8 percent slopes-----	1,770	0.2
503C	Balmlake fine sandy loam, 8 to 15 percent slopes-----	700	*
503E	Balmlake fine sandy loam, 15 to 30 percent slopes-----	400	*
508	Wyndmere fine sandy loam-----	980	0.1
540	Seelyeville muck-----	15,580	1.7
541	Rifle mucky peat-----	51,540	5.6
544	Cathro muck-----	14,730	1.6
564	Friendship loamy sand-----	2,610	0.3
567A	Verndale sandy loam, 0 to 2 percent slopes-----	11,750	1.3

See footnote at end of table.

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
567B	Verndale sandy loam, 2 to 6 percent slopes-----	5,050	0.5
579C2	Formdale-Langhei-Sandberg complex, 6 to 12 percent slopes, eroded-----	920	*
624	Rosy sandy loam-----	850	*
701	Runeberg mucky loam, depressionals-----	2,400	0.2
711B	Arvilla-Sandberg complex, 2 to 6 percent slopes-----	5,960	0.6
711C	Arvilla-Sandberg complex, 6 to 12 percent slopes-----	8,200	0.9
718B	Naytahwaush loam, 2 to 8 percent slopes-----	820	*
718C	Naytahwaush loam, 8 to 15 percent slopes-----	1,110	0.1
718E	Naytahwaush loam, 15 to 30 percent slopes-----	460	*
721E	Corliss loamy sand, 20 to 35 percent slopes-----	690	*
746	Haslie muck-----	16,410	1.8
747B	Audubon silty clay loam, 0 to 6 percent slopes-----	3,860	0.4
753D	Abbeylake loamy sand, 12 to 20 percent slopes-----	900	*
753E	Abbeylake loamy sand, 20 to 30 percent slopes-----	910	*
765	Smiley loam-----	3,640	0.4
767	Auganaush loam-----	110	*
775B	Sugarbush-Two Inlets complex, 1 to 8 percent slopes-----	18,850	2.0
775C	Sugarbush-Two Inlets complex, 8 to 15 percent slopes-----	20,990	2.3
776B	Snellman-Sugarbush complex, 2 to 8 percent slopes-----	18,810	2.0
776C	Snellman-Sugarbush complex, 8 to 15 percent slopes-----	35,090	3.8
776E	Snellman-Sugarbush complex, 15 to 30 percent slopes-----	18,250	2.0
778B	Dorset-Corliss complex, 1 to 6 percent slopes-----	6,640	0.7
778C	Dorset-Corliss complex, 6 to 12 percent slopes-----	4,880	0.5
780B	Audubon-Boyerlake complex, 1 to 6 percent slopes-----	2,290	0.3
780C2	Audubon-Boyerlake complex, 6 to 12 percent slopes, eroded-----	3,220	0.3
780D2	Audubon-Boyerlake complex, 12 to 20 percent slopes, eroded-----	1,010	0.1
785	Hamerly-Winger complex-----	13,640	1.5
786	Winger-Hamerly-Colvin complex-----	11,370	1.2
797	Mooselake and Lupton soils-----	7,200	0.8
867B	Graycalm-Menahga complex, 1 to 8 percent slopes-----	3,210	0.3
867C	Graycalm-Menahga complex, 8 to 15 percent slopes-----	2,720	0.3
867E	Graycalm-Menahga complex, 15 to 30 percent slopes-----	1,840	0.2
903B	Barnes-Langhei complex, 2 to 6 percent slopes-----	6,840	0.7
903C2	Barnes-Langhei complex, 6 to 12 percent slopes, eroded-----	4,010	0.4
931C2	Formdale-Langhei complex, 6 to 12 percent slopes, eroded-----	17,010	1.8
942D2	Langhei-Barnes complex, 12 to 20 percent slopes, eroded-----	1,320	0.1
943D2	Langhei-Formdale complex, 12 to 20 percent slopes, eroded-----	4,560	0.5
943E	Langhei-Formdale complex, 20 to 30 percent slopes-----	690	*
951B	Nebish-Sugarbush complex, 2 to 8 percent slopes-----	3,020	0.3
951C	Nebish-Sugarbush complex, 8 to 15 percent slopes-----	2,790	0.3
951E	Nebish-Sugarbush complex, 15 to 30 percent slopes-----	820	*
1015	Udipsamments, cut and fill land-----	990	0.1
1016	Udorthents, loamy, cut and fill land-----	330	*
1027	Udorthents, wet substratum, fill land-----	410	*
1030	Pits, gravel-Udipsamments complex-----	1,430	0.2
1104B	Waukon-Dorset complex, 1 to 8 percent slopes-----	540	*
1104C	Waukon-Dorset complex, 8 to 15 percent slopes-----	990	0.1
1111	Nidaros muck, frequently flooded-----	1,110	0.1
1113	Haslie, Seelyeville, and Cathro soils, ponded-----	6,950	0.8
1125B	Sverdrup-Abbeylake complex, 1 to 6 percent slopes-----	1,300	0.2
1125C	Sverdrup-Abbeylake complex, 6 to 12 percent slopes-----	380	*
1126B	Verndale-Nymore complex, 1 to 6 percent slopes-----	4,190	0.4
1127A	Bootlake-Graycalm complex, 0 to 2 percent slopes-----	3,830	0.4
1127B	Bootlake-Graycalm complex, 2 to 8 percent slopes-----	3,980	0.4
1128	Cathro muck, frequently flooded-----	1,360	0.2
1129	Lindaas silty clay loam, morainic-----	3,300	0.4
1130	Wolverton fine sandy loam-----	1,600	0.2
1131B	Verndale-Abbeylake complex, 1 to 6 percent slopes-----	3,580	0.4
1132B	Eagleview-Balmlake complex, 1 to 8 percent slopes-----	2,580	0.3
1132C	Eagleview-Balmlake complex, 8 to 15 percent slopes-----	1,620	0.2
1132E	Eagleview-Balmlake complex, 15 to 30 percent slopes-----	610	*
1135	Foxlake silty clay loam-----	2,140	0.2

See footnote at end of table.

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1136	Nidaros muck-----	6,430	0.7
1137B	Birchlake silty clay loam, 1 to 6 percent slopes-----	3,500	0.4
1137C	Birchlake silty clay loam, 6 to 12 percent slopes, eroded-----	2,750	0.3
1137D	Birchlake silty clay loam, 12 to 20 percent slopes, eroded-----	1,230	0.1
1137E	Birchlake silty clay loam, 20 to 30 percent slopes-----	240	*
1138	Rushlake and Hangaard soils, lake beaches-----	3,460	0.4
1140B	Eagleview-Snellman complex, 1 to 8 percent slopes-----	2,470	0.3
1140C	Eagleview-Snellman complex, 8 to 15 percent slopes-----	1,510	0.2
1149	Hamerly clay loam-----	4,650	0.5
1195B	Sybil-Eagleview complex, 2 to 8 percent slopes-----	220	*
1195C	Sybil-Eagleview complex, 8 to 15 percent slopes-----	260	*
1195E	Sybil-Eagleview complex, 15 to 30 percent slopes-----	110	*
1196B	Lida-Two Inlets complex, 1 to 8 percent slopes-----	340	*
1196C	Lida-Two Inlets complex, 8 to 15 percent slopes-----	920	*
1196E	Lida-Two Inlets complex, 15 to 30 percent slopes-----	550	*
1200	Egglake loam-----	4,290	0.5
1201C	Sugarbush-Snellman complex, 8 to 15 percent slopes-----	5,110	0.6
1201E	Sugarbush-Snellman complex, 15 to 35 percent slopes-----	4,880	0.5
1210	Paddock-Epoufette complex-----	1,600	0.2
1211	Egglake-Cathro complex-----	2,890	0.3
1225	Wykeham-Karlstad complex-----	900	*
1227	Quam, Cathro, and Urness soils, ponded-----	3,950	0.4
1230	Haslie and Nidaros soils, ponded-----	10,300	1.1
1234B	Formdale-Buse complex, 2 to 6 percent slopes-----	16,360	1.8
1235B	Formdale-Buse-Sandberg complex, 2 to 6 percent slopes-----	970	0.1
1236B	Eagleview loamy sand, 1 to 8 percent slopes-----	5,970	0.6
1236C	Eagleview loamy sand, 8 to 15 percent slopes-----	5,040	0.5
1236E	Eagleview loamy sand, 15 to 30 percent slopes-----	3,420	0.4
1238E	Two Inlets-Sugarbush complex, 15 to 30 percent slopes-----	12,080	1.3
1242D	Sandberg-Arvilla complex, 12 to 20 percent slopes-----	3,100	0.3
1243B	Sol sandy loam, 2 to 8 percent slopes, very stony-----	850	*
1243C	Sol sandy loam, 8 to 15 percent slopes, very stony-----	3,500	0.4
1243E	Sol sandy loam, 15 to 30 percent slopes, very stony-----	800	*
1244B	Sol-Sugarbush complex, 2 to 8 percent slopes, very stony-----	2,300	0.3
1244C	Sol-Sugarbush complex, 8 to 15 percent slopes, very stony-----	6,600	0.7
1244E	Sol-Sugarbush complex, 15 to 30 percent slopes, very stony-----	3,000	0.3
1246	Winger silty clay loam-----	7,720	0.8
1247D	Corliss-Dorset complex, 12 to 20 percent slopes-----	1,260	0.1
1248C	Nymore-Verndale complex, 6 to 12 percent slopes-----	1,730	0.2
1249C	Graycalm-Bootlake complex, 8 to 15 percent slopes-----	2,160	0.2
1250C	Abbeylake-Verndale complex, 6 to 12 percent slopes-----	3,580	0.4
1251	Lamoure silt loam, channeled, frequently flooded-----	890	*
1252B	Bootlake-Eagleview complex, 1 to 8 percent slopes-----	7,390	0.8
1263C	Eagleview-Bootlake complex, 8 to 15 percent slopes-----	4,020	0.4
1291	Sedgenville loam, frequently flooded-----	700	*
1306	Karlstad sandy loam-----	3,680	0.4
1317	Vallers silty clay loam-----	10,630	1.2
1318	Darnen loam-----	380	*
1319B	Rockwood sandy loam, 2 to 6 percent slopes, stony-----	6,750	0.7
1319C	Rockwood sandy loam, 6 to 12 percent slopes, stony-----	1,530	0.2
1319D	Rockwood sandy loam, 12 to 20 percent slopes, stony-----	160	*
1320B	Blowers sandy loam, 1 to 5 percent slopes, stony-----	15,130	1.6
1321	Paddock fine sandy loam, stony-----	7,390	0.8
1365	Hillview fine sandy loam-----	590	*
1825B	Seelyville muck, seep land, 1 to 10 percent slopes-----	2,510	0.3
1878	Hamre muck-----	1,960	0.2
1938	Lakepark clay loam-----	4,060	0.4
1942	Forada mucky loam, depressional-----	1,190	0.1
1967	Hamerly-Vallers complex-----	14,210	1.5

See footnote at end of table.

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1975	Oylen sandy loam-----	2,060	0.2
1997	Vallers-Hamerly-Winger complex-----	6,160	0.7
	Water-----	84,600	9.2
	Total-----	924,300	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 description is followed by the detailed soil map units associated with the series.

Characteristics of the soil and the material in which it formed are identified for each soil series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units on the detailed maps in Part III of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given in Part II of this survey.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

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

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

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

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

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the

basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Verndale sandy loam, 0 to 2 percent slopes, is a phase of the Verndale series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are called 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. Snellman-Sugarbush complex, 8 to 15 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 Pits, gravel-Udipsamments complex is an example.

The table "Acreage and Proportionate Extent of the Soils" in Parts I and II of this survey gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Aazdahl Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 3 percent

Taxonomic class: Fine-loamy, mixed Aquic Haploborolls

Typical Pedon

Aazdahl clay loam, 2,000 feet west and 200 feet south of the northeast corner of sec. 30, T. 141 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A—9 to 13 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; neutral; clear smooth boundary.

Bw—13 to 19 inches; olive brown (2.5Y 4/3) clay loam; weak fine subangular blocky structure; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; about 3 percent gravel; neutral; clear smooth boundary.

Bk—19 to 32 inches; grayish brown (2.5Y 5/2) clay loam; weak fine subangular blocky structure; friable; common medium distinct yellowish brown (10YR 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 4 percent gravel; violently effervescent; slightly alkaline; gradual smooth boundary.

C—32 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; common medium distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 17 to 27 inches

Thickness of the mollic epipedon: 10 to 16 inches

Content of rock fragments: 2 to 8 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—clay loam

Bw horizon:

Hue—2.5Y or 10YR

Value—3 or 4

Chroma—2 to 4

Texture—clay loam or silty clay loam

Bk horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—clay loam, silty clay loam, or loam

C horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 6

Texture—clay loam, silty clay loam, or loam

26—Aazdahl clay loam**Composition**

Aazdahl and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: 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

- Formdale and similar soils
- Langhei and similar soils
- Flom and similar soils
- Quam 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

Abbeylake Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 1 to 30 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Abbeylake loamy sand, 12 to 20 percent slopes, 800 feet east and 1,600 feet north of the southwest corner

of sec. 13, T. 138 N., R. 41 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; about 3 percent gravel; slightly acid; abrupt smooth boundary.

Bw—8 to 24 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; about 3 percent gravel; neutral; clear smooth boundary.

C1—24 to 45 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 4 percent gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

C2—45 to 60 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; few carbonate coatings on the underside of pebbles; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 percent

Content of rock fragments: 0 to 10 percent gravel

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand

Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 or 4

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

C horizon:

Hue—10YR

Value—5 or 6

Chroma—3 or 4

Texture—coarse sand or sand

753D—Abbeylake loamy sand, 12 to 20 percent slopes**Composition**

Abbeylake and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 12 to 20 percent

Component Description

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: 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

- Sverdrup and similar soils
- Verndale and similar soils
- Fordville 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

753E—Abbeylake loamy sand, 20 to 30 percent slopes

Composition

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 20 to 30 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches
Organic matter content: 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

- Sverdrup and similar soils
- Verndale and similar soils
- Fordville 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

1250C—Abbeylake-Verndale complex, 6 to 12 percent slopes

Composition

Abbeylake and similar soils: About 60 percent
 Verndale and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Abbeylake

Surface layer texture: Loamy coarse sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches
Organic matter content: Moderate

Verndale

Surface layer texture: Coarse sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Arvilla Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 2 to 20 percent

Taxonomic class: Sandy, mixed Udic Haploborolls

Typical Pedon

Arvilla sandy loam (fig. I-6), in an area of Arvilla-Sandberg complex, 2 to 6 percent slopes, 600 feet west and 1,800 feet north of the southeast corner of sec. 29, T. 138 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.

Bw1—8 to 11 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; about 5 percent gravel; neutral; clear smooth boundary.

Bw2—11 to 15 inches; dark yellowish brown (10YR 3/4) sandy loam; weak fine subangular blocky structure; friable; about 5 percent gravel; neutral; clear smooth boundary.

2Bw3—15 to 17 inches; dark yellowish brown (10YR 4/4) gravelly loamy coarse sand; weak fine

subangular blocky structure; very friable; about 15 percent gravel; neutral; clear smooth boundary.

2C—17 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches

Thickness of the loamy mantle: 14 to 25 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—sandy loam

Content of rock fragments—0 to 7 percent gravel

Bw horizon:

Hue—7.5YR or 10YR

Value—2 to 5

Chroma—2 to 4

Texture—sandy loam or coarse sandy loam

Content of rock fragments—0 to 7 percent gravel

2C horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

Texture—gravelly coarse sand or coarse sand

Content of rock fragments—5 to 35 percent gravel

711B—Arvilla-Sandberg complex, 2 to 6 percent slopes

Composition

Arvilla and similar soils: About 65 percent

Sandberg and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 2 to 6 percent

Component Description

Arvilla

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.6 inches

Organic matter content: Moderate

Sandberg

Surface layer texture: Coarse sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.4 inches

Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Osakis and similar soils
- Forada 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

711C—Arvilla-Sandberg complex, 6 to 12 percent slopes

Composition

Arvilla and similar soils: About 50 percent

Sandberg and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Arvilla

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.6 inches

Organic matter content: Moderate

Sandberg

Surface layer texture: Coarse sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches

Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Osakis and similar soils
- Forada 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

Audubon Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 20 percent

Taxonomic class: Fine, montmorillonitic Vertic Haploborolls

Typical Pedon

Audubon silty clay loam (fig. I-7), in an area of Audubon-Boyerlake complex, 1 to 6 percent slopes, 1,400 feet north and 100 feet west of the southeast corner of sec. 15, T. 139 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; neutral; abrupt smooth boundary.

Bk1—9 to 20 inches; brown (10YR 5/3) silty clay loam; weak fine subangular blocky structure; friable; common light gray (10YR 7/2) filaments and threads of segregated lime; about 1 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—20 to 27 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate medium angular blocky structure; friable; common fine distinct light brownish gray (10YR 6/2) iron depletions and few fine faint yellowish brown (10YR 5/4) iron concentrations; common light gray (10YR 7/2) filaments and threads of segregated lime; about 1 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—27 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate medium angular blocky soil aggregates; friable; common medium distinct light brownish gray (2.5Y 6/2) iron depletions and common medium distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 1 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 4 percent

Depth to carbonates: 0 to 20 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 in the upper part and 1 or 2 in the lower part

Texture—silty clay loam

Bk horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 or 4

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

C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 or 4

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

747B—Audubon silty clay loam, 0 to 6 percent slopes

Composition

Audubon and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Rises on moraines

Slope range: 0 to 6 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 3 to 6 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches

Organic matter content: 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

- Boyerlake and similar soils
- Foxlake and similar soils
- Dovray and similar soils
- Cathro 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

780B—Audubon-Boyerlake complex, 1 to 6 percent slopes

Composition

Audubon and similar soils: About 70 percent

Boyerlake and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: Audubon—1 to 6 percent; Boyerlake—3 to 6 percent

Component Description

Audubon

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till
Flooding: None
Depth to the water table: 3 to 6 feet
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches
Organic matter content: High

Boyerlake

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches
Organic matter content: 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

- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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

780C2—Audubon-Boyerlake complex, 6 to 12 percent slopes, eroded

Composition

Audubon and similar soils: About 65 percent
 Boyerlake and similar soils: About 25 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Audubon

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3 to 6 feet
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches
Organic matter content: High

Boyerlake

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches
Organic matter content: 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

- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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

780D2—Audubon-Boyerlake complex, 12 to 20 percent slopes, eroded

Composition

Audubon and similar soils: About 60 percent
 Boyerlake and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 12 to 20 percent

Component Description

Audubon

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3 to 6 feet
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches
Organic matter content: High

Boyerlake

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches
Organic matter content: 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

- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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: Upper part—moderate; lower part—slow or moderately slow
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, frigid Mollic Albaqualfs

Typical Pedon

Auganaush loam, 2,120 feet north and 500 feet east of the southwest corner of sec. 35, T. 144 N., R. 40 W.,

in Clearwater County, Minnesota:

A—0 to 5 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; many fine roots; about 1 percent gravel; slightly acid; clear wavy boundary.

E—5 to 8 inches; dark grayish brown (2.5Y 4/2) loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; common medium distinct dark olive gray (5Y 3/2) iron depletions; many fine roots; about 1 percent gravel; moderately acid; clear irregular boundary.

Btg1—8 to 17 inches; grayish brown (2.5Y 5/2) clay; moderate medium subangular blocky structure; very firm; common fine distinct olive (5Y 5/3) iron concentrations; common medium roots; common moderately thick very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; about 1 percent gravel; slightly acid; gradual wavy boundary.

Btg2—17 to 22 inches; olive gray (5Y 5/2) silty clay loam; moderate medium subangular blocky structure; firm; few medium distinct light olive brown (2.5Y 5/4) iron concentrations; few medium roots; common moderately thick very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; about 2 percent gravel; neutral; gradual wavy boundary.

Btg3—22 to 38 inches; olive gray (5Y 5/2) silty clay loam; weak medium subangular blocky structure; firm; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; few medium roots; few thin very dark grayish brown (2.5Y 3/2) clay films in pores and on fracture faces; few light gray (10YR 7/2) filaments and threads of segregated lime; slightly effervescent; slightly alkaline; about 2 percent gravel; clear wavy boundary.

Cg—38 to 60 inches; light olive gray (5Y 6/2) silty clay loam; massive; firm; common medium prominent light olive brown (2.5Y 5/4) and few fine faint olive (5Y 5/4) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 40 inches
Content of rock fragments: 1 to 8 percent

Ap or A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6
 Chroma—1 or 2
 Texture—loam or silt loam

Btg horizon:

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

Cg horizon:

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

767—Auganaush loam**Composition**

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

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches
Organic matter content: 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

- Naytahwaush and similar soils
- Dovray and similar soils
- Cathro 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

Baumlake Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderately rapid or moderate; lower part—moderate
Landform: Moraines, outwash plains, and valley trains
Parent material: Glaciolacustrine deposits
Slope range: 1 to 30 percent
Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Baumlake fine sandy loam, 15 to 30 percent slopes, 2,250 feet east and 1,800 feet north of the southwest corner of sec. 2, T. 142 N., R. 39 W.

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

E—2 to 15 inches; brown (10YR 5/3) fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; moderately acid; clear smooth boundary.

Bt—15 to 28 inches; dark yellowish brown (10YR 4/4) loam; few fine faint yellowish brown (10YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; many thin brown and dark brown (10YR 4/3) clay films on faces of peds and in pores; slightly acid; clear wavy boundary.

2C—28 to 60 inches; stratified light yellowish brown (10YR 6/4) very fine sandy loam and pale brown (10YR 6/3) fine sand; weak medium platy soil aggregates; very friable; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 48 inches
Content of rock fragments: 0 to 3 percent gravel

Ap or A horizon:

Hue—10YR
 Value—2 to 4
 Chroma—1 to 3
 Texture—fine sandy loam

E horizon:

Hue—10YR
 Value—4 to 6
 Chroma—2 to 4
 Texture—very fine sand, loamy fine sand, or fine sandy loam

Bt horizon:

Hue—10YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—fine sandy loam, sandy loam, or loam

2C horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—3 to 6
 Texture—stratified fine sand, sand, loamy fine sand, silt loam, very fine sand, and very fine sandy loam

503B—Balmlake fine sandy loam, 1 to 8 percent slopes

Composition

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

Setting

Landform: Rises on moraines
Position on the landform: Back slopes and shoulders
Slope range: 1 to 8 percent

Component Description

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches
Organic matter content: 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

- Eagleview and similar soils
- Dalbo and similar soils
- Rosy and similar soils
- Hillview and similar soils
- Cathro 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

503C—Balmlake fine sandy loam, 8 to 15 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: 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

- Eagleview and similar soils
- Dalbo and similar soils
- Rosy and similar soils
- Hillview and similar soils
- Cathro 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

503E—Balmlake fine sandy loam, 15 to 30 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 15 to 30 percent

Component Description

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: 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

- Eagleview and similar soils
- Dalbo and similar soils
- Rosy and similar soils
- Hillview 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

Barnes Series

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

Typical Pedon

Barnes loam, in an area of Barnes-Langhei complex, 6 to 12 percent slopes, eroded, 2,400 feet east and 400 feet south of the northwest corner of sec. 9, T. 142 N., R. 41 W.

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

Bw—8 to 19 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.

Bk—19 to 33 inches; pale brown (10YR 6/3) loam; weak fine subangular blocky structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

C—33 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; about 5 percent gravel; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 10 percent

Depth to carbonates: 0 to 20 inches

Ap or A horizon:

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

Bw horizon:

Hue—10YR or 2.5Y
Value—2 to 5
Chroma—3 or 4
Texture—loam or clay loam

Bk horizon:

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

C horizon:

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

33B—Barnes loam, 2 to 6 percent slopes

Composition

Barnes and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Rises on moraines

Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Langhei and similar soils
- Aazdahl and similar soils
- Flom and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

903B—Barnes-Langhei complex, 2 to 6 percent slopes

Composition

Barnes and similar soils: About 65 percent

Langhei and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: Barnes—2 to 6 percent; Langhei—3 to 6 percent

Component Description

Barnes

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderate

Langhei

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Hamerly and similar soils
- Vallers and similar soils
- Lakepark and similar soils
- Quam 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

903C2—Barnes-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Barnes and similar soils: About 55 percent

Langhei and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Barnes

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches
Organic matter content: Moderate

Langhei

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches
Organic matter content: 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

- Hamerly and similar soils
- Vallers and similar soils
- Lakepark and similar soils
- Quam 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

Beltrami Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderate or moderately rapid; next part—moderately slow or moderate; lower part—moderate
Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Beltrami loam, 500 feet east and 100 feet south of the northwest corner of sec. 9, T. 141 N., R. 40 W.

- A—0 to 4 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; about 2 percent gravel; neutral; clear smooth boundary.
- E—4 to 8 inches; dark gray (10YR 4/1) sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; about 2 percent gravel; neutral; clear smooth boundary.
- Bt—8 to 22 inches; olive brown (2.5Y 4/4) clay loam; moderate medium subangular blocky structure; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions; many thick very dark gray (10YR 3/1) clay films on faces of peds and in pores; about 3 percent gravel; neutral; clear smooth boundary.
- Bk—22 to 43 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; few fine distinct gray (10YR 6/1) iron depletions and yellowish brown (10YR 5/6) iron concentrations; about 5 percent gravel; many light gray (10YR 7/2) filaments and threads of segregated lime; violently effervescent; slightly alkaline; gradual smooth boundary.
- C—43 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct gray (10YR 6/1) iron depletions and dark yellowish brown (10YR 5/6) iron concentrations; about 6 percent gravel; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Content of rock fragments: 2 to 10 percent

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 or 2

Texture—loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam, sandy loam, or loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—clay loam or sandy clay loam

Bk and C horizons:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

125—Beltrami loam

Composition

Beltrami and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.3 inches

Organic matter content: 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

- Nebish and similar soils
- Smiley and similar soils
- Quam and similar soils
- Cathro 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

Birchlake Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately slow; lower part—slow

Landform: Moraines

Parent material: Till

Slope range: 1 to 30 percent

Taxonomic class: Fine, montmorillonitic Aquic Argiborolls

Typical Pedon

Birchlake silty clay loam, 1 to 6 percent slopes, 1,800 feet east and 1,100 feet south of the northwest corner of sec. 33, T. 140 N., R. 41 W.

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

Bt—8 to 22 inches; dark yellowish brown (10YR 3/4) clay; strong medium angular blocky structure; friable; many thick very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 2 percent gravel; neutral; clear smooth boundary.

Btk—22 to 27 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate medium subangular blocky structure; friable; common fine distinct yellowish brown (10YR 5/6) iron concentrations; few thin dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; strongly effervescent with lime disseminated in ped interiors; slightly alkaline; clear wavy boundary.

Bk—27 to 40 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate fine subangular blocky structure; friable; common fine distinct light brownish gray (2.5Y 6/2) iron depletions and common fine faint light olive brown (2.5Y 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—40 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate fine subangular blocky soil aggregates; friable; common medium distinct light gray (2.5Y 6/2) iron depletions and common fine faint light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 30 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 4 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1
Texture—silty clay loam

Bt horizon:

Hue—10YR or 2.5Y
Value—3 to 5
Chroma—1 to 4
Texture—clay, silty clay, or silty clay loam

Bk and C horizons:

Hue—2.5Y or 10YR
Value—5 or 6
Chroma—2 to 4
Texture—silty clay loam or clay loam

1137B—Birchlake silty clay loam, 1 to 6 percent slopes**Composition**

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

Setting

Landform: Rises on moraines
Slope range: 1 to 6 percent

Component Description

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 13.6 inches
Organic matter content: 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

- Boyerlake and similar soils
- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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

1137C—Birchlake silty clay loam, 6 to 12 percent slopes, eroded**Composition**

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 13.9 inches
Organic matter content: 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

- Boyerlake and similar soils
- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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

1137D—Birchlake silty clay loam, 12 to 20 percent slopes, eroded**Composition**

Birchlake and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 12 to 20 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting

layer: About 13.9 inches

Organic matter content: 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

- Boyerlake and similar soils
- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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

1137E—Birchlake silty clay loam, 20 to 30 percent slopes

Composition

Birchlake and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 20 to 30 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting

layer: About 13.9 inches

Organic matter content: 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

- Boyerlake and similar soils
- Foxlake and similar soils
- Lakepark and similar soils
- Dovray and similar soils
- Cathro 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

Blowers Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; next part—moderately slow; lower part—very slow

Landform: Drumlins

Parent material: Till

Slope range: 1 to 5 percent

Taxonomic class: Coarse-loamy, mixed Glossaquic Eutroboralfs

Typical Pedon

Blowers sandy loam, 1 to 5 percent slopes, stony, 1,500 feet south and 200 feet west of the northeast corner of sec. 27, T. 138 N., R. 36 W.

A—0 to 3 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; about 8 percent gravel; neutral; abrupt smooth boundary.

E—3 to 14 inches; brown (10YR 5/3) sandy loam, light gray (10YR 7/2) dry; weak thin platy structure;

friable; about 8 percent gravel; neutral; clear smooth boundary.

B/E—14 to 22 inches; about 80 percent dark yellowish brown (10YR 4/4) sandy loam (Bt) and 20 percent brown (10YR 5/3) sandy loam (E); weak medium subangular blocky structure; friable; common medium prominent light brownish gray (2.5Y 6/2) iron depletions and yellowish brown (10YR 5/6) iron concentrations; about 8 percent gravel; slightly acid; clear smooth boundary.

Bt—22 to 32 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common medium distinct strong brown (7.5YR 4/6) iron concentrations and few fine prominent light brownish gray (2.5Y 6/2) iron depletions; many thin dark brown (10YR 3/3) clay films on faces of peds and in pores; about 6 percent gravel; slightly acid; clear smooth boundary.

BC—32 to 47 inches; light yellowish brown (10YR 6/4) sandy loam; weak medium platy soil aggregates; friable; few light gray (10YR 7/2) filaments and threads of segregated lime; about 6 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cd—47 to 60 inches; light yellowish brown (10YR 6/4) sandy loam; weak medium platy soil aggregates; firm; few light gray (10YR 7/2) filaments and threads of segregated lime; about 6 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 32 to 60 inches

Depth to dense till: 40 to 60 inches

Content of rock fragments: 2 to 15 percent

Ap or A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 or 3

Texture—sandy loam or loamy sand

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—3 to 6

Texture—sandy loam or sandy clay loam

Cd horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 to 5

Texture—sandy loam

1320B—Blowers sandy loam, 1 to 5 percent slopes, stony

Composition

Blowers and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drumlins

Position on the landform: Back slopes and shoulders

Slope range: 1 to 5 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.0 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 4.9 inches

Organic matter content: 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

- Rockwood and similar soils
- Rosy and similar soils
- Paddock and similar soils
- Runeberg and similar soils
- Cathro 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

Bootlake Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid or rapid;

next part—moderately rapid; lower part—rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 0 to 15 percent

Taxonomic class: Coarse-loamy, mixed Typic
Eutroboralfs

Typical Pedon

Bootlake sandy loam (fig. 1-8), in an area of Bootlake-Graycalm complex, 0 to 2 percent slopes, 1,200 feet west and 1,700 feet south of the northeast corner of sec. 9, T. 139 N., R. 36 W.

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

E—3 to 7 inches; dark brown (10YR 4/3) loamy sand, pale brown (10YR 6/3) dry; weak thin platy structure; very friable; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt—7 to 13 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; many thin dark brown (10YR 4/3) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

Bw—13 to 47 inches; dark yellowish brown (10YR 4/6) coarse sand; single grain; loose; about 8 percent gravel; slightly acid; clear smooth boundary.

C—47 to 60 inches; pale brown (10YR 6/3) coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 8 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 60 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 7 percent gravel

E horizon:

Hue—10YR

Value—3 to 5

Chroma—3 or 4

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

Content of rock fragments—0 to 7 percent gravel

Bt horizon:

Hue—7.5YR or 10YR

Value—3 or 4

Chroma—3 or 4

Texture—sandy loam, coarse sandy loam, or sandy

clay loam in the upper part; loamy sand or

loamy coarse sand in the lower part

Content of rock fragments—0 to 7 percent gravel

Bw horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—4 to 6

Texture—sand or coarse sand

Content of rock fragments—0 to 15 percent gravel

C horizon:

Hue—10YR

Value—5 or 6

Chroma—3 or 4

Texture—sand or coarse sand

Content of rock fragments—0 to 15 percent gravel

315A—Bootlake sandy loam, 0 to 2 percent slopes

Composition

Bootlake and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats on outwash plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.0 inches

Organic matter content: 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

- Eagleview and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

315B—Bootlake sandy loam, 2 to 5 percent slopes

Composition

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Eagleview and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1127A—Bootlake-Graycalm complex, 0 to 2 percent slopes

Composition

Bootlake and similar soils: About 50 percent
Graycalm and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Flats on outwash plains
Slope range: 0 to 2 percent

Component Description

Bootlake

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: Moderately low

Graycalm

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.2 inches
Organic matter content: 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

- Friendship and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1127B—Bootlake-Graycalm complex, 2 to 8 percent slopes

Composition

Bootlake and similar soils: About 50 percent
 Graycalm and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 2 to 8 percent

Component Description

Bootlake

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: Moderately low

Graycalm

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Friendship and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1252B—Bootlake-Eagleview complex, 1 to 8 percent slopes

Composition

Bootlake and similar soils: About 50 percent
 Eagleview and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 1 to 8 percent

Component Description

Bootlake

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.0 inches
Organic matter content: Moderately low

Eagleview

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Friendship and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- Meehan and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Boyerlake Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Slow

Landform: Moraines

Parent material: Till

Slope range: 3 to 30 percent

Taxonomic class: Fine, montmorillonitic, frigid Vertic Eutrochrepts

Typical Pedon

Boyerlake silty clay loam, in an area of Audubon-Boyerlake complex, 12 to 20 percent slopes, eroded, 800 feet east and 2,600 feet north of the southwest corner of sec. 3, T. 139 N., R. 43 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—7 to 17 inches; light olive brown (2.5Y 5/3) silty clay loam; moderate medium angular blocky structure; friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

Bk2—17 to 37 inches; light olive brown (2.5Y 5/3) silty clay loam; moderate medium angular blocky structure; friable; common medium distinct grayish brown (2.5Y 5/2) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—37 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; moderate medium angular blocky soil aggregates; friable; many coarse distinct yellowish brown (10YR 5/4) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated

lime; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: Occurring throughout the profile

Content of rock fragments: 1 to 4 percent

Ap horizon:

Hue—10YR

Value—3 to 5 moist; 6 or 7 dry

Chroma—2 or 3

Texture—silty clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

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

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

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

Buse Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Till

Slope range: 3 to 6 percent

Taxonomic class: Fine-loamy, mixed Typic Calciborolls

Typical Pedon

Buse clay loam, in an area of Formdale-Buse complex, 2 to 6 percent slopes, 600 feet west and 100 feet north of the southeast corner of sec. 8, T. 141 N., R. 41 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 3 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—7 to 15 inches; light yellowish brown (10YR 6/4) clay loam; weak fine subangular blocky structure; friable; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—15 to 35 inches; yellowish brown (10YR 5/4) clay loam; weak fine subangular blocky structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly

effervescent; moderately alkaline; gradual smooth boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) loam; few medium distinct grayish brown (2.5Y 5/2) iron depletions (relict); massive; friable; few medium distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: Typically occurring throughout the profile

Thickness of the mollic epipedon: 7 to 10 inches

Content of rock fragments: 2 to 12 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—loam or clay loam

Bygland Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately slow; next part—slow or moderately slow; lower part—moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 1 to 15 percent

Taxonomic class: Fine, montmorillonitic Aquertic Argiborolls

Typical Pedon

Bygland silty clay loam, 1 to 6 percent slopes, 500 feet east and 2,000 feet south of the northwest corner of sec. 6, T. 138 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

Bt1—8 to 11 inches; very dark grayish brown (10YR 3/2) silty clay; moderate medium subangular blocky

structure; friable; many thin black (N 2/0) clay films on faces of peds and in pores; neutral; gradual wavy boundary.

Bt2—11 to 22 inches; olive brown (2.5Y 4/3) silty clay; moderate medium subangular blocky structure; friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations; many thick very dark gray (10YR 3/1) clay films on faces of peds and in pores; neutral; clear wavy boundary.

Bk—22 to 38 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; many white (10YR 8/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—38 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium platy soil aggregates; friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 30 inches

Thickness of the mollic epipedon: 7 to 16 inches

Ap or A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—silty clay loam

Bt horizon:

Hue—10YR or 2.5Y

Value—2 to 4

Chroma—2 to 4

Texture—silty clay, clay, or silty clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 5

Texture—silty clay loam or silt loam

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—silty clay loam or silt loam

422B—Bygland silty clay loam, 1 to 6 percent slopes

Composition

Bygland and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Rises on moraines

Slope range: 1 to 6 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.9 inches

Organic matter content: 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
- Dovray and similar soils
- Cathro 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

422C—Bygland silty clay loam, 6 to 15 percent slopes**Composition**

Bygland and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 6 to 15 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

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

Organic matter content: 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
- Dovray and similar soils
- Cathro 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 slow to moderately rapid; lower part—moderately slow or moderate

Landform: Moraines, drumlins, and flood plains

Parent material: Organic materials and glaciolacustrine deposits or till

Slope range: 0 to 1 percent

Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 1,700 feet west and 300 feet south of the northeast corner of sec. 24, T. 142 N., R. 43 W.

Oap—0 to 8 inches; black (10YR 2/1) muck; about 40 percent fiber, 1 percent rubbed; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

Oa—8 to 22 inches; black (10YR 2/1) muck; about 40 percent fiber, 2 percent rubbed; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

A—22 to 33 inches; black (5Y 2.5/1) silty clay loam, very dark gray (5Y 3/1) dry; weak medium

subangular blocky structure; friable; neutral; clear smooth boundary.

Cg1—33 to 49 inches; grayish brown (5Y 5/2) clay loam; weak medium subangular blocky soil aggregates; common medium prominent yellowish brown (10YR 4/6) iron concentrations; friable; about 4 percent gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—49 to 60 inches; gray (5Y 5/1) clay loam; massive; friable; many coarse prominent dark yellowish brown (10YR 5/6) iron concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches

Fiber content: 10 to 50 percent unrubbed; less than 16 percent rubbed

Content of wood fragments: Less than 15 percent

Oa or Oap horizon:

Hue—5YR, 7.5YR, 10YR, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

A horizon:

Hue—2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

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

Content of rock fragments—0 to 10 percent

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

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

Content of rock fragments—0 to 10 percent

544—Cathro muck

Composition

Cathro and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and

glaciolacustrine deposits or till

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 15.9 inches

Organic matter content: 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
- Winger and similar soils
- Smiley and similar soils
- Egglake and similar soils
- Paddock 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

1128—Cathro muck, frequently flooded

Composition

Cathro and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats on flood plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and glaciolacustrine deposits or till

Flooding: Frequent

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

Available water capacity to 60 inches or root-limiting layer: About 15.3 inches

Organic matter content: 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

- Lamoure and similar soils
- Vallery 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

Chapett Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic class: Fine-loamy, mixed Boralfic Udic Argiborolls

Typical Pedon

Chapett fine sandy loam, 2 to 8 percent slopes, 1,500 feet west and 900 feet south of the northeast corner of sec. 4, T. 138 N., R. 42 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.

E—8 to 9 inches; dark brown (10YR 4/3) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium platy structure; very friable; about 5 percent gravel; neutral; clear smooth boundary.

Bt1—9 to 15 inches; dark brown (10YR 4/3) sandy clay loam; moderate medium subangular blocky structure; friable; many thin brown (10YR 5/3) sand and silt coatings on faces of peds and in pores; about 5 percent gravel; neutral; gradual smooth boundary.

Bt2—15 to 23 inches; dark brown (10YR 4/3) sandy clay loam; moderate medium subangular blocky structure; friable; many thin dark brown (10YR 3/3) clay films on faces of peds; about 5 percent gravel; neutral; clear smooth boundary.

Bk—23 to 33 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium platy structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—33 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; weak medium platy soil aggregates; very friable; few light gray (10YR 7/2) filaments and

threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches

Depth to the base of the argillic horizon: 14 to 28 inches

Content of rock fragments: 2 to 10 percent

Depth to carbonates: 14 to 28 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

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

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

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

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or loam

20B—Chapett fine sandy loam, 2 to 8 percent slopes

Composition

Chapett and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.8 inches

Organic matter content: 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

- Wykeham and similar soils
- Smiley and similar soils
- Quam and similar soils
- Cathro 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, 8 to 15 percent slopes, eroded

Composition

Chapett and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches

Organic matter content: 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

- Wykeham and similar soils
- Smiley and similar soils
- Quam and similar soils
- Cathro 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, 15 to 30 percent slopes

Composition

Chapett and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.8 inches

Organic matter content: 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

- Wykeham and similar soils
- Lakepark and similar soils
- Smiley and similar soils
- Quam and similar soils
- Cathro 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

Colvin Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Fine-silty, frigid Typic Calciaquolls

Typical Pedon

Colvin silty clay loam, 1,700 feet west and 2,600 feet south of the northeast corner of sec. 2, T. 141 N., R. 42 W.

A—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; strongly effervescent; moderately alkaline; clear smooth boundary.

Bkg1—10 to 14 inches; dark gray (5Y 4/1) silt loam, gray (5Y 6/1) dry; weak fine subangular blocky structure; friable; violently effervescent with lime disseminated throughout; moderately alkaline; clear smooth boundary.

Bkg2—14 to 26 inches; light olive gray (5Y 6/2) silt loam; weak fine subangular blocky structure; friable; few fine distinct olive yellow (2.5Y 6/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; violently effervescent; moderately alkaline; gradual smooth boundary.

Cg1—26 to 43 inches; light olive gray (5Y 6/2) silt loam; massive; friable; common medium distinct light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg2—43 to 60 inches; light olive gray (5Y 6/2) silt loam; massive; friable; few medium distinct light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches

Carbonates: Occurring throughout the profile

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 to 7

Chroma—0 to 2

Texture—silt loam or silty clay loam

Cg horizon:

Hue—2.5Y or 5Y

Value—3 to 6

Chroma—1 to 4

Texture—silt loam or silty clay loam

47—Colvin silty clay loam

Composition

Colvin and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.9 inches

Organic matter content: 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

- McIntosh and similar soils
- The depressional Colvin soils and similar soils
- Hamre and similar soils
- Quam 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

351—Colvin silty clay loam, depressional

Composition

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

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches
Organic matter content: 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

- McIntosh and similar soils
- Winger and similar soils
- Rockwell and similar soils
- Hamre and similar soils
- Cathro 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

Corliss Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Moraines, outwash plains, and valley trains

Parent material: Glacial outwash

Slope range: 1 to 35 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Corliss loamy sand, 20 to 35 percent slopes, 600 feet south and 50 feet east of the northwest corner of sec. 32, T. 138 N., T. 42 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loamy sand, very dark gray (10YR 4/1) dry; weak fine granular structure; very friable; about 5 percent gravel; neutral; abrupt smooth boundary.
Bw—7 to 9 inches; dark brown (10YR 4/3) gravelly loamy coarse sand; single grain; loose; about 20 percent gravel; neutral; clear smooth boundary.
C—9 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches

A or Ap horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand

Content of rock fragments—3 to 25 percent gravel

Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 or 4

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

Content of rock fragments—10 to 35 percent gravel

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

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

Content of rock fragments—10 to 35 percent gravel

721E—Corliss loamy sand, 20 to 35 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 20 to 35 percent

Component Description

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 2.9 inches

Organic matter content: 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
- Arvilla and similar soils
- Fordville 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

1247D—Corliss-Dorset complex, 12 to 20 percent slopes

Composition

Corliss and similar soils: About 65 percent

Dorset and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 12 to 20 percent

Component Description

Corliss

Surface layer texture: Loamy coarse sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches

Organic matter content: Moderate

Dorset

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.2 inches

Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Dalbo Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; next part—slow or moderately slow; lower part—moderately slow or moderate

Landform: Moraines and outwash plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 30 percent

Taxonomic class: Fine, montmorillonitic Vertic Eutroboralfs

Typical Pedon

Dalbo silt loam, 0 to 2 percent slopes, 1,800 feet south and 200 feet east of the northwest corner of sec. 4, T. 142 N., R. 38 W.

- A—0 to 2 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; neutral; abrupt smooth boundary.
- E—2 to 6 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; moderate thin platy structure; friable; neutral; clear wavy boundary.
- Bt1—6 to 15 inches; dark brown (10YR 4/3) silty clay; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; many thin dark brown (10YR 3/3) clay films on faces of peds and in pores; neutral; clear wavy boundary.
- Bt2—15 to 22 inches; dark brown (10YR 4/3) silty clay; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; few fine faint dark grayish brown (2.5Y 4/2) iron depletions; many thin dark brown (10YR 3/3) clay films on faces of peds and in pores; neutral; gradual wavy boundary.
- BC—22 to 41 inches; olive brown (2.5Y 4/4) silty clay loam; moderate thin platy structure; friable; few medium distinct grayish brown (2.5Y 5/2) iron depletions and common medium distinct dark yellowish brown (10YR 4/6) iron concentrations; slightly acid; clear wavy boundary.
- C—41 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam; moderate medium platy soil aggregates; friable; common medium faint light brownish gray (2.5Y 6/2) iron depletions and common medium distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 42 inches

Ap or A horizon:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam

E horizon:

Hue—10YR
Value—4 to 6
Chroma—1 or 2
Texture—silt loam, loam, silty clay loam, very fine sandy loam, or fine sandy loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—silty clay loam, silty clay, or clay

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

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

133A—Dalbo silt loam, 0 to 2 percent slopes**Composition**

Dalbo and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats on moraines and outwash plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.3 inches

Organic matter content: 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

- Wykeham and similar soils
- Friendship and similar soils
- Rosy and similar soils
- Lindaas and similar soils
- Cathro 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

133B—Dalbo silt loam, 2 to 8 percent slopes**Composition**

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 2 to 8 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.8 inches
Organic matter content: 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

- Snellman and similar soils
- Graycalm and similar soils
- Balmlake and similar soils
- Lindaas and similar soils
- Cathro 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

133C—Dalbo silt loam, 8 to 15 percent slopes**Composition**

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches
Organic matter content: 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

- Snellman and similar soils
- Graycalm and similar soils
- Balmlake and similar soils
- Lindaas and similar soils
- Cathro 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

133E—Dalbo silt loam, 15 to 30 percent slopes**Composition**

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 15 to 30 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits

Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches
Organic matter content: 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

- Snellman and similar soils
- Graycalm and similar soils
- Balmlake and similar soils
- Lindaas 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

Darnen Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Outwash plains and valley trains
Parent material: Colluvium
Slope range: 0 to 3 percent
Taxonomic class: Fine-loamy, mixed Pachic Udic Haploborolls

Typical Pedon

Darnen loam, 400 feet east and 350 feet south of the northwest corner of sec. 19, T. 138 N., R. 41 W.

- Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.
- A1—10 to 38 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; about 2 percent gravel; neutral; clear smooth boundary.
- A2—38 to 56 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; neutral; gradual smooth boundary.
- Bw—56 to 60 inches; dark grayish brown (10YR 4/2)

loam; weak medium subangular blocky structure; friable; about 1 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 20 to 60 inches
Thickness of the mollic epipedon: 24 to 48 inches
Content of rock fragments: 0 to 5 percent gravel

Ap or A horizon:

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

B horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—2 to 4
 Texture—loam or clay loam

1318—Darnen loam

Composition

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

Setting

Landform: Swales on outwash plains and valley trains
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Colluvium
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches
Organic matter content: 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

- Fordville and similar soils
- Arvilla 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

Dorset Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Moraines, outwash plains, and valley trains

Parent material: Glacial outwash

Slope range: 0 to 20 percent

Taxonomic class: Coarse-loamy, mixed Udic Argiborolls

Typical Pedon

Dorset sandy loam, 2 to 6 percent slopes (fig. I-9), 2,200 feet east and 500 feet north of the southwest corner of sec. 26, T. 141 N., R. 38 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; about 5 percent gravel; moderately acid; abrupt smooth boundary.

Bt—10 to 17 inches; dark brown (10YR 4/3) sandy loam; moderate medium subangular blocky structure; friable; many thin very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 5 percent gravel; neutral; clear smooth boundary.

2BC—17 to 29 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grain; loose; about 30 percent gravel; neutral; clear smooth boundary.

2C—29 to 60 inches; light yellowish brown (10YR 6/4) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 25 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches

Thickness of the mollic epipedon: 7 to 11 inches

Thickness of the loamy mantle: 12 to 24 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 10 percent gravel

Bt horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 or 4

Texture—loam or sandy loam

Content of rock fragments—0 to 10 percent gravel

2C horizon:

Hue—7.5YR or 10YR

Value—3 to 6

Chroma—3 to 6

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

Content of rock fragments—10 to 35 percent gravel

406A—Dorset sandy loam, 0 to 2 percent slopes

Composition

Dorset and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats on outwash plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.3 inches

Organic matter content: 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

- Corliss and similar soils
- Two Inlets and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

406B—Dorset sandy loam, 2 to 6 percent slopes**Composition**

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Corliss and similar soils
- Two Inlets and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

778B—Dorset-Corliss complex, 1 to 6 percent slopes**Composition**

Dorset and similar soils: About 70 percent

Corliss and similar soils: About 25 percent
Inclusions: About 5 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 1 to 6 percent

Component Description**Dorset**

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: High

Corliss

Surface layer texture: Loamy coarse sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches
Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- Nidaros 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

778C—Dorset-Corliss complex, 6 to 12 percent slopes

Composition

Dorset and similar soils: About 50 percent
 Corliss and similar soils: About 35 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Dorset

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches
Organic matter content: High

Corliss

Surface layer texture: Loamy coarse sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 2.8 inches
Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Dovray Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—slow or moderately slow;
 lower part—slow
Landform: Moraines
Parent material: Colluvium and till
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, frigid Cumulic
 Vertic Epiaquolls

Typical Pedon

Dovray silty clay, 2,200 feet west and 1,800 feet south of the northeast corner of sec. 14, T. 139 N., R. 42 W.
 Ap—0 to 10 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; neutral; abrupt smooth boundary.
 A1—10 to 29 inches; black (N 2/0) silty clay, dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.
 A2—29 to 43 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.
 Bkg—43 to 54 inches; olive gray (5Y 5/2) silty clay; weak fine subangular blocky structure; friable; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline; gradual smooth boundary.
 Cg—54 to 60 inches; gray (5Y 5/1) silty clay; massive; friable; common medium distinct light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 1 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 60 inches
Thickness of the mollic epipedon: 24 to 54 inches
Ap or A horizon:
 Hue—10YR, 2.5Y, 5Y, or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—silty clay
Bg horizon:
 Hue—2.5Y or 5Y
 Value—3 to 6

Chroma—1 or 2
 Texture—silty clay or silty clay loam
 Content of rock fragments—0 to 5 percent

Cg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—silty clay, silty clay loam, or clay loam
 Content of rock fragments—0 to 5 percent

137—Dovray silty clay**Composition**

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

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Colluvium and till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches
Organic matter content: 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

- Audubon and similar soils
- Foxlake and similar soils
- Hamre and similar soils
- Cathro 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

Eagleview Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains, valley trains, and moraines
Parent material: Glacial outwash
Slope range: 1 to 30 percent
Taxonomic class: Mixed, frigid Argic Udipsamments

Typical Pedon

Eagleview loamy sand (fig. I-10), in an area of Eagleview-Balmlake complex, 8 to 15 percent slopes, 400 feet south and 1,000 feet west of the northeast corner of sec. 16, T. 140 N., R. 40 W.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; about 1 percent gravel; neutral; abrupt smooth boundary.
- E—7 to 16 inches; brown (10YR 5/3) sand, light brownish gray (10YR 6/2) dry; single grain; loose; about 1 percent gravel; neutral; clear wavy boundary.
- Bw—16 to 23 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 1 percent gravel; neutral; abrupt smooth boundary.
- E and Bt1—23 to 33 inches; dark yellowish brown (10YR 4/6) sand (E); single grain; loose; lamellae of dark brown (7.5YR 4/4) sandy loam (Bt) ½ inch thick at depths of 23 inches and 32 inches; weak medium subangular blocky structure; friable; common thin clay coatings on sand grains and clay bridging between sand grains; about 1 percent gravel; neutral; abrupt smooth boundary.
- E and Bt2—33 to 37 inches; yellowish brown (10YR 5/4) sand (E); single grain; loose; lamellae of dark yellowish brown (10YR 4/4) loamy sand (Bt) 1 inch thick at a depth of 36 inches; weak fine subangular blocky structure; common thin clay coatings on sand grains and clay bridging between sand grains; about 1 percent gravel; neutral; clear smooth boundary.
- C2—37 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; few carbonate coatings on the underside of pebbles; about 1 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Content of rock fragments: 0 to 10 percent gravel
Depth to carbonates: 25 to 50 inches

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 to 3
 Texture—loamy sand

E horizon:

Hue—10YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—sand, coarse sand, loamy sand, or loamy coarse sand

Bw horizon:

Hue—10YR
 Value—4 to 6
 Chroma—3 or 4
 Texture—sand or coarse sand

E part of the E and Bt horizon:

Hue—10YR
 Value—5 or 6
 Chroma—3 or 4
 Texture—sand or coarse sand

Bt part of the E and Bt horizon:

Hue—7.5YR or 10YR
 Value—3 or 4
 Chroma—3 or 4
 Texture—loamy sand, loamy coarse sand, sandy loam, or coarse sandy loam

C horizon:

Hue—10YR
 Value—5 or 6
 Chroma—3 or 4
 Texture—sand or coarse sand

1132B—Eagleview-Balmlake complex, 1 to 8 percent slopes

Composition

Eagleview and similar soils: About 50 percent
 Balmlake and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 1 to 8 percent

Component Description

Eagleview

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.0 inches
Organic matter content: Moderately low

Balmlake

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches
Organic matter content: 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

- Bootlake and similar soils
- Snellman and similar soils
- Rosy and similar soils
- Friendship and similar soils
- Hillview and similar soils
- Epoufette 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

1132C—Eagleview-Balmlake complex, 8 to 15 percent slopes

Composition

Eagleview and similar soils: About 50 percent
 Balmlake and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Eagleview

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.7 inches

Organic matter content: Moderately low

Balmlake

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches

Organic matter content: 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

- Bootlake and similar soils
- Snellman and similar soils
- Rosy and similar soils
- Friendship and similar soils
- Hillview and similar soils
- Epoufette 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

1132E—Eagleview-Balmlake complex, 15 to 30 percent slopes

Composition

Eagleview and similar soils: About 50 percent

Balmlake and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Eagleview

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.5 inches

Organic matter content: Moderately low

Balmlake

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.3 inches

Organic matter content: 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

- Bootlake and similar soils
- Snellman and similar soils
- Rosy and similar soils
- Friendship and similar soils
- Hillview and similar soils
- Epoufette 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

1140B—Eagleview-Snellman complex, 1 to 8 percent slopes

Composition

Eagleview and similar soils: About 50 percent

Snellman and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: Eagleview—1 to 8 percent; Snellman—2 to 8 percent

Component Description**Eagleview**

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.8 inches

Organic matter content: Moderately low

Snellman

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Bootlake and similar soils
- Wykeham and similar soils
- Friendship and similar soils
- Egglake and similar soils
- Meehan and similar soils
- Nidaros 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

1140C—Eagleview-Snellman complex, 8 to 15 percent slopes**Composition**

Eagleview and similar soils: About 50 percent

Snellman and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description**Eagleview**

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.1 inches

Organic matter content: Moderately low

Snellman

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: 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

- Bootlake and similar soils
- Wykeham and similar soils
- Friendship and similar soils
- Egglake and similar soils
- Meehan and similar soils
- Nidaros 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

1236B—Eagleview loamy sand, 1 to 8 percent slopes

Composition

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 1 to 8 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Bootlake and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1236C—Eagleview loamy sand, 8 to 15 percent slopes

Composition

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches
Organic matter content: 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

- Bootlake and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1236E—Eagleview loamy sand, 15 to 30 percent slopes

Composition

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 15 to 30 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches
Organic matter content: 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

- Bootlake and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1263C—Eagleview-Bootlake complex, 8 to 15 percent slopes**Composition**

Eagleview and similar soils: About 50 percent
 Bootlake and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description**Eagleview**

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches
Organic matter content: Moderately low

Bootlake

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches
Organic matter content: 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

- Friendship and similar soils
- Karlstad and similar soils
- Epoufette and similar soils
- Meehan and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Egeland Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderately rapid; lower part—moderate
Landform: Moraines

Parent material: Glaciolacustrine deposits
Slope range: 1 to 12 percent
Taxonomic class: Coarse-loamy, mixed Udic
 Haploborolls

Typical Pedon

Egeland fine sandy loam, 6 to 12 percent slopes, 1,600 feet west and 100 feet north of the southeast corner of sec. 31, T. 142 N., R. 41 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

Bw1—8 to 13 inches; very dark grayish brown (10YR 3/2) fine sandy loam; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

Bw2—13 to 22 inches; dark brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

Bk—22 to 35 inches; yellowish brown (10YR 5/4) loamy fine sand; weak very fine subangular blocky structure; very friable; many light gray (10YR 7/2) filaments and threads of segregated lime; violently effervescent; moderately alkaline; gradual smooth boundary.

C—35 to 60 inches; stratified yellowish brown (10YR 5/4) fine sandy loam, light yellowish brown (10YR 6/4) fine sand, and light yellowish brown (2.5Y 6/4) silt loam; massive; very friable and loose; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 45 inches
Thickness of the mollic epipedon: 8 to 16 inches
Content of rock fragments: 0 to 10 percent gravel

Ap or A horizon:
 Hue—10YR
 Value—2 or 3
 Chroma—1
 Texture—fine sandy loam

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

Bk horizon:
 Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—2 to 4

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

C horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

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

141B—Egeland fine sandy loam, 1 to 6 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 1 to 6 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches

Organic matter content: 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

- Sverdrup and similar soils
- Barnes and similar soils
- Wyndmere and similar soils
- Rockwell 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

141C—Egeland fine sandy loam, 6 to 12 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches
Organic matter content: 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

- Sverdrup and similar soils
- Barnes and similar soils
- Wyndmere and similar soils
- Rockwell 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

Egglake Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderate or moderately rapid; lower part—moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Egglake loam, in an area of Egglake-Cathro complex, 2,600 feet south and 1,600 feet west of the northeast corner of sec. 2, T. 139 N., R. 38 W.

A—0 to 4 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; about 5 percent gravel and 1 percent cobbles and stones; neutral; clear smooth boundary.

E—4 to 9 inches; grayish brown (2.5Y 5/2) fine sandy loam, gray (10YR 6/1) dry; weak medium platy structure parting to weak fine subangular blocky; very friable; about 7 percent gravel and 1 percent cobbles and stones; neutral; clear smooth boundary.

Btg—9 to 25 inches; grayish brown (2.5Y 5/2) sandy clay loam; weak fine subangular blocky structure; friable; common fine prominent dark reddish brown (5YR 3/4) iron concentrations; few thin very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 7 percent gravel and 1 percent cobbles and stones; neutral; gradual smooth boundary.

Bg—25 to 34 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium subangular blocky structure; very friable; common fine distinct yellowish brown (10YR 5/6) iron concentrations; about 8 percent gravel and 2 percent cobbles and stones; neutral; clear smooth boundary.

Bkg—34 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium platy soil aggregates; very friable; common medium distinct light olive gray (5Y 6/2) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; common light gray (10YR 7/2) filaments and threads of segregated lime; about 8 percent gravel and 2 percent cobbles and stones; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Content of rock fragments: 2 to 10 percent

Ap or A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam or sandy loam

Bt horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—sandy clay loam, sandy loam, or loam

Bg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—2 to 4
 Texture—sandy loam or coarse sandy loam

Bkg or Cg horizon:

Hue—2.5Y or 5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—sandy loam or coarse sandy loam

1200—Egglake loam***Composition***

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

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 7.9 inches
Organic matter content: 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

- Snellman and similar soils
- Wykeham and similar soils
- Cathro 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

1211—Egglake-Cathro complex***Composition***

Egglake and similar soils: About 65 percent
 Cathro and similar soils: About 25 percent
 Inclusions: About 10 percent

Setting

Landform: Egglake—drainageways and flats on moraines; Cathro—depressions on moraines
Slope range: Egglake—0 to 2 percent; Cathro—0 to 1 percent

Component Description***Egglake***

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

Cathro

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic materials and glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 15.6 inches
Organic matter content: 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

- Snellman and similar soils
- Wykeham and similar soils
- Hillview 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

Epoufette Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderately rapid or rapid;
lower part—very rapid

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, frigid Mollic
Endoaqualfs

Typical Pedon

Epoufette sandy loam, 1,900 feet south and 400 feet west of the northeast corner of sec. 26, T. 139 N., R. 38 W.

Ap—0 to 6 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 3 percent gravel; neutral; abrupt smooth boundary.

Eg—6 to 12 inches; grayish brown (2.5Y 5/2) loamy sand, light gray (2.5Y 7/2) dry; weak thin platy structure; very friable; common medium distinct light olive brown (2.5Y 5/6) iron concentrations; about 5 percent gravel; neutral; clear smooth boundary.

Btg—12 to 20 inches; dark grayish brown (2.5Y 4/2) sandy loam; moderate medium subangular blocky structure; friable; common medium distinct dark yellowish brown (10YR 4/6) iron concentrations; few thin very dark grayish brown (2.5Y 3/2) clay films on faces of peds; about 5 percent gravel; neutral; gradual smooth boundary.

Bg—20 to 29 inches; grayish brown (2.5Y 5/2) loamy coarse sand; weak fine subangular blocky structure; very friable; common medium distinct yellowish brown (10YR 5/6) iron concentrations; about 10 percent gravel; neutral; clear smooth boundary.

2Cg—29 to 60 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; single grain; few medium distinct yellowish brown (10YR 5/6) iron concentrations; loose; few carbonate coatings on the underside of pebbles; about 20 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—sandy loam

Content of rock fragments—0 to 15 percent gravel

Eg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 or 2

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

Content of rock fragments—5 to 25 percent gravel

Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 or 2

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

Content of rock fragments—5 to 25 percent gravel

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—5 or 6

Chroma—1 or 2

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

Content of rock fragments—5 to 35 percent gravel

191—Epoufette sandy loam

Composition

Epoufette and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on outwash plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 2.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 2.7 inches

Organic matter content: 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

- Sugarbush and similar soils
- Karlstad and similar soils
- Friendship and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Flom Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, frigid Typic Endoaquolls

Typical Pedon

Flom silty clay loam, 2,300 feet west and 2,100 feet north of the southeast corner of sec. 8, T. 139 N., R. 43 W.

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

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

Bg—16 to 24 inches; olive gray (5Y 5/2) silty clay loam; weak medium subangular blocky structure; friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; about 2 percent gravel; slightly alkaline; clear smooth boundary.

Bkg—24 to 36 inches; light olive gray (5Y 6/2) clay loam; weak fine subangular blocky structure; friable; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

Cg—36 to 60 inches; light olive gray (5Y 6/2) clay loam; massive; friable; common medium distinct light olive

brown (2.5Y 5/6) iron concentrations; few white (10YR 8/2) filaments and threads of segregated lime; about 3 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 48 inches

Thickness of the mollic epipedon: 10 to 24 inches

Content of rock fragments: 2 to 10 percent

Ap or A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam, silty clay loam, or loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 or 3

Texture—clay loam or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—clay loam or loam

36—Flom silty clay loam

Composition

Flom and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.5 inches

Organic matter content: 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

- Formdale and similar soils
- Aazdahl and similar soils
- Quam and similar soils
- Hamre and similar soils
- Cathro 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

Forada Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—rapid

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

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

Typical Pedon

Forada loam, 1,300 feet east and 1,700 feet south of the northwest corner of sec. 23, T. 139 N., R. 41 W.

Ap—0 to 7 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to weak fine granular; friable; about 2 percent gravel; moderately acid; abrupt smooth boundary.

A—7 to 14 inches; very dark gray (N 3/0) sandy loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; friable; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bg—14 to 22 inches; dark grayish brown (2.5Y 4/2) sandy loam; weak fine subangular blocky structure; friable; common fine distinct light brownish gray (10YR 6/2) iron depletions and few fine prominent strong brown (7.5YR 5/6) iron concentrations; about 5 percent gravel; slightly acid; gradual smooth boundary.

2BCg—22 to 40 inches; light brownish gray (2.5Y 6/2) coarse sand; single grain; loose; about 10 percent gravel; neutral; clear smooth boundary.

2Cg—40 to 60 inches; light brownish gray (2.5Y 6/2)

gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 15 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the loamy mantle: 20 to 40 inches

Depth to carbonates: 20 to 50 inches

Thickness of the mollic epipedon: 10 to 24 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam or mucky loam

Content of rock fragments—0 to 10 percent gravel

Bg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or loam

Content of rock fragments—0 to 10 percent gravel

2Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 6

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

Content of rock fragments—0 to 35 percent gravel

375—Forada loam

Composition

Forada and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

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

Organic matter content: 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

- Arvilla and similar soils
- Verndale and similar soils
- Osakis and similar soils
- Oylen and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1942—Forada mucky loam, depressional

Composition

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

Setting

Landform: Depressions on outwash plains
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 5.0 inches
Organic matter content: 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

- Forada and similar soils
- Hangaard and similar soils
- Epoufette and similar soils
- Nidaros 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

Fordville Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderate or moderately rapid; lower part—rapid or very rapid
Landform: Outwash plains and valley trains
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls

Typical Pedon

Fordville loam, 1,900 feet east and 150 feet north of the southwest corner of sec. 30, T. 138 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; about 3 percent gravel; slightly acid; abrupt smooth boundary.
- A—10 to 17 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; about 3 percent gravel; slightly acid; clear smooth boundary.
- Bw—17 to 28 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; about 4 percent gravel; slightly acid; clear smooth boundary.
- 2BC—28 to 36 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; about 7 percent gravel; neutral; clear smooth boundary.
- 2C—36 to 60 inches; light yellowish brown (10YR 6/4) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 20 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 30 inches
Thickness of the loamy mantle: 20 to 40 inches
Depth to carbonates: 20 to 60 inches

Ap or A horizon:

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

Bw horizon:

Hue—10YR
Value—2 to 4
Chroma—2 to 4

Texture—loam, silt loam, or clay loam
Content of rock fragments—0 to 7 percent

BC horizon:

Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 or 3
Texture—sand or coarse sand
Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 4
Texture—gravelly sand or gravelly coarse sand
Content of rock fragments—15 to 35 percent gravel

339—Fordville loam**Composition**

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

Setting

Landform: Swales on outwash plains and valley trains
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.4 inches
Organic matter content: 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

- Arvilla and similar soils
- Darnen 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

Forman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderate; lower part—moderately slow
Landform: Moraines
Parent material: Till
Slope range: 2 to 30 percent
Taxonomic class: Fine-loamy, mixed Udic Argiborolls

Typical Pedon

Forman clay loam, 2 to 6 percent slopes, 300 feet west and 2,000 feet south of the northeast corner of sec. 2, T. 142 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt—8 to 15 inches; dark brown (10YR 4/3) clay loam; moderate medium angular blocky structure; friable; many thin dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 3 percent gravel; neutral; clear wavy boundary.

Bk—15 to 32 inches; brown (10YR 5/3) clay loam; weak medium subangular blocky structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; few medium distinct light brownish gray (2.5Y 6/2) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 4 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 2 to 10 percent
Depth to carbonates: 12 to 30 inches

Ap or A horizon:

Hue—10YR
Value—2
Chroma—1
Texture—clay loam

Bt horizon:

Hue—10YR or 2.5Y
Value—3 or 4
Chroma—1 to 3
Texture—clay loam or silty clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6
 Chroma—3 or 4
 Texture—clay loam or loam

C horizon:

Hue—10YR or 2.5Y
 Value—5 or 6
 Chroma—3 to 6
 Texture—clay loam or loam

168B—Forman clay loam, 2 to 6 percent slopes***Composition***

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: 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

- Langhei and similar soils
- Gonvick and similar soils
- Smiley and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

168C2—Forman clay loam, 6 to 12 percent slopes, eroded***Composition***

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: 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

- Langhei and similar soils
- Gonvick and similar soils
- Smiley and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

168D2—Forman clay loam, 12 to 20 percent slopes, eroded

Composition

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 12 to 20 percent

Component Description

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: 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

- Langhei and similar soils
- Gonvick and similar soils
- Smiley and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

168E—Forman clay loam, 20 to 30 percent slopes

Composition

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

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 20 to 30 percent

Component Description

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches
Organic matter content: 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

- Langhei and similar soils
- Gonvick and similar soils
- Smiley and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

Formdale Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderate; lower part—moderately slow
Landform: Moraines
Parent material: Till
Slope range: 2 to 30 percent
Taxonomic class: Fine-loamy, mixed Udic Haploborolls

Typical Pedon

Formdale clay loam, in an area of Formdale-Buse complex, 2 to 6 percent slopes, 1,350 feet south and

250 feet east of the northwest corner of sec. 23, T. 140 N., R. 43 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Bw—8 to 15 inches; dark brown (10YR 4/3) clay loam; weak fine subangular blocky structure; friable; about 4 percent gravel; neutral; clear smooth boundary.

Bk—15 to 26 inches; light yellowish brown (10YR 6/4) clay loam; weak medium subangular blocky structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

C—26 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 8 to 20 inches

Thickness of the mollic epipedon: 8 to 14 inches

Content of rock fragments: 2 to 8 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam

Bw horizon:

Hue—10YR; 2.5Y in the lower part

Value—3 to 5

Chroma—3 or 4

Texture—clay loam, silty clay loam, or loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 or 4

Texture—clay loam or silty clay loam

C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—3 to 6

Texture—clay loam or silty clay loam

171B—Formdale clay loam, 2 to 5 percent slopes

Composition

Formdale and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 5 percent

Component Description

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Langhei and similar soils
- Aazdahl and similar soils
- Flom and similar soils
- Quam and similar soils
- Hamre and similar soils
- Cathro 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

579C2—Formdale-Langhei-Sandberg complex, 6 to 12 percent slopes, eroded

Composition

Formdale and similar soils: About 35 percent

Langhei and similar soils: About 35 percent

Sandberg and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Formdale

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderate

Langhei

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderately low

Sandberg

Surface layer texture: Coarse sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.2 inches
Organic matter content: 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

- Arvilla and similar soils
- Aazdahl and similar soils
- Flom and similar soils
- Forada and similar soils
- Lakepark and similar soils
- Quam 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

931C2—Formdale-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Formdale and similar soils: About 55 percent
 Langhei and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Formdale

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderate

Langhei

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: 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

- Aazdahl and similar soils
- Flom and similar soils
- Lakepark and similar soils
- Quam 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

1234B—Formdale-Buse complex, 2 to 6 percent slopes

Composition

Formdale and similar soils: About 60 percent
Buse and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: Formdale—2 to 6 percent; Buse—3 to 6 percent

Component Description

Formdale

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderate

Buse

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Langhei and similar soils
- Aazdahl and similar soils
- Flom and similar soils
- Lakepark and similar soils
- Quam 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

1235B—Formdale-Buse-Sandberg complex, 2 to 6 percent slopes

Composition

Formdale and similar soils: About 40 percent
Buse and similar soils: About 25 percent
Sandberg and similar soils: About 20 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: Formdale—2 to 6 percent; Buse—3 to 6 percent; Sandberg—2 to 6 percent

Component Description

Formdale

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderate

Buse

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderate

Sandberg

Surface layer texture: Coarse sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches

Organic matter content: 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

- Langhei and similar soils
- Aazdahl and similar soils
- Flom and similar soils
- Lakepark and similar soils
- Quam 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

Foxlake Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Fine, montmorillonitic, frigid Vertic Epiaquolls

Typical Pedon

Foxlake silty clay loam, 1,500 feet north and 2,600 feet west of the southeast corner of sec. 11, T. 139 N., R. 42 W.

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

A—10 to 19 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; about 1 percent gravel; neutral; clear smooth boundary.

Bg—19 to 38 inches; dark gray (5Y 4/1) silty clay loam; weak fine subangular blocky structure; firm; about 2 percent gravel; common light gray (10YR 7/2) filaments and threads of segregated lime; slightly effervescent; slightly alkaline; clear smooth boundary.

Bkg—38 to 49 inches; light olive gray (5Y 6/2) silty clay loam; weak medium angular blocky structure; firm; common medium distinct yellowish brown (10YR 5/6) iron concentrations; about 2 percent gravel; common light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent;

moderately alkaline; gradual smooth boundary. Cg—49 to 60 inches; gray (5Y 6/1) silty clay loam; massive; firm; common fine prominent yellowish brown (10YR 5/6) iron concentrations; about 2 percent gravel; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches

Thickness of the mollic epipedon: 12 to 24 inches

Content of rock fragments: 1 to 4 percent

Ap or A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

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

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

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

1135—Foxlake silty clay loam

Composition

Foxlake and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 12.9 inches

Organic matter content: 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

- Audubon and similar soils
- Birchlake and similar soils
- Dovray and similar soils
- Cathro 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

Friendship Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Friendship loamy sand, 950 feet east and 300 feet south of the northwest corner of sec. 22, T. 138 N., R. 38 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy sand, very dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; about 1 percent gravel; slightly acid; clear smooth boundary.

Bw1—3 to 18 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; about 2 percent gravel; slightly acid; gradual smooth boundary.

Bw2—18 to 31 inches; yellowish brown (10YR 5/4) sand; single grain; loose; slightly acid; clear smooth boundary.

BC—31 to 46 inches; pale brown (10YR 6/3) sand; single grain; loose; common medium prominent strong brown (7.5YR 4/6) iron concentrations; about 2 percent gravel; neutral; gradual smooth boundary.

C—46 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; common medium prominent dark yellowish brown (10YR 4/6) iron concentrations; about 2 percent gravel; neutral.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel

Depth to carbonates: 40 to more than 60 inches

Ap or A horizon:

Hue—7.5YR or 10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand

Bw horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—sand or loamy sand

BC and C horizons:

Hue—7.5YR, 10YR, or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—sand or coarse sand

564—Friendship loamy sand**Composition**

Friendship and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: 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

- Eagleview and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Gonvick Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; next part—moderately slow or moderate; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed Aquic Argiborolls

Typical Pedon

Gonvick loam, 300 feet east and 1,800 feet south of the northwest corner of sec. 1, T. 142 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, gray (10YR 5/1) dry; weak medium granular structure; friable; about 2 percent gravel; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/21) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear smooth boundary.

Bt1—12 to 22 inches; olive brown (2.5Y 4/3) clay loam; moderate medium subangular blocky structure; friable; few fine faint dark grayish brown (2.5Y 4/2) iron depletions; many thick very dark gray (10YR 3/1) clay films on faces of peds and in pores; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bt2—22 to 34 inches; olive brown (2.5Y 4/3) clay loam; moderate medium subangular blocky structure; friable; few fine faint dark grayish brown (2.5Y 4/2) iron depletions and common fine distinct (10YR 5/6) iron concentrations; few moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 3 percent gravel; neutral; clear smooth boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; many fine faint grayish brown (2.5Y 5/2) iron depletions and common fine distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 38 inches

Thickness of the mollic epipedon: 8 to 16 inches

Content of rock fragments: 2 to 8 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

Bk or C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

180—Gonvick loam

Composition

Gonvick and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: 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

- Forman and similar soils
- Smiley and similar soils
- Quam and similar soils
- Hamre and similar soils
- Cathro 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

Graycalm Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 0 to 30 percent

Taxonomic class: Mixed, frigid Argic Udipsamments

Typical Pedon

Graycalm loamy sand (fig. I-11), in an area of Graycalm-Menahga complex, 1 to 8 percent slopes, 3,300 feet south and 1,000 feet west of the northeast corner of sec. 23, T. 141 N., R. 36 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

E—6 to 21 inches; brown (10YR 5/3) sand, light brownish gray (10YR 6/2) dry; single grain; loose; about 1 percent gravel; slightly acid; gradual smooth boundary.

E and Bt—21 to 46 inches; yellowish brown (10YR 5/4) sand (E); single grain; loose; lamellae of dark brown (7.5YR 4/4) loamy sand (Bt) ¼ to 1 inch thick; weak medium subangular blocky structure; friable; common thin clay coatings on sand grains and clay bridging between sand grains; about 1 percent gravel; neutral; clear smooth boundary.

C—46 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 1 percent gravel; neutral.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel

Depth to carbonates: 50 inches or more

Ap or A horizon:

Hue—10YR

Value—2 or 3; 3 or 4 in cultivated areas

Chroma—1 or 2; 2 or 3 in cultivated areas

Texture—loamy sand

E horizon:

Hue—10YR

Value—5 to 7

Chroma—1 to 3

Texture—sand, loamy sand, or loamy coarse sand

Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 7

Chroma—4 to 8

Texture—sand or loamy sand

E part of the E and Bt horizon:

Hue—10YR

Value—5 to 7

Chroma—2 to 6

Texture—sand or loamy sand

Bt part of the E and Bt horizon:

Hue—7.5YR or 10YR

Value—3 to 6

Chroma—4 to 6

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

C horizon:

Hue—10YR

Value—5 to 7

Chroma—2 to 6

Texture—sand or coarse sand

867B—Graycalm-Menahga complex, 1 to 8 percent slopes

Composition

Graycalm and similar soils: About 60 percent

Menahga and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 1 to 8 percent

Component Description

Graycalm

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Moderately low

Menahga

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Bootlake and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- Nidaros 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

867C—Graycalm-Menahga complex, 8 to 15 percent slopes

Composition

Graycalm and similar soils: About 60 percent

Menahga and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Graycalm

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.2 inches

Organic matter content: Moderately low

Menahga

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: 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

- Bootlake and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- Nidaros 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

867E—Graycalm-Menahga complex, 15 to 30 percent slopes

Composition

Graycalm and similar soils: About 60 percent

Menahga and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Graycalm

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.3 inches

Organic matter content: Moderately low

Menahga

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.2 inches

Organic matter content: 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

- Bootlake and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette 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

1249C—Graycalm-Bootlake complex, 8 to 15 percent slopes

Composition

Graycalm and similar soils: About 60 percent

Bootlake and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Graycalm

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.9 inches

Organic matter content: Moderately low

Bootlake

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.9 inches

Organic matter content: 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

- Friendship and similar soils
- Karlstad and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Hamerly Series

Depth class: Very deep

Drainage class: Moderately well drained and somewhat poorly drained

Permeability: Moderate or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, frigid Aeric Calciaquolls

Typical Pedon

Hamerly clay loam, in an area of Hamerly-Winger complex, 1,100 feet south and 600 feet west of the northeast corner of sec. 21, T. 141 N., R. 43 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) clay loam,

dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 23 inches; pale brown (10YR 6/3) clay loam; weak very fine subangular blocky structure; friable; about 2 percent gravel; violently effervescent with lime disseminated throughout; slightly alkaline; gradual smooth boundary.

Bk2—23 to 33 inches; yellowish brown (10YR 5/4) clay loam; weak fine subangular blocky structure; friable; few fine distinct light gray (10YR 6/1) iron depletions; many light gray (10YR 7/2) filaments and threads of segregated lime; about 4 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

C—33 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; common medium distinct light gray (10YR 6/1) iron depletions; few light gray (10YR 7/2) filaments and threads of segregated lime; about 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 10 percent

Carbonates: Typically occurring throughout the profile

Ap or A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—clay loam or loam

Bk horizon:

Hue—10YR or 2.5Y

Value—3 to 7

Chroma—1 to 4

Texture—clay loam or loam

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—clay loam or loam

184—Hamerly loam

Composition

Hamerly and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2 to 4 feet

Available water capacity to 60 inches or root-limiting

layer: About 10.5 inches

Organic matter content: 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

- Langhei and similar soils
- Barnes and similar soils
- Vallers and similar soils
- Quam and similar soils
- The depressional Winger soils 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

785—Hamerly-Winger complex

Composition

Hamerly and similar soils: About 60 percent

Winger and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Hamerly—flats and rises on moraines;

Winger—rims of depressions and flats on moraines

Slope range: Hamerly—1 to 3 percent; Winger—0 to 2 percent

Component Description

Hamerly

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting

layer: About 10.3 inches

Organic matter content: High

Winger

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits and till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting

layer: About 11.3 inches

Organic matter content: 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

- Barnes and similar soils
- The depressional Colvin soils and similar soils
- Hamre and similar soils
- Quam 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

1149—Hamerly clay loam

Composition

Hamerly and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2 to 4 feet

Available water capacity to 60 inches or root-limiting

layer: About 10.3 inches

Organic matter content: 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

- Formdale and similar soils
- Langhei and similar soils
- Flom and similar soils
- Quam 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

1967—Hamerly-Vallers complex

Composition

Hamerly and similar soils: About 55 percent

Vallers and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Hamerly—flats and rises on moraines;

Vallers—rims of depressions and flats on moraines

Slope range: Hamerly—1 to 3 percent; Vallers—0 to 2 percent

Component Description

Hamerly

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting

layer: About 10.2 inches

Organic matter content: High

Vallers

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.0 inches
Organic matter content: 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

- Barnes and similar soils
- McIntosh and similar soils
- Winger and similar soils
- The depressional Winger soils and similar soils
- Quam 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

Hamre Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow or moderate
Landform: Moraines
Parent material: Organic material and glaciolacustrine deposits or till
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Hamre muck, 2,100 feet west and 500 feet north of the southeast corner of sec. 1, T. 143 N., R. 42 W., in Mahnomen County, Minnesota:

- Oa—0 to 14 inches; black (N 2/0) muck; about 15 percent fiber unrubbed, less than 5 percent rubbed; weak fine granular structure; very friable; neutral; clear smooth boundary.
- A—14 to 19 inches; black (N 2/0) clay loam; weak medium subangular blocky structure; friable; about 2 percent gravel; neutral; clear wavy boundary.
- Bg—19 to 60 inches; grayish brown (2.5Y 5/2) clay loam; weak very fine subangular blocky structure; friable; many coarse distinct light olive brown (2.5Y 5/4) and few medium prominent strong brown (7.5YR 5/8) iron concentrations; about 5 percent

gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 25 inches
Thickness of the organic material: 8 to 16 inches

Oa or Oap horizon:

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

Ap or A horizon:

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

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

Content of rock fragments—0 to 10 percent

Bg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2

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

Content of rock fragments—0 to 10 percent

1878—Hamre muck

Composition

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

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic materials and glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 14.1 inches
Organic matter content: 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
- Winger and similar soils
- Colvin and similar soils
- Smiley and similar soils
- Egglake 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

Hangaard Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderately rapid; lower part—rapid or very rapid

Landform: Outwash plains and beach ridges

Parent material: Glacial outwash and beach deposits

Slope range: 0 to 2 percent

Taxonomic class: Sandy, mixed, frigid Typic Endoaquolls

Typical Pedon

Hangaard sandy loam, in an area of Rushlake and Hangaard soils, lake beaches, 1,700 feet west and 1,200 feet south of the northeast corner of sec. 8, T. 138 N., R. 41 W.

A—0 to 13 inches; black (N 2/0) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; about 5 percent gravel; neutral; clear smooth boundary.

Cg1—13 to 30 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; few fine faint olive brown (2.5Y 4/4) iron concentrations; common carbonate coatings on the underside of pebbles; about 35 percent gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—30 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; few fine prominent strong brown (7.5YR 5/6) iron concentrations; common carbonate coatings on the underside of pebbles; about 30 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 11 to 24 inches

Thickness of the mollic epipedon: 7 to 20 inches

Thickness of the loamy mantle: 7 to 20 inches

Content of rock fragments: 10 to 35 percent gravel

Ap or A horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

Texture—sandy loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 3 (chroma of 3 occurs where hue is 5Y)

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

111—Hangaard sandy loam**Composition**

Hangaard and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on outwash plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches

Organic matter content: 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

- Sverdrup and similar soils
- Osakis and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

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

Haslie Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—slow or moderately slow

Landform: Moraines and outwash plains

Parent material: Organic material and coprogenous earth

Slope range: 0 to 1 percent

Taxonomic class: Coprogenous, euc Limnic Borosaprists

Typical Pedon

Haslie muck, 2,400 feet east and 800 feet north of the southwest corner of sec. 11, T. 140 N., R. 42 W.

Oap—0 to 8 inches; muck, black (10YR 2/1) broken face and rubbed; about 25 percent fiber unrubbed, about 5 percent rubbed; moderate medium platy structure; very friable; primarily herbaceous fiber; neutral; abrupt smooth boundary.

Oa1—8 to 21 inches; muck, black (10YR 2/1) broken face and rubbed; about 25 percent fiber unrubbed, about 5 percent rubbed; moderate medium platy structure; very friable; primarily herbaceous fiber; neutral; clear smooth boundary.

Oa2—21 to 43 inches; muck, black (N 2/0) broken face and rubbed; about 5 percent fiber unrubbed, about 1 percent rubbed; weak fine subangular blocky structure; very friable; primarily herbaceous fiber; neutral; clear smooth boundary.

Cg—43 to 60 inches; gray (5Y 5/1) mucky silt loam (coprogenous earth); massive; friable; about 10 percent shell fragments; violently effervescent with lime disseminated throughout; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches

Fiber content: Less than 35 percent unrubbed; less than 10 percent rubbed

Content of wood fragments: Less than 15 percent

Oa or Oap horizon:

Hue—10YR, 7.5YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

Cg horizon:

Hue—10YR, 2.5Y, 5Y, 5GY, or neutral

Value—2 to 6

Chroma—0 to 3

746—Haslie muck

Composition

Haslie and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines and outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 21.4 inches

Organic matter content: 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
- Winger and similar soils
- Smiley and similar soils
- Egglake and similar soils
- Paddock and similar soils
- Forada 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: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Haslie

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Available water capacity to 60 inches or root-limiting layer: About 16.7 inches

Organic matter content: Very high

Seelyeville

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: Very high

Cathro

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: 4.0 feet above to 0.5 foot below the surface

Available water capacity to 60 inches or root-limiting layer: About 17.6 inches

Organic matter content: 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

- Egglake and similar soils
- Smiley and similar soils
- Paddock 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

1230—Haslie and Nidaros soils, ponded

Composition

Haslie: Variable

Nidaros: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains

Slope range: 0 to 1 percent

Component Description

Haslie

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Available water capacity to 60 inches or root-limiting layer: About 16.3 inches

Organic matter content: Very high

Nidaros

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and outwash

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Available water capacity to 60 inches or root-limiting layer: About 18.3 inches

Organic matter content: 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

- Hangaard and similar soils
- Forada and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Seelyeville 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

Hillview Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately rapid

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Hillview fine sandy loam, 1,400 feet east and 150 feet north of the southwest corner of sec. 35, T. 138 N., R. 36 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; moderately acid; abrupt smooth boundary.

Eg—8 to 19 inches; grayish brown (2.5Y 5/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; weak medium platy structure; very friable; common medium distinct dark yellowish brown (10YR 3/4) iron concentrations; slightly acid; clear smooth boundary.

Btg—19 to 28 inches; grayish brown (2.5Y 5/2) fine sandy loam; weak fine subangular blocky structure; very friable; common medium distinct dark yellowish brown (10YR 4/6) iron concentrations; common thin very dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bg—28 to 43 inches; light brownish gray (2.5Y 6/2) fine sandy loam; weak fine subangular blocky structure; very friable; many medium prominent dark yellowish brown (10YR 4/6) iron concentrations; slightly acid; clear smooth boundary.

Cg1—43 to 48 inches; light olive brown (2.5Y 5/4) fine sand; single grain; loose; many coarse distinct light brownish gray (2.5Y 6/2) iron depletions; slightly acid; clear smooth boundary.

Cg2—48 to 60 inches; grayish brown (2.5Y 6/2) silt loam; massive; friable; common coarse distinct dark yellowish brown (10YR 3/6) iron concentrations; slightly acid.

Range in Characteristics

Depth to carbonates: 27 to 60 inches

Content of rock fragments: 0 to 5 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Eg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2

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

Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 or 2

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

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 4

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

1365—Hillview fine sandy loam

Composition

Hillview and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.0 inches

Organic matter content: 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

- Rosy and similar soils
- Egglake and similar soils
- Paddock and similar soils
- Epoufette and similar soils
- Cathro 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

Karlstad Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 1 to 3 percent

Taxonomic class: Coarse-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Karlstad sandy loam, 200 feet west and 2,500 feet south of the northeast corner of sec. 9, T. 141 N., R. 40 W.

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

E—3 to 15 inches; brown (10YR 5/3) loamy sand, light brownish gray (10YR 6/2) dry; weak thin platy structure; very friable; about 2 percent gravel; strongly acid; clear smooth boundary.

Bt—15 to 27 inches; dark brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; few fine distinct gray (10YR 6/1) iron depletions; many thin dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; slightly acid; clear smooth boundary.

2C—27 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; common coarse distinct light olive brown (2.5Y 5/6) iron concentrations; few carbonate coatings on the underside of pebbles; about 15 percent gravel;

slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 8 to 30 inches

Thickness of the loamy mantle: 8 to 26 inches

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 15 percent gravel

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

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

Content of rock fragments—0 to 15 percent gravel

Bt horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—2 to 4

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

Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—gravelly coarse sand or gravelly sand

Content of rock fragments—15 to 35 percent gravel

1306—Karlstad sandy loam

Composition

Karlstad and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.2 inches

Organic matter content: 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

- Two Inlets and similar soils
- Bootlake and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Lakepark Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Colluvium and till

Slope range: 1 to 3 percent

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

Typical Pedon

Lakepark clay loam, 1,700 feet east and 200 feet south of the northwest corner of sec. 19, T. 139 N., R. 43 W.

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

A1—8 to 20 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A2—20 to 28 inches; very dark gray (N 3/0) clay loam, dark gray (N 4/0) dry; weak medium subangular blocky structure; friable; slightly alkaline; clear smooth boundary.

Bg—28 to 34 inches; olive gray (5Y 5/2) silty clay loam; weak medium subangular blocky structure; friable; few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; about 1 percent gravel; slightly alkaline; clear smooth boundary.

Cg—34 to 60 inches; light brownish gray (2.5Y 6/2)

loam; massive; friable; common medium distinct yellowish brown (10YR 5/8) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 25 to 50 inches

Thickness of the mollic epipedon: 24 to 60 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam

Content of rock fragments—0 to 5 percent

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam, silty clay loam, or loam

Content of rock fragments—0 to 5 percent

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—clay loam, loam, or silty clay loam

Content of rock fragments—2 to 8 percent

1938—Lakepark clay loam

Composition

Lakepark and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways on moraines

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Colluvium and till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.9 inches

Organic matter content: 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

- Aazdahl and similar soils
- Flom and similar soils
- Quam 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

Lamoure Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow or moderate

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, mixed (calcareous), frigid
Cumulic Endoaquolls

Typical Pedon

Lamoure silt loam, channeled, frequently flooded, 150 feet south and 150 feet west of the northeast corner of sec. 19, T. 140 N., R. 43 W.

- A1—0 to 10 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.
- A2—10 to 33 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; strongly effervescent with lime disseminated throughout; slightly alkaline; gradual smooth boundary.
- A3—33 to 41 inches; very dark gray (5Y 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; strongly effervescent with lime disseminated throughout; slightly alkaline; clear smooth boundary.
- Cg1—41 to 53 inches; grayish brown (2.5Y 5/2) fine sandy loam; massive; very friable; common coarse distinct light olive brown (2.5Y 5/4) iron concentrations; slightly effervescent with lime disseminated throughout; slightly alkaline; clear smooth boundary.
- Cg2—53 to 60 inches; gray (5Y 5/1), stratified sandy loam and loamy fine sand; massive; very friable; slightly effervescent with lime disseminated throughout; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 24 to 60 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silt loam or silty clay loam

Content of rock fragments—none

Cg horizon:

Hue—2.5Y or 5Y

Value—2 to 6

Chroma—0 to 2

Texture—stratified silt loam to loamy fine sand

Content of rock fragments—0 to 3 percent gravel

418—Lamoure silty clay loam, occasionally flooded

Composition

Lamoure and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats on flood plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Occasional

Seasonal high water table: At the surface to 1.5 feet below the surface

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

Organic matter content: 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

- Fordum 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

1251—Lamoure silt loam, channeled, frequently flooded

Composition

Lamoure and similar soils: About 95 percent
Inclusions: About 5 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 1.5 feet below the surface
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches
Organic matter content: 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

- Sedgeville 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

Langhei Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate or moderately slow
Landform: Moraines
Parent material: Till
Slope range: 3 to 30 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Eutrochrepts

Typical Pedon

Langhei clay loam, in an area of Formdale-Langhei complex, 6 to 12 percent slopes, eroded, 2,500 feet

north and 550 feet east of the southwest corner of sec. 23, T. 140 N., R. 43 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, light gray (10YR 7/2) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk—8 to 19 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; friable; few strong brown (7.5YR 4/6) iron concretions; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—19 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; few strong brown (7.5YR 4/6) iron concretions; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: Occurring throughout the profile

Content of rock fragments: 2 to 10 percent

Ap or A horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—1 or 2

Texture—clay loam or loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 7

Chroma—2 to 4

Texture—loam or clay loam

942D2—Langhei-Barnes complex, 12 to 20 percent slopes, eroded

Composition

Langhei and similar soils: About 55 percent
Barnes and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 12 to 20 percent

Component Description**Langhei**

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches
Organic matter content: Moderately low

Barnes

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches
Organic matter content: 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

- Hamerly and similar soils
- Vallers and similar soils
- Lakepark and similar soils
- Quam 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

943D2—Langhei-Formdale complex, 12 to 20 percent slopes, eroded**Composition**

Langhei and similar soils: About 50 percent
 Formdale and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders
Slope range: 12 to 20 percent

Component Description**Langhei**

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderately low

Formdale

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: 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

- Aazdahl and similar soils
- Flom and similar soils
- Lakepark and similar soils
- Quam 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

943E—Langhei-Formdale complex, 20 to 30 percent slopes**Composition**

Langhei and similar soils: About 55 percent
 Formdale and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 20 to 30 percent

Component Description

Langhei

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderately low

Formdale

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Aazdahl and similar soils
- Flom and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Hayland
- Pasture

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

- Agronomy section

Lida Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 1 to 30 percent

Taxonomic class: Coarse-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Lida sandy loam, in an area of Lida-Two Inlets complex, 8 to 15 percent slopes, 1,450 feet west and 750 feet south of the northeast corner of sec. 5, T. 137 N., R. 40 W., in Otter Tail County, Minnesota:

A1—0 to 2 inches; black (10YR 2/1) sandy loam, very dark brown (10YR 2/2) dry; weak fine and medium granular structure; very friable; many very fine and fine roots; about 3 percent gravel; neutral; clear smooth boundary.

A2—2 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; very friable; common very fine and fine roots; about 6 percent gravel; neutral; abrupt smooth boundary.

E—8 to 17 inches; grayish brown (10YR 5/2) loamy sand, light gray (10YR 7/2) dry; weak medium and coarse subangular blocky structure; friable; few very fine and fine roots; about 8 percent gravel; neutral; clear wavy boundary.

Bt1—17 to 25 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; moderate coarse and medium subangular blocky structure; firm; few very fine and fine roots; many faint brown (10YR 4/3) continuous clay films on faces of peds and in pores; about 16 percent gravel; neutral; clear wavy boundary.

Bt2—25 to 36 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; moderate medium and fine subangular blocky structure; friable; few very fine and fine roots; common faint brown (10YR 4/3) discontinuous clay bridging between sand grains; about 17 percent gravel; slightly acid; gradual wavy boundary.

Bt3—36 to 41 inches; brown (10YR 4/3) gravelly loamy sand; moderate fine and medium subangular blocky structure; friable; few very fine and fine roots; many faint brown (10YR 4/3) continuous clay bridging between sand grains; about 15 percent gravel; neutral; abrupt wavy boundary.

2C—41 to 60 inches; brown (10YR 5/3) gravelly sand; single grain; loose; about 18 percent gravel; common carbonate coatings on the underside of pebbles; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 27 to 60 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3
 Texture—loamy sand and sandy loam
 Content of rock fragments—0 to 7 percent gravel

E horizon:

Hue—10YR
 Value—4 or 5
 Chroma—2 to 4
 Texture—loamy sand, loamy coarse sand, loamy fine sand, or sandy loam
 Content of rock fragments—0 to 7 percent gravel

Bt horizon:

Hue—7.5YR or 10YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—sandy loam, coarse sandy loam, or the gravelly analogs of these textures; subhorizons are loamy sand, sandy clay loam, loamy coarse sand, loam, or the gravelly analogs of these textures
 Content of rock fragments—0 to 7 percent gravel

2Bk horizon:

Hue—10YR, 2.5Y, or 7.5YR
 Value—4 to 7
 Chroma—2 to 6
 Texture—loamy sand, loamy coarse sand, sand, coarse sand, or the gravelly analogs of these textures
 Content of rock fragments—10 to 35 percent gravel

2C horizon (if it occurs):

Hue—10YR, 2.5Y, or 7.5YR
 Value—4 to 7
 Chroma—2 to 6
 Texture—sand, coarse sand, gravelly sand, or gravelly coarse sand
 Content of rock fragments—10 to 35 percent gravel

1196B—Lida-Two Inlets complex, 1 to 8 percent slopes

Composition

Lida and similar soils: About 65 percent
 Two Inlets and similar soils: About 20 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 1 to 8 percent

Component Description

Lida

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)

Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.1 inches
Organic matter content: Moderate

Two Inlets

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: 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

- Karlstad and similar soils
- Rushlake and similar soils
- Epoufette and similar soils
- Hangaard and similar soils
- Nidaros 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

1196C—Lida-Two Inlets complex, 8 to 15 percent slopes

Composition

Lida and similar soils: About 60 percent
 Two Inlets and similar soils: About 25 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Lida

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.9 inches
Organic matter content: Moderate

Two Inlets

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.6 inches
Organic matter content: 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

- Karlstad and similar soils
- Rushlake and similar soils
- Epoufette and similar soils
- Hangaard and similar soils
- Nidaros 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

1196E—Lida-Two Inlets complex, 15 to 30 percent slopes

Composition

Lida and similar soils: About 60 percent
 Two Inlets and similar soils: About 25 percent
 Inclusions: About 15 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 15 to 30 percent

Component Description

Lida

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: Moderate

Two Inlets

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches
Organic matter content: 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

- Karlstad and similar soils
- Rushlake and similar soils
- Epoufette and similar soils
- Hangaard and similar soils
- Nidaros 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

Lindaas Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderate; next part—slow;

lower part—moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic class: Fine, montmorillonitic, frigid Typic Argiaquolls

Typical Pedon

Lindaas silty clay loam, morainic, 2,300 feet east and 1,200 feet north of the southwest corner of sec. 33, T. 139 N., R. 43 W.

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

A—8 to 14 inches; black (N 2/0) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Btg1—14 to 20 inches; very dark grayish brown (2.5Y 3/2) clay; moderate fine subangular blocky structure; friable; many thick very dark gray (N 3/0) clay films on faces of peds and in pores; neutral; gradual smooth boundary.

Btg2—20 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate medium subangular blocky structure; friable; common fine distinct olive brown (2.5Y 5/4) iron concentrations; many thin very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; neutral; clear smooth boundary.

Cg—29 to 60 inches; grayish brown (2.5Y 5/2) silty clay; weak medium platy soil aggregates; friable; common medium faint olive brown (2.5Y 5/4) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 35 inches

Thickness of the mollic epipedon: 16 inches or more

Ap or A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam

Bt horizon:

Hue—10YR, 2.5Y, or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—silty clay or clay

Cg horizon:

Hue—2.5Y or 5Y

Value—5 to 7

Chroma—1 to 4

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

1129—Lindaas silty clay loam, morainic

Composition

Lindaas and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting

layer: About 8.0 inches

Organic matter content: 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

- Bygland and similar soils
- Dalbo and similar soils
- Dovray and similar soils
- Cathro 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

Lupton Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow to moderately rapid

Landform: Moraines and outwash plains

Parent material: Organic materials

Slope range: 0 to 1 percent

Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Lupton muck, in an area of Mooselake and Lupton soils,

1,200 feet west and 200 feet north of the southeast corner of sec. 13, T. 142 N., R. 37 W.

Oa1—0 to 15 inches; muck, very dark brown (10YR 2/2) broken face and black (10YR 2/1) rubbed; about 45 percent fiber, about 15 percent rubbed; about 15 percent woody fragments; weak thin platy structure; very friable; primarily herbaceous fibers; slightly acid; gradual smooth boundary.

Oa2—15 to 32 inches; muck, very dark brown (10YR 2/2) broken face and black (10YR 2/1) rubbed; about 40 percent fiber, about 10 percent rubbed; about 10 percent woody fragments; weak medium platy structure; very friable; primarily herbaceous fibers; slightly acid; gradual smooth boundary.

Oe—32 to 39 inches; mucky peat, dark brown (7.5YR 3/2) broken face and rubbed; about 65 percent fiber, about 25 percent rubbed; about 10 percent wood fragments; weak medium platy structure; very friable; primarily herbaceous fibers; slightly acid; gradual smooth boundary.

O'a—39 to 60 inches; muck, very dark brown (10YR 2/2) broken face and black (10YR 2/1) rubbed; about 40 percent fiber, about 10 percent rubbed; about 5 percent woody fragments; weak thin platy structure; very friable; primarily herbaceous fibers; neutral.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Content of wood fragments: 10 to 30 percent

Thickness of hemic material in the subsurface and bottom tiers: Less than 10 inches

Oap, Ap, or A horizon:

Hue—7.5YR or 10YR

Value—2 or 3

Chroma—1 to 3

Texture—muck

McIntosh Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderate or moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits and till

Slope range: 0 to 3 percent

Taxonomic class: Fine-silty, frigid Aeric Calciaquolls

Typical Pedon

McIntosh silt loam, 150 feet east and 2,400 feet north of

the southwest corner of sec. 8, T. 141 N., R. 42 W.

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

Bk1—9 to 17 inches; dark gray (10YR 4/1) silt loam; weak fine subangular blocky structure; friable; violently effervescent with lime disseminated throughout; slightly alkaline; gradual smooth boundary.

Bk2—17 to 30 inches; light yellowish brown (2.5Y 6/4) silt loam; weak fine subangular blocky structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; violently effervescent; moderately alkaline; clear smooth boundary.

2C—30 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; common medium distinct light gray (10YR 6/1) iron depletions and yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 3 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the lacustrine mantle: 24 to 40 inches

Carbonates: Occurring throughout the profile

Ap or A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

Content of rock fragments—none

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 to 4

Texture—silt loam, silty clay loam, or loam

Content of rock fragments—none

C horizon (if it occurs):

Hue—2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—silt loam or silty clay loam

Content of rock fragments—2 to 10 percent

2C horizon:

Hue—2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—loam or clay loam

Content of rock fragments—2 to 10 percent

108—McIntosh silt loam**Composition**

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

Setting

Landform: Flats and rises on moraines
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits and till
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches
Organic matter content: 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

- Barnes and similar soils
- Winger and similar soils
- The depressional Winger soils and similar soils
- Quam 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

Meehan Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Outwash plains
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Meehan loamy sand, 1,850 feet north and 100 feet east of the southwest corner of sec. 26, T. 139 N., R. 36 W.

- A—0 to 5 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; about 3 percent gravel; strongly acid; clear smooth boundary.
- E—5 to 13 inches; dark brown (10YR 4/3) loamy sand, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations; about 5 percent gravel; moderately acid; clear smooth boundary.
- Bw—13 to 25 inches; brown (10YR 5/3) coarse sand; single grain; loose; common fine distinct strong brown (7.5YR 5/6) iron concentrations and common fine distinct light brownish gray (2.5Y 6/2) iron depletions; about 5 percent gravel; moderately acid; clear smooth boundary.
- C—25 to 60 inches; light yellowish brown (2.5Y 6/4) coarse sand; single grain; loose; common fine distinct yellowish brown (10YR 5/6) iron concentrations and common medium distinct light brownish gray (2.5Y 6/2) iron depletions; about 5 percent gravel; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel

Ap or A horizon:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

E horizon:

Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 or 3
Texture—loamy sand or sand

Bw or BC horizon:

Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 to 8
Texture—sand, loamy sand, coarse sand, or loamy coarse sand

C horizon:

Hue—7.5YR, 10YR, or 2.5Y
Value—4 to 7
Chroma—2 to 4
Texture—coarse sand or sand

202—Meehan loamy sand**Composition**

Meehan and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on outwash plains

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 1 to 3 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: 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

- Eagleview and similar soils
- Friendship and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Menahga Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 1 to 30 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Menahga loamy sand, in an area of Graycalm-Menahga

complex, 1 to 8 percent slopes, 2,300 feet west and 400 feet north of the southeast corner of sec. 22, T. 139 N., R. 36 W.

A—0 to 3 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; about 2 percent gravel; moderately acid; clear smooth boundary.

Bw1—3 to 12 inches; dark brown (10YR 4/3) loamy sand, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; very friable; about 3 percent gravel; strongly acid; clear smooth boundary.

Bw2—12 to 33 inches; dark yellowish brown (10YR 4/6) coarse sand; single grain; loose; about 11 percent gravel; moderately acid; gradual smooth boundary.

Bw3—33 to 42 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 1 percent gravel; neutral; clear smooth boundary.

BC—42 to 50 inches; yellowish brown (10YR 5/6) coarse sand; single grain; loose; about 3 percent gravel; neutral; clear smooth boundary.

C—50 to 60 inches; light yellowish brown (10YR 6/4) coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 6 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Content of rock fragments: 0 to 10 percent gravel

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—coarse sand or sand

C horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—3 to 6

Texture—coarse sand or sand

Mooselake Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate or moderately rapid

Landform: Moraines and outwash plains

Parent material: Organic materials



Figure I-6.—A profile of Arvilla sandy loam. This soil has a loamy mantle about 14 to 25 inches thick over sand and gravel. The soil formed in glacial outwash. Depth is marked in feet.

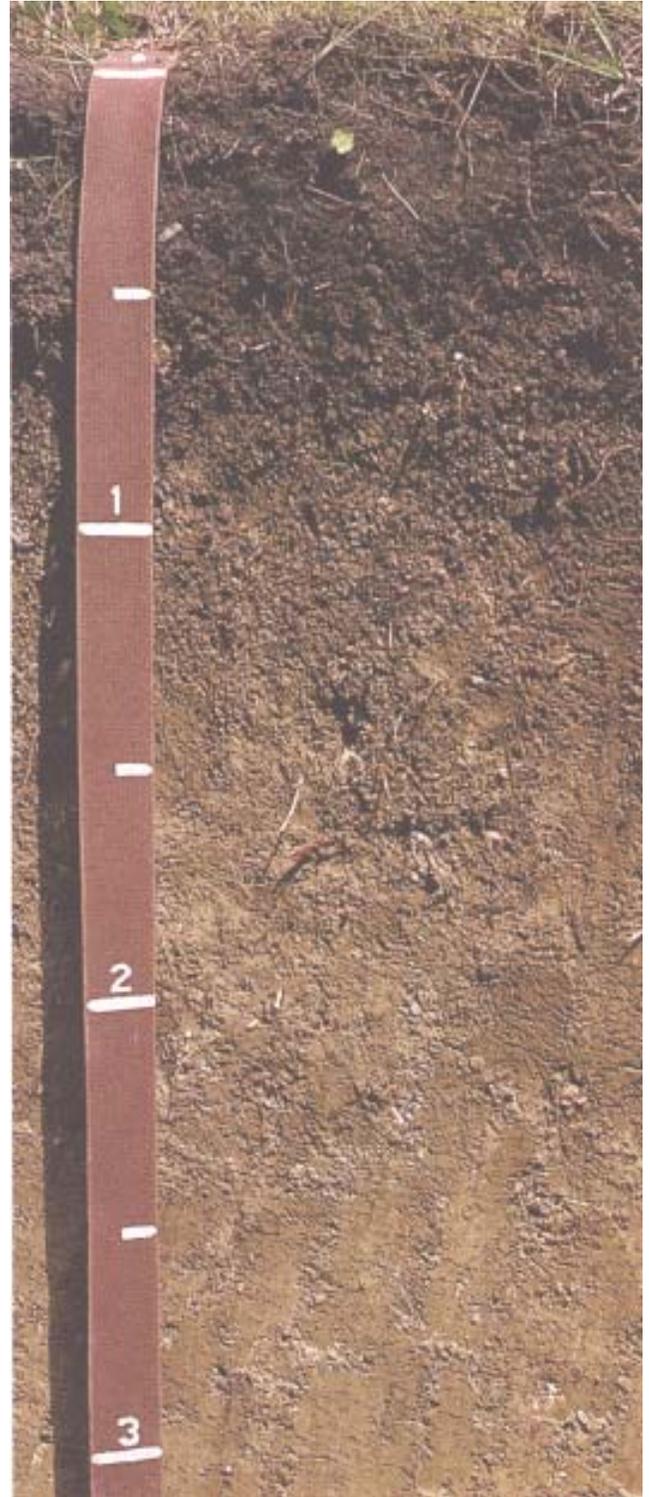


Figure I-7.—A profile of Audubon silty clay loam. The surface layer, which has been darkened by organic matter, extends to a depth of about 10 inches. This soil formed in glacial till. Depth is marked in feet.



Figure I-8.—A profile of Bootlake sandy loam. A layer of clay depletion is between the depths of 4 and 24 inches, and a layer of clay accumulation is between the depths of 24 and 38 inches. This soil formed in glacial outwash. Depth is marked in feet.



Figure I-9.—A profile of Dorset sandy loam. This soil has a loamy mantle about 18 inches thick over sand and gravel. The soil formed in glacial outwash. The content of gravel in the underlying material ranges from 10 to 35 percent. Depth is marked in feet.



Figure I-10.—A profile of Eagleview loamy sand. Lamellae and layers of clay accumulation are between the depths of 30 and 47 inches. Free carbonates are at a depth of about 47 inches. This soil formed in glacial outwash. Depth is marked in feet.



Figure I-11.—A profile of Graycalm loamy sand. A layer of clay depletion is between the depths of 3 and 20 inches. Lamellae are at a depth of about 20 inches. This soil formed in glacial outwash. The content of gravel is less than 15 percent. Depth is marked in feet.



Figure I-12.—A profile of Nebish loam. A layer of clay accumulation is between the depths of 12 and 20 inches. The underlying material is glacial till. Depth is marked in feet.



Figure I-13.—A profile of Sandberg coarse sandy loam. The surface layer, which has been darkened by organic matter, extends to a depth of about 8 inches. Free carbonates are at a depth of about 18 inches. This soil formed in glacial outwash. Depth is marked in feet.



Figure I-14.—A profile of Snellman sandy loam. A layer of clay accumulation is between the depths of 12 and 20 inches. This soil formed in glacial till. Depth is marked in feet.



Figure I-15.—A profile of Sugarbush sandy loam. A layer of clay accumulation is between the depths of 16 and 27 inches. This soil formed in glacial outwash. Depth is marked in feet.



Figure I-16.—A profile of Two Inlets coarse sandy loam. The layer between the depths of 10 and 24 inches has clay bridging between sand grains. This soil formed in glacial outwash. Depth is marked in feet.

Slope range: 0 to 1 percent

Taxonomic class: Euic Typic Borohemists

Typical Pedon

Mooselake muck, in an area of Mooselake and Lupton soils, 2,400 feet west and 1,900 feet north of the southeast corner of sec. 11, T. 145 N., R. 37 W., in Clearwater County, Minnesota:

Oa—0 to 15 inches; muck, very dark grayish brown (10YR 3/2) broken face, very dark brown (10YR 2/2) rubbed and pressed; 20 percent fiber, 5 percent rubbed; weak medium platy structure; very friable; about 40 percent woody fragments more than 2 millimeters in diameter; slightly acid; clear wavy boundary.

Oe1—15 to 40 inches; mucky peat, dark yellowish brown (10YR 4/4) broken face, dark brown (10YR 4/3) rubbed and pressed; 65 percent fiber, 40 percent rubbed; weak medium platy structure; very friable; about 10 percent woody fragments more than 2 millimeters in diameter; slightly acid; gradual wavy boundary.

Oe2—40 to 60 inches; mucky peat, dark yellowish brown (10YR 4/4) broken face, very dark grayish brown (10YR 3/2) rubbed and pressed; 50 percent fiber, 35 percent rubbed; weak medium platy structure; very friable; about 10 percent woody fragments more than 2 millimeters in diameter; slightly acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Fiber content: 35 to 75 percent unrubbed; 15 to 50 percent rubbed

Content of wood fragments: 15 to 50 percent

Oa or Oap horizon:

Hue—7.5YR or 10YR

Value—2 or 3

Chroma—1 to 3

Texture of the fine-earth fraction—muck

Oe horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—2 to 6

Texture of the fine-earth fraction—mucky peat

797—Mooselake and Lupton soils

Composition

Mooselake: Variable

Lupton: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines and outwash plains

Slope range: 0 to 1 percent

Component Description

Mooselake

Surface layer texture: Mucky peat

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 27.0 inches

Organic matter content: Very high

Lupton

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: 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

- Wykeham and similar soils
- Egglake and similar soils
- Epoufette and similar soils
- Lindaas and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

Naytahwaush Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate or moderately slow; next part—slow; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic class: Fine, montmorillonitic Mollic
Eutroboralfs

Typical Pedon

Naytahwaush loam, 8 to 15 percent slopes, 800 feet west and 400 feet north of the southeast corner of sec. 12, T. 142 N., R. 41 W.

- A—0 to 4 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; slightly acid; clear smooth boundary.
- E—4 to 6 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; friable; about 1 percent gravel; slightly acid; clear smooth boundary.
- Bt—6 to 23 inches; dark brown (10YR 4/3) silty clay; moderate medium angular blocky structure; friable; many thin dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; moderately acid; gradual smooth boundary.
- BC—23 to 32 inches; light olive brown (2.5Y 4/3) silty clay loam; moderate medium angular blocky structure; friable; few thin very dark grayish brown (10YR 3/2) clay films on faces of fractures; many light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; slightly alkaline; gradual wavy boundary.
- C—32 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; moderate medium angular blocky soil aggregates; friable; common medium distinct gray (10YR 5/1) iron depletions; common medium distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Content of rock fragments: 1 to 5 percent

Ap or A horizon:

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

E horizon:

Hue—10YR or 2.5Y
Value—3 to 6
Chroma—1 to 4
Texture—loam, silt loam, or fine sandy loam

Bt horizon:

Hue—10YR or 2.5Y
Value—3 to 5
Chroma—3 or 4

Texture—clay, silty clay, or silty clay loam

BC horizon:

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

C horizon:

Hue—10YR or 2.5Y
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: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: 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

- Birchlake and similar soils
- Foxlake and similar soils
- Auganaush and similar soils
- Dovray and similar soils
- Cathro 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: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Birchlake and similar soils
- Auganaush and similar soils
- Foxlake and similar soils
- Dovray and similar soils
- Cathro 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: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Birchlake and similar soils
- Auganaush and similar soils
- Foxlake and similar soils
- Dovray and similar soils
- Cathro 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

Nebish Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate or moderately rapid

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Nebish loam (fig. I-12), in an area of Nebish-Sugarbush complex, 2 to 8 percent slopes, 300 feet east and 1,300 feet south of the northwest corner of sec. 20, T. 141 N., R. 40 W.

A—0 to 2 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; about 3 percent gravel; slightly acid; abrupt smooth boundary.

E—2 to 7 inches; brown (10YR 5/3) fine sandy loam, light brownish gray (10YR 6/2) dry; moderate thin platy structure; very friable; about 8 percent gravel; slightly acid; clear smooth boundary.

Bt1—7 to 16 inches; dark brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; friable; many brown (10YR 5/3) sand and silt coatings on faces of peds and in pores; about 3 percent gravel; moderately acid; gradual smooth boundary.

Bt2—16 to 26 inches; dark brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; friable; many thin dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 5 percent gravel; moderately acid; clear smooth boundary.

Bk—26 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common fine distinct yellowish brown (10YR 5/6) iron concentrations; about 10 percent gravel; many light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 42 inches

Content of rock fragments: 2 to 10 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

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

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—clay loam or loam

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—clay loam or loam

40B—Nebish loam, 2 to 8 percent slopes

Composition

Nebish and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: 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

- Beltrami and similar soils
- Smiley and similar soils
- Hamre and similar soils
- Cathro 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

40C—Nebish loam, 8 to 15 percent slopes

Composition

Nebish and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: 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

- Beltrami and similar soils
- Smiley and similar soils
- Hamre and similar soils
- Cathro 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

40E—Nebish loam, 15 to 30 percent slopes**Composition**

Nebish and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: 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

- Beltrami and similar soils
- Smiley and similar soils
- Hamre and similar soils
- Cathro 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

951B—Nebish-Sugarbush complex, 2 to 8 percent slopes**Composition**

Nebish and similar soils: About 60 percent

Sugarbush and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description**Nebish**

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderately low

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches
Organic matter content: 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

- Two Inlets and similar soils
- Eagleview and similar soils
- Balmlake and similar soils
- Beltrami and similar soils
- Smiley and similar soils
- Cathro 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

951C—Nebish-Sugarbush complex, 8 to 15 percent slopes

Composition

Nebish and similar soils: About 60 percent
 Sugarbush and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Nebish

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting

layer: About 9.5 inches
Organic matter content: Moderately low

Sugarbush

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.6 inches
Organic matter content: 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

- Two Inlets and similar soils
- Eagleview and similar soils
- Balmlake and similar soils
- Beltrami and similar soils
- Smiley and similar soils
- Cathro 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

951E—Nebish-Sugarbush complex, 15 to 30 percent slopes

Composition

Nebish and similar soils: About 60 percent
 Sugarbush and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 15 to 30 percent

Component Description

Nebish

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)

Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches
Organic matter content: Moderately low

Sugarbush

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches
Organic matter content: 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

- Two Inlets and similar soils
- Eagleview and similar soils
- Balmlake and similar soils
- Beltrami and similar soils
- Smiley and similar soils
- Cathro 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

Nidaros Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderately slow to moderately rapid; lower part—rapid
Landform: Outwash plains and valley trains
Parent material: Organic materials and outwash
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euc Terric Borosaprists

Typical Pedon

Nidaros muck, 2,200 feet south and 100 feet west of the northeast corner of sec. 15, T. 139 N., R. 41 W.
 Oa—0 to 31 inches; muck, black (7.5YR 2/0) broken face and rubbed; weak fine granular structure; very friable; neutral; abrupt smooth boundary.
 A—31 to 42 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; slightly acid; clear smooth boundary.
 Bg—42 to 49 inches; dark gray (5Y 4/1) sandy loam; weak medium subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.
 2Cg—49 to 60 inches; gray (5Y 5/1) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 15 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Content of wood fragments: 0 to 15 percent
Content of rock fragments: None in the organic material; 0 to 35 percent gravel in the mineral sediments

Oa or Oap horizon:

Hue—10YR, 2.5Y, or neutral
 Value—2 to 4
 Chroma—0 to 3
 Texture—muck

A horizon:

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

2Cg horizon:

Hue—2.5Y, 5Y, or neutral
 Value—4 to 6
 Chroma—0 to 4
 Texture—sand, coarse sand, or the gravelly analogs of these textures

1111—Nidaros muck, frequently flooded

Composition

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

Setting

Landform: Flats on flood plains
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and outwash

Flooding: Frequent

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

Available water capacity to 60 inches or root-limiting layer: About 13.3 inches

Organic matter content: 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

- Forada and similar soils
- Hangaard and similar soils
- Epoufette and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

1136—Nidaros muck

Composition

Nidaros and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and outwash

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 16.2 inches

Organic matter content: 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

- Forada and similar soils
- Epoufette and similar soils
- Hangaard and similar soils
- Seelyeville and similar soils
- The depressional Forada soils and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

Nymore Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 1 to 20 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Nymore loamy sand, in an area of Verndale-Nymore complex, 1 to 6 percent slopes, 400 feet east and 200 feet north of the southwest corner of sec. 29, T. 140 N., R. 36 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; about 4 percent gravel; strongly acid; abrupt smooth boundary.

Bw1—7 to 17 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; about 5 percent gravel; moderately acid; clear smooth boundary.

Bw2—17 to 41 inches; dark brown (7.5YR 5/4) coarse sand; single grain; loose; about 8 percent gravel; moderately acid; gradual smooth boundary.

C—41 to 60 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; about 5 percent gravel; slightly acid.

Range in Characteristics

Depth to carbonates: 40 inches or more

Content of rock fragments: 0 to 10 percent gravel

Ap or A horizon:

Hue—10YR

Value—2 or 3
 Chroma—1 to 3
 Texture—loamy sand

Bw horizon:

Hue—7.5YR or 10YR
 Value—3 to 6
 Chroma—3 to 6
 Texture—coarse sand, sand, loamy coarse sand, or loamy sand

C horizon:

Hue—7.5YR or 10YR
 Value—5 to 7
 Chroma—2 to 6
 Texture—coarse sand or sand

207D—Nymore loamy sand, 12 to 20 percent slopes

Composition

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 12 to 20 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.4 inches
Organic matter content: 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

- Verndale and similar soils
- Oylen and similar soils
- Forada 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

1248C—Nymore-Verndale complex, 6 to 12 percent slopes

Composition

Nymore and similar soils: About 60 percent
 Verndale and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 6 to 12 percent

Component Description

Nymore

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.4 inches
Organic matter content: Moderate

Verndale

Surface layer texture: Coarse sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.2 inches
Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Osakis Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate or moderately rapid; lower part—rapid

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Sandy, mixed Aquic Haploborolls

Typical Pedon

Osakis sandy loam, 2,000 feet west and 2,100 feet south of the northeast corner of sec. 29, T. 138 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

Bw1—8 to 11 inches; dark brown (10YR 3/3) sandy loam; weak medium subangular blocky structure; friable; about 2 percent gravel; neutral; gradual smooth boundary.

Bw2—11 to 18 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; weak fine subangular blocky structure; very friable; about 6 percent gravel; neutral; clear smooth boundary.

2C1—18 to 35 inches; pale brown (10YR 6/3) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 20 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2C2—35 to 60 inches; light olive brown (2.5Y 5/3) gravelly coarse sand; single grain; loose; common medium faint light brownish gray (10YR 6/2) iron depletions; common carbonate coatings on the underside of pebbles; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 25 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the loamy mantle: 12 to 20 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 10 percent gravel

Bw horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

Texture—sandy loam or loam

Content of rock fragments—0 to 10 percent gravel

2Bw horizon (if it occurs):

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

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

Content of rock fragments—10 to 35 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 or 3

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

Content of rock fragments—10 to 35 percent gravel

413—Osakis sandy loam

Composition

Osakis and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains

Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.2 inches

Organic matter content: 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

- Corliss and similar soils
- Arvilla and similar soils
- Forada and similar soils
- The depressional Forada soils 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

Oylen Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate or moderately rapid; lower part—rapid

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed Aquic Argiborolls

Typical Pedon

Oylen sandy loam, 1,800 feet west and 250 feet south of the northeast corner of sec. 21, T. 141 N., R. 37 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.

A—10 to 13 inches; very dark gray (10YR 3/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; about 5 percent gravel; neutral; clear smooth boundary.

Bt—13 to 22 inches; dark brown (10YR 4/3) sandy loam; moderate medium subangular blocky structure; friable; many thin dark brown (10YR 3/3) clay films on faces of peds and in pores; about 5 percent gravel; neutral; clear smooth boundary.

2Bw1—22 to 33 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; about 7 percent gravel; neutral; gradual smooth boundary.

2Bw2—33 to 52 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; common medium distinct yellowish brown (10YR 5/6) iron concentrations and common medium prominent light brownish gray (2.5Y 6/2) iron depletions; about 7 percent gravel; neutral; clear smooth boundary.

2C—52 to 60 inches; light brownish gray (2.5Y 6/2) coarse sand; single grain; few fine distinct yellowish

brown (10YR 5/6) iron concentrations; loose; common carbonate coatings on the underside of pebbles; about 10 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 36 to 60 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the loamy mantle: 15 to 24 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

Content of rock fragments—0 to 5 percent gravel

Bt horizon:

Hue—10YR

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam or loam

Content of rock fragments—0 to 5 percent gravel

2Bw horizon:

Hue—7.5YR, 10YR, or 2.5Y

Value—4 or 5

Chroma—2 to 4

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

Content of rock fragments—0 to 25 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

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

Content of rock fragments—0 to 25 percent gravel

1975—Oylen sandy loam

Composition

Oylen and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 5.2 inches

Organic matter content: 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

- Nymore and similar soils
- Verndale and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Paddock Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderate; next part—moderately slow; lower part—very slow

Landform: Drumlins

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, frigid Udollic Epiaqualfs

Typical Pedon

Paddock fine sandy loam, stony, 1,300 feet east and 300 feet south of the northwest corner of sec. 28, T. 138 N., R. 36 W.

A—0 to 4 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 8 percent gravel; slightly acid; clear smooth boundary.

E1—4 to 11 inches; dark grayish brown (2.5Y 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak medium platy structure; friable; few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; about 8 percent gravel; neutral; clear wavy boundary.

E2—11 to 16 inches; grayish brown (2.5Y 5/2) sandy

loam; weak medium subangular blocky structure; friable; common coarse distinct dark yellowish brown (10YR 4/6) iron concentrations; about 8 percent gravel; slightly acid; clear smooth boundary.

Btg—16 to 26 inches; grayish brown (2.5Y 5/2) sandy clay loam; moderate medium subangular blocky structure; friable; common coarse distinct dark yellowish brown (10YR 4/6) iron concentrations; many thin dark grayish brown (2.5Y 5/2) clay films on faces of peds and in pores; about 6 percent gravel; moderately acid; clear smooth boundary.

BCg—26 to 43 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; common medium distinct grayish brown (2.5Y 5/2) iron depletions; about 6 percent gravel; moderately acid; clear smooth boundary.

Cd—43 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak thin platy soil aggregates; firm; few light gray (10YR 7/2) filaments and threads of segregated lime; about 6 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches

Content of rock fragments: 2 to 15 percent

Depth to dense till: 40 to 60 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or fine sandy loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam or sandy clay loam

Cd horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam

1210—Paddock-Epoufette complex

Composition

Paddock and similar soils: About 50 percent

Epoufette and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Flats

Slope range: 0 to 2 percent

Component Description**Paddock**

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1 to 2 feet

Available water capacity to 60 inches or root-limiting layer: About 4.8 inches

Organic matter content: High

Epoufette

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 2.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.0 inches

Organic matter content: 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

- Blowers and similar soils
- Karlstad and similar soils
- Runeberg and similar soils
- Cathro 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

1321—Paddock fine sandy loam, stony**Composition**

Paddock and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drumlins

Position on the landform: Foot slopes and toe slopes

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1 to 2 feet

Available water capacity to 60 inches or root-limiting layer: About 6.4 inches

Organic matter content: 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

- Blowers and similar soils
- Hillview and similar soils
- Runeberg and similar soils
- Cathro 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

1030—Pits, gravel-Udipsamments complex**Composition**

Pits: 50 percent

Udipsamments and similar soils: About 45 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Slope range: 1 to 50 percent

Component Description**Pits**

Dominant parent material: Glacial outwash

Udipsamments

Surface layer texture: Sand

Depth class: Very deep (more than 60 inches)

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Very low

Major Uses of the Unit

- Wildlife habitat

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

- Wildlife Habitat section

Quam Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Colluvium and till

Slope range: 0 to 1 percent

Taxonomic class: Fine-silty, mixed, frigid Cumulic Endoaquolls

Typical Pedon

Quam silty clay loam, 1,400 feet west and 250 feet north of the southeast corner of sec. 4, T. 142 N., R. 41 W.

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

A1—10 to 29 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; slightly alkaline; gradual smooth boundary.

A2—29 to 42 inches; very dark gray (5Y 3/1) silty clay loam, very dark gray (5Y 3/1) dry; weak fine subangular blocky structure; friable; slightly alkaline; gradual smooth boundary.

Cg1—42 to 48 inches; light olive gray (5Y 6/2) silty clay loam; massive; friable; common medium distinct dark yellowish brown (10YR 4/6) iron concentrations; few light gray (2.5Y 7/2) filaments and threads of segregated lime; strongly effervescent; slightly alkaline; clear smooth boundary.

2Cg2—48 to 60 inches; olive gray (5Y 5/2) clay loam; massive; friable; common medium distinct light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Thickness of the mollic epipedon: 24 to 80 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam or silt loam

Content of rock fragments—0 to 5 percent

Bg horizon (if it occurs):

Hue—2.5Y, 5Y, or neutral

Value—2 to 4

Chroma—0 or 1

Texture—silty clay loam or silt loam

Content of rock fragments—0 to 8 percent

Cg and 2Cg horizons:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

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

Content of rock fragments—0 to 8 percent

344—Quam silty clay loam

Composition

Quam and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Colluvium and till

Flooding: None

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

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

Organic matter content: 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

- Hamerly and similar soils
- Vallery and similar soils

- Winger and similar soils
- Hamre and similar soils
- Cathro 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

1227—Quam, Cathro, and Urness soils, ponded

Composition

Quam and similar soils: About 30 percent
 Cathro and similar soils: About 30 percent
 Urness and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Quam

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Colluvium and till
Flooding: None
Seasonal high water table: 3.0 feet above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 12.5 inches
Organic matter content: Very high

Cathro

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic materials and glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: 4.0 feet above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 17.9 inches
Organic matter content: Very high

Urness

Surface layer texture: Mucky silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained

Dominant parent material: Coprogenous earth

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

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

Organic matter content: 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
- Colvin and similar soils
- Smiley and similar soils
- Foxlake and similar soils
- Seelyeville 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

Rifle Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Landform: Moraines and outwash plains
Parent material: Organic materials
Slope range: 0 to 1 percent
Taxonomic class: Euic Typic Borohemists

Typical Pedon

Rifle mucky peat, 2,100 feet north and 200 feet west of the southeast corner of sec. 31, T. 140 N., R. 40 W.

Oe1—0 to 14 inches; mucky peat, dark reddish brown (5YR 2/2) broken face and rubbed; about 70 percent fiber unrubbed, about 20 percent rubbed; massive; primarily herbaceous fibers; moderately acid; clear smooth boundary.

Oe2—14 to 40 inches; mucky peat, dark reddish brown (5YR 3/2) broken face and rubbed; about 70 percent fiber unrubbed, about 30 percent rubbed; massive; primarily herbaceous fibers; moderately acid; clear smooth boundary.

Oe3—40 to 60 inches; mucky peat, dark reddish brown (5YR 3/2) broken face and rubbed; about 65 percent fiber unrubbed, about 25 percent rubbed;

massive; primarily herbaceous fibers; moderately acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Content of wood fragments: 0 to 15 percent

Surface tier:

Hue—5YR, 7.5YR, or 10YR

Value—2 to 6

Chroma—1 to 4

Texture—mucky peat

Subsurface and bottom tiers:

Hue—5YR, 7.5YR, or 10YR

Value—2 to 5

Chroma—2 to 5

Texture—mucky peat

541—Rifle mucky peat

Composition

Rifle and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines and outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky peat

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 31.8 inches

Organic matter content: 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
- Smiley and similar soils
- Egglake and similar soils
- Forada and similar soils
- Epoufette and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

Rockwell Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderate to rapid; lower part—moderate or moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits and till

Slope range: 0 to 1 percent

Taxonomic class: Coarse-loamy, frigid Typic Calciaquolls

Typical Pedon

Rockwell loam, 180 feet east and 1,100 feet north of the southwest corner of sec. 34, T. 142 N., R. 43 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; strongly effervescent; slightly alkaline; clear smooth boundary.

Ak—12 to 18 inches; very dark gray (N 3/0) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; violently effervescent with lime disseminated throughout; slightly alkaline; clear smooth boundary.

Bkg—18 to 25 inches; light brownish gray (2.5Y 6/2) fine sandy loam; weak very fine subangular blocky structure; very friable; common fine distinct light yellowish brown (2.5Y 6/4) and olive yellow (2.5Y 5/6) iron concentrations; violently effervescent with lime disseminated throughout; moderately alkaline; clear smooth boundary.

2Cg1—25 to 32 inches; grayish brown (2.5Y 5/2) loamy fine sand; single grain; common medium distinct yellowish brown (10YR 5/6 and 5/8) iron concentrations; loose; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

3Cg2—32 to 60 inches; light brownish gray (2.5Y 6/2) loam; massive; friable; common fine prominent yellowish brown (10YR 5/8) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 18 inches

Thickness of the lacustrine sediments: 20 to 40 inches

Carbonates: Occurring throughout the profile

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—loam
 Content of rock fragments—none

Bkg horizon:

Hue—2.5Y, 5Y, or neutral
 Value—4 to 6
 Chroma—0 to 2
 Texture—sandy loam, fine sandy loam, loam, or loamy sand
 Content of rock fragments—none

2Cg horizon:

Hue—2.5Y or 5Y
 Value—5 or 6
 Chroma—1 to 3
 Texture—sand, fine sand, loamy sand, or loamy fine sand
 Content of rock fragments—none

3Cg horizon:

Hue—2.5Y or 5Y
 Value—5 or 6
 Chroma—1 or 2
 Texture—loam or clay loam
 Content of rock fragments—1 to 8 percent

63—Rockwell loam**Composition**

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

Setting

Landform: Flats and swales on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits and till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: 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

- Wolverton and similar soils
- Hamerly and similar soils
- Wyndmere and similar soils
- Quam 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

Rockwood Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderate; next part—moderately slow; lower part—very slow
Landform: Drumlins
Parent material: Till
Slope range: 2 to 20 percent
Taxonomic class: Coarse-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Rockwood sandy loam, 2 to 6 percent slopes, stony, 700 feet south and 1,700 feet west of the northeast corner of sec. 15, T. 138 N., R. 36 W.

- A—0 to 4 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; about 10 percent gravel; slightly acid; clear smooth boundary.
- E—4 to 14 inches; brown (10YR 5/3) sandy loam, light gray (10YR 7/2) dry; weak medium platy structure; friable; about 8 percent gravel; slightly acid; clear wavy boundary.
- B/E—14 to 19 inches; 60 percent dark yellowish brown (10YR 4/4) sandy clay loam (Bt) and 40 percent brown (10YR 5/3) sandy loam (E); weak medium subangular blocky structure; friable; few thin clay films on faces of peds and in pores; about 8 percent gravel; slightly acid; clear smooth boundary.
- Bt—19 to 30 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; many thick dark brown (10YR 3/3) clay films on faces of peds and in pores; about 6 percent gravel; slightly acid; clear smooth boundary.
- BC—30 to 45 inches; light yellowish brown (10YR 6/4) sandy loam; weak thin platy soil aggregates; friable;

many light gray (10YR 7/2) filaments and threads of segregated lime; about 6 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cd—45 to 60 inches; light yellowish brown (10YR 6/4) sandy loam; weak thin platy soil aggregates; firm; few light gray (10YR 7/2) filaments and threads of segregated lime; about 6 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches

Content of rock fragments: 2 to 15 percent

Depth to dense till: 40 to 60 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam or loamy sand

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam or sandy clay loam

Cd horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—sandy loam

1319B—Rockwood sandy loam, 2 to 6 percent slopes, stony

Composition

Rockwood and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drumlins

Position on the landform: Back slopes and shoulders

Slope range: 2 to 6 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.7 inches

Organic matter content: 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

- Blowers and similar soils
- Paddock and similar soils
- Runeberg and similar soils
- Cathro 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

1319C—Rockwood sandy loam, 6 to 12 percent slopes, stony

Composition

Rockwood and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drumlins

Position on the landform: Back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.9 inches

Organic matter content: 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

- Blowers and similar soils
- Paddock and similar soils
- Runeberg and similar soils
- Cathro 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

1319D—Rockwood sandy loam, 12 to 20 percent slopes, stony**Composition**

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

Setting

Landform: Drumlins

Position on the landform: Back slopes and shoulders

Slope range: 12 to 20 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.9 inches

Organic matter content: 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

- Blowers and similar soils
- Paddock and similar soils
- Runeberg and similar soils
- Cathro 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

Rosy Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed Glossaquic Eutroboralfs

Typical Pedon

Rosy sandy loam, 1,700 feet south and 900 feet east of the northwest corner of sec. 34, T. 138 N., R. 36 W.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; about 1 percent gravel; moderately acid; abrupt smooth boundary.
- E—9 to 18 inches; brown (10YR 5/3) loamy fine sand, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; very friable; about 1 percent gravel; slightly acid; clear smooth boundary.
- B/E—18 to 20 inches; about 60 percent brown (10YR 5/3) loamy fine sand (E) and about 40 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); weak fine subangular blocky structure; very friable; about 1 percent gravel; slightly acid; clear smooth boundary.
- Bt—20 to 26 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; friable; few fine distinct light brownish gray (10YR 6/2) iron depletions and few medium distinct yellowish brown (10YR 5/6) iron concentrations; few thin dark brown (10YR 3/3) clay films on faces of peds and in pores; about 1 percent gravel; slightly acid; clear smooth boundary.
- 2E and Bt—26 to 37 inches; yellowish brown (10YR 5/4) loamy fine sand (E) and dark yellowish brown (10YR 4/4) fine sandy loam (Bt); weak and moderate subangular blocky structure; very friable (E) and friable (Bt); few fine distinct light brownish gray (10YR 6/2) iron depletions and few medium distinct yellowish brown (10YR 5/6) iron concentrations; common thin clay coatings on sand grains and clay bridging between sand grains;

slightly acid; clear smooth boundary.

2C—37 to 60 inches; light olive brown (2.5Y 5/4) loamy fine sand; massive; very friable; few fine distinct light brownish gray (2.5Y 6/2) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; slightly acid.

Range in Characteristics

Depth to carbonates: 29 to 60 inches

Content of rock fragments: 0 to 3 percent gravel

Ap or A horizon:

Hue—10YR

Value—2 or 3; 3 to 5 in the Ap horizon

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 or 2

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

Bt horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—2 to 4

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

2E and Bt horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—loamy fine sand and fine sandy loam

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—2 to 4

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

624—Rosy sandy loam

Composition

Rosy and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches

Organic matter content: 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

- Balmlake and similar soils
- Dalbo and similar soils
- Hillview and similar soils
- Cathro 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

Runeberg Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate or moderately slow; lower part—slow or moderately slow

Landform: Drumlins

Parent material: Till

Slope range: 0 to 1 percent

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

Typical Pedon

Runeberg mucky loam, depressional, 2,790 feet north and 2,380 feet west of the southeast corner of sec. 13, T. 137 N., R. 36 W., in Otter Tail County, Minnesota:

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

Bg1—10 to 14 inches; dark gray (10YR 4/1) loam; weak medium subangular blocky structure; friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations; about 1 percent gravel; neutral; clear smooth boundary.

Bg2—14 to 21 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; firm; common medium prominent brown (7.5YR 5/4) and strong brown (7.5YR 5/6) iron concentrations; about 1 percent gravel; neutral; clear smooth boundary.

Bg3—21 to 36 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; firm; common coarse prominent strong brown (7.5YR 5/6) iron concentrations; about 1 percent gravel; slightly alkaline; clear smooth boundary.

Cg1—36 to 48 inches; light brownish gray (2.5Y 6/2) sandy loam; massive; firm; few medium prominent strong brown (7.5YR 5/6) iron concentrations; about 1 percent gravel; few white (10YR 8/2) carbonate concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2—48 to 60 inches; light olive gray (5Y 6/2) sandy loam; massive; firm; few fine prominent yellowish brown (10YR 5/6) iron concentrations; about 2 percent gravel; few white (10YR 8/2) carbonate concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 36 inches

Thickness of the mollic epipedon: 8 to 15 inches

Content of rock fragments: 3 to 15 percent

A or Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—mucky loam

Bg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or loam

Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—5 or 6

Chroma—1 to 3

Texture—sandy loam

701—Runeberg mucky loam, depressional

Composition

Runeberg and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions between drumlins

Slope range: 0 to 1 percent

Component Description

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 8.3 inches

Organic matter content: 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

- Paddock and similar soils
- Hamre and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

Rushlake 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 class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Rushlake loamy sand, in an area of Rushlake and Hangaard soils, lake beaches, 1,800 feet west and 1,500 feet south of the northeast corner of sec. 8, T. 138 N., R. 41 W.

A—0 to 7 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; about 2 percent gravel; neutral; clear smooth boundary.

BC—7 to 19 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; common carbonate coatings on the underside of pebbles; about 15 percent gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

C—19 to 60 inches; light brownish gray (10YR 6/2) gravelly coarse sand; single grain; loose; few

carbonate coatings on the underside of pebbles; about 20 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand

Content of rock fragments—0 to 15 percent gravel

BC or Bw horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—2 to 8

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

Content of rock fragments—10 to 35 percent gravel

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

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

Content of rock fragments—10 to 35 percent gravel

1138—Rushlake and Hangaard soils, lake beaches

Composition

Rushlake: Variable

Hangaard: Variable

Inclusions: About 10 percent

Setting

Landform: Beach ridges

Slope range: Rushlake—0 to 3 percent; Hangaard—0 to 2 percent

Component Description

Rushlake

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Beach deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Moderate

Hangaard

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Beach deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 3.0 inches

Organic matter content: 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

- Corliss and similar soils
- Abbeylake and similar soils
- Two Inlets and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Sandberg Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Upper part—moderately rapid; lower part—very rapid

Landform: Moraines, outwash plains, and valley trains

Parent material: Glacial outwash

Slope range: 2 to 20 percent

Taxonomic class: Sandy, mixed Udorthentic Haploborolls

Typical Pedon

Sandberg coarse sandy loam (fig. 1-13), in an area of Arvilla-Sandberg complex, 2 to 6 percent slopes, 700 feet west and 1,300 feet south of the northeast corner of sec. 29, T. 138 N., R. 43 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) coarse sandy loam, very dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 5 percent gravel; neutral; abrupt smooth boundary.
Bw—8 to 15 inches; dark brown (10YR 3/3) gravelly

loamy coarse sand; weak fine subangular blocky structure; very friable; about 15 percent gravel; neutral; clear smooth boundary.

Bk—15 to 36 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; few carbonate coatings on the underside of pebbles; about 25 percent gravel; slightly effervescent; slightly alkaline; gradual smooth boundary.

C—36 to 60 inches; pale brown (10YR 6/3) gravelly coarse sand; single grain; loose; about 25 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

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—coarse sandy loam

Content of rock fragments—3 to 25 percent gravel

Bw horizon (if it occurs):

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 or 4

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

Content of rock fragments—5 to 35 percent gravel

Bk and C horizons:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—2 to 6

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

Content of rock fragments—5 to 35 percent gravel

1242D—Sandberg-Arvilla complex, 12 to 20 percent slopes

Composition

Sandberg and similar soils: About 65 percent

Arvilla and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 12 to 20 percent

Component Description

Sandberg

Surface layer texture: Coarse sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.1 inches

Organic matter content: Moderate

Arvilla

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: 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

- Corliss and similar soils
- Fordville and similar soils
- Darnen and similar soils
- Osakis and similar soils
- Forada 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

Sedgeville Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate; lower part—rapid

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, frigid
Fluvaquentic Endoaquolls

Typical Pedon

Sedgeville loam, frequently flooded, 1,300 feet east and

200 feet south of the northwest corner of sec. 3, T. 138 N., R. 38 W.

A—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; about 1 percent gravel; neutral; clear wavy boundary.

Cg1—8 to 17 inches; grayish brown (2.5Y 5/2) sandy loam; moderate medium subangular blocky soil aggregates; very friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations; about 5 percent gravel; neutral; clear wavy boundary.

Cg2—17 to 34 inches; grayish brown (2.5Y 5/2) coarse sandy loam; weak fine subangular blocky soil aggregates; very friable; few fine prominent strong brown (7.5YR 5/6) iron concentrations; about 10 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

Cg3—34 to 60 inches; grayish brown (2.5Y 5/2) gravelly loamy coarse sand; single grain; loose; few thin strata of dark grayish brown (2.5Y 4/2) sandy loam, sandy clay loam, and silt loam; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Content of rock fragments: 0 to 60 percent gravel

Depth to sandy alluvium: 24 to 40 inches

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—loam

Cg horizon (loamy part):

Hue—7.5YR, 10YR, 2.5Y, 5Y, or neutral

Value—2 to 6

Chroma—0 to 4

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

Cg horizon (sandy part):

Hue—7.5YR, 10YR, 2.5Y, 5Y, or neutral

Value—4 to 6

Chroma—0 to 4

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

1291—Sedgeville loam, frequently flooded

Composition

Sedgeville and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats on flood plains

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

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

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: 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

- Lamoure and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

Seelyeville Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow to moderately rapid

Landform: Moraines, outwash plains, and seeps

Parent material: Organic materials

Slope range: 0 to 10 percent

Taxonomic class: Euic Typic Borosapristis

Typical Pedon

Seelyeville muck, 250 feet east and 2,600 feet south of the northwest corner of sec. 18, T. 139 N., R. 40 W.

Oa1—0 to 24 inches; muck, very dark grayish brown (10YR 3/2) broken face and rubbed; about 30 percent fiber, about 3 percent rubbed; very friable; primarily herbaceous fibers; neutral; gradual smooth boundary.

Oa2—24 to 48 inches; muck, very dark gray (10YR 3/1) broken face and rubbed; about 35 percent fiber, about 2 percent rubbed; very friable; primarily herbaceous fibers; neutral; clear smooth boundary.

Oa3—48 to 60 inches; muck, very dark gray (10YR 3/1)

broken face and rubbed; about 30 percent fiber, about 1 percent rubbed; very friable; primarily herbaceous fibers; neutral.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Fiber content: Less than 35 percent unrubbed; less than 16 percent rubbed

Thickness of hemic material in the subsurface and bottom tiers: Less than 10 inches

Oap, Ap, or A horizon:

Hue—7.5YR or 10YR

Value—2 or 3

Chroma—1 or 2

Texture—muck

Oe horizon (if it occurs):

Hue—10YR

Value—2 or 3

Chroma—2 or 3

Texture—mucky peat

540—Seelyeville muck

Composition

Seelyeville and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines and outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: 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

- Vallery and similar soils
- Winger and similar soils
- Smiley and similar soils
- Egglake and similar soils

- Epoufette and similar soils
- Forada and similar soils

Major Uses of the Unit

- Forest land

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

- Forest Land section

1825B—Seelyeville muck, seep land, 1 to 10 percent slopes

Composition

Seelyeville and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Seeps (sidehill seeps)

Slope range: 1 to 10 percent

Component Description

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

Seasonal high water table: At the surface to 2 feet below the surface

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: 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

- Vallery and similar soils
- Egglake and similar soils
- Forada and similar soils
- Epoufette 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

Smiley Series

Depth class: Very deep

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

Typical Pedon

Smiley loam, 50 feet east and 400 feet north of the southwest corner of sec. 11, T. 138 N., R. 43 W.

A—0 to 13 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; about 2 percent gravel; neutral; clear smooth boundary.

Btg1—13 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay loam; moderate medium subangular blocky structure; friable; common fine distinct yellowish brown (10YR 5/6) iron concentrations; many thick very dark gray (10YR 3/1) clay films on faces of peds and in pores; about 3 percent gravel; neutral; clear smooth boundary.

Btg2—18 to 26 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium subangular blocky structure; friable; common fine distinct yellowish brown (10YR 5/6) iron concentrations; common thick very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 3 percent gravel; neutral; clear smooth boundary.

Bkg—26 to 47 inches; light brownish gray (2.5Y 5/2) loam; weak fine subangular blocky structure; friable; common coarse distinct light olive brown (2.5Y 5/4) and common medium distinct yellowish brown (10YR 5/6) iron concentrations; many white (10YR 8/1) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cg—47 to 60 inches; light brownish gray (2.5Y 6/2) loam; massive; friable; common medium distinct light olive brown (2.5Y 5/4) and common fine faint (10YR 5/6) iron concentrations; few white (10YR 8/1) filaments and threads of segregated lime; about 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

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

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

Bkg horizon:
 Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam or clay loam

Cg horizon:
 Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam or clay loam

765—Smiley loam

Composition

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

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: 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

- Gonvick and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Hamre and similar soils
- Cathro 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

Snellman Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate or moderately rapid; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 35 percent

Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Snellman sandy loam, 2 to 8 percent slopes (fig. I-14), 600 feet east and 1,300 feet north of the southwest corner of sec. 6, T. 139 N., R. 37 W.

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

E1—2 to 8 inches; brown (10YR 5/3) loamy sand, light gray (10YR 7/2) dry; weak thin platy structure; very friable; about 3 percent gravel; moderately acid; clear smooth boundary.

E2—8 to 16 inches; pale brown (10YR 6/3) loamy sand, white (10YR 8/1) dry; weak thin platy structure; very friable; about 3 percent gravel; moderately acid; clear wavy boundary.

Bt1—16 to 18 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; many thin light yellowish brown (10YR 6/4) sand and silt coatings on faces of peds and in pores; about 4 percent gravel; strongly acid; clear wavy boundary.

Bt2—18 to 31 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate coarse subangular blocky structure; friable; many thick very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 4 percent gravel; moderately acid; clear smooth boundary.

Bk—31 to 41 inches; light olive brown (2.5Y 5/4) sandy loam; moderate medium platy structure; friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—41 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; massive; friable; few light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Content of rock fragments: 2 to 15 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

E horizon:

Hue—10YR

Value—5 or 6

Chroma—3 or 4

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

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—sandy clay loam, loam, or sandy loam

Bk and C horizons:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or loam

267B—Snellman sandy loam, 2 to 8 percent slopes

Composition

Snellman and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: 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

- Nebish and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Cathro 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

267C—Snellman sandy loam, 8 to 15 percent slopes**Composition**

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Nebish and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Cathro 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

267E—Snellman sandy loam, 15 to 30 percent slopes**Composition**

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: 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

- Nebish and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Cathro 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

776B—Snellman-Sugarbush complex, 2 to 8 percent slopes**Composition**

Snellman and similar soils: About 60 percent
 Sugarbush and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 2 to 8 percent

Component Description**Snellman**

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.8 inches
Organic matter content: Moderate

Sugarbush

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.6 inches
Organic matter content: 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

- Eagleview and similar soils
- Two Inlets and similar soils
- Balmlake and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake 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

776C—Snellman-Sugarbush complex, 8 to 15 percent slopes**Composition**

Snellman and similar soils: About 60 percent
 Sugarbush and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description**Snellman**

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: Moderate

Sugarbush

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: 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

- Eagleview and similar soils
- Two Inlets and similar soils
- Balmlake and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake 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

776E—Snellman-Sugarbush complex, 15 to 30 percent slopes

Composition

Snellman and similar soils: About 55 percent
Sugarbush and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Snellman

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: Moderate

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.9 inches

Organic matter content: 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

- Eagleview and similar soils
- Two Inlets and similar soils
- Balmlake and similar soils
- Wykeham and similar soils

- Karlstad and similar soils
- Egglake 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

Sol Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate or moderately rapid; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Sol sandy loam, 2 to 8 percent slopes, very stony, 2,350 feet west and 2,000 feet south of the northeast corner of sec. 22, T. 142 N., R. 37 W.

A—0 to 3 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; about 5 percent gravel; neutral; clear smooth boundary.

E—3 to 15 inches; brown (10YR 5/3) loamy sand, light gray (10YR 7/2) dry; weak fine subangular blocky structure; very friable; about 5 percent gravel; neutral; gradual wavy boundary.

E/B—15 to 17 inches; about 60 percent brown (10YR 5/3) loamy sand and 40 percent dark yellowish brown (10YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; about 7 percent gravel; neutral; clear wavy boundary.

Bt—17 to 30 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; many thick dark brown (7.5YR 3/4) clay films on faces of peds and in pores; about 7 percent gravel; slightly acid; clear wavy boundary.

Bk—30 to 42 inches; light olive brown (2.5Y 5/4) sandy loam; weak medium platy structure; very friable; many light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; violently effervescent; slightly alkaline; gradual smooth boundary.

C—42 to 60 inches; light olive brown (2.5Y 5/3) sandy loam; weak medium platy soil aggregates; very friable; few light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 45 inches

Content of rock fragments: 2 to 10 percent

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 or 2

Texture—sandy loam

E horizon:

Hue—10YR

Value—5 or 6

Chroma—2 or 3

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

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—3 to 5

Texture—sandy clay loam or loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 5

Texture—sandy loam or fine sandy loam

1243B—Sol sandy loam, 2 to 8 percent slopes, very stony

Composition

Sol and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: 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

- Wykeham and similar soils
- Egglake and similar soils
- Cathro 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

1243C—Sol sandy loam, 8 to 15 percent slopes, very stony

Composition

Sol and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.3 inches

Organic matter content: 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

- Wykeham and similar soils
- Egglake and similar soils
- Cathro 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

1243E—Sol sandy loam, 15 to 30 percent slopes, very stony**Composition**

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.6 inches

Organic matter content: 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

- Wykeham and similar soils
- Egglake and similar soils
- Cathro 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

1244B—Sol-Sugarbush complex, 2 to 8 percent slopes, very stony**Composition**

Sol and similar soils: About 65 percent
Sugarbush and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: Sol—2 to 8 percent; Sugarbush—1 to 8 percent

Component Description**Sol**

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderate

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: 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

- Two Inlets and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake and similar soils
- Epoufette and similar soils
- Cathro 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

1244C—Sol-Sugarbush complex, 8 to 15 percent slopes, very stony

Composition

Sol and similar soils: About 60 percent
Sugarbush and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Sol

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

Sugarbush

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.5 inches
Organic matter content: 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

- Two Inlets and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake and similar soils
- Epoufette and similar soils
- Cathro 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

1244E—Sol-Sugarbush complex, 15 to 30 percent slopes, very stony

Composition

Sol and similar soils: About 55 percent
Sugarbush and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 15 to 30 percent

Component Description

Sol

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.0 inches
Organic matter content: Moderate

Sugarbush

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.4 inches
Organic matter content: 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

- Two Inlets and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake and similar soils

- Epoufette and similar soils
- Cathro 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

Sugarbush Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid or rapid; next part—moderately rapid; lower part—very rapid

Landform: Moraines, outwash plains, and valley trains

Parent material: Glacial outwash

Slope range: 1 to 35 percent

Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Sugarbush sandy loam (fig. I-15), in an area of Sugarbush-Two Inlets complex, 1 to 8 percent slopes, 1,200 feet west and 1,100 feet south of the northeast corner of sec. 15, T. 142 N., R. 40 W.

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

E—3 to 13 inches; brown (10YR 5/3) loamy sand, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; very friable; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bt—13 to 25 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; many distinct dark brown (7.5YR 4/4) clay films on faces of peds and in pores; about 5 percent gravel; slightly acid; clear smooth boundary.

2C—25 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; few carbonate coatings on the underside of pebbles; about 20 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 10 percent gravel

E horizon:

Hue—10YR

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

2C horizon:

Hue—7.5YR or 10YR

Value—5 or 6

Chroma—3 to 6

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

Content of rock fragments—15 to 35 percent gravel

332B—Sugarbush sandy loam, 1 to 8 percent slopes

Composition

Sugarbush and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 1 to 8 percent

Component Description

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Two Inlets and similar soils

- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

775B—Sugarbush-Two Inlets complex, 1 to 8 percent slopes

Composition

Sugarbush and similar soils: About 55 percent

Two Inlets and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 1 to 8 percent

Component Description

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.4 inches

Organic matter content: Moderately low

Two Inlets

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: 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

- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

775C—Sugarbush-Two Inlets complex, 8 to 15 percent slopes

Composition

Sugarbush and similar soils: About 50 percent

Two Inlets and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.3 inches

Organic matter content: Moderately low

Two Inlets

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: 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

- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1201C—Sugarbush-Snellman complex, 8 to 15 percent slopes

Composition

Sugarbush and similar soils: About 65 percent

Snellman and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.3 inches

Organic matter content: Moderately low

Snellman

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: 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

- Two Inlets and similar soils
- Eagleview and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake and similar soils
- Nidaros 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

1201E—Sugarbush-Snellman complex, 15 to 35 percent slopes

Composition

Sugarbush and similar soils: About 65 percent

Snellman and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 35 percent

Component Description

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.6 inches

Organic matter content: Moderately low

Snellman

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches
Organic matter content: 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

- Two Inlets and similar soils
- Eagleview and similar soils
- Wykeham and similar soils
- Karlstad and similar soils
- Egglake and similar soils
- Nidaros 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

Sverdrup Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Outwash plains and valley trains
Parent material: Glacial outwash
Slope range: 1 to 12 percent
Taxonomic class: Sandy, mixed Udic Haploborolls

Typical Pedon

Sverdrup sandy loam, in an area of Sverdrup-Abbeylake complex, 1 to 6 percent slopes, 2,600 feet north and 1,150 feet east of the southwest corner of sec. 19, T. 138 N., R. 41 W.

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

Bw1—10 to 17 inches; dark yellowish brown (10YR 4/4)

sandy loam; weak medium subangular blocky structure; very friable; about 3 percent gravel; slightly acid; clear smooth boundary.

2Bw2—17 to 25 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; about 4 percent gravel; neutral; clear smooth boundary.

2C—25 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; few carbonate coatings on the underside of pebbles; about 5 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 44 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the loamy mantle: 14 to 24 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 5 percent gravel

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—0 to 5 percent gravel

2Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

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

Content of rock fragments—0 to 10 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—fine sand, sand, or coarse sand

Content of rock fragments—0 to 10 percent gravel

1125B—Sverdrup-Abbeylake complex, 1 to 6 percent slopes

Composition

Sverdrup and similar soils: About 70 percent

Abbeylake and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 1 to 6 percent

Component Description

Sverdrup

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.5 inches

Organic matter content: Moderate

Abbeylake

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Osakis and similar soils
- Forada and similar soils
- The depressional Forada soils 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

1125C—Sverdrup-Abbeylake complex, 6 to 12 percent slopes

Composition

Sverdrup and similar soils: About 50 percent

Abbeylake and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 6 to 12 percent

Component Description

Sverdrup

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.6 inches

Organic matter content: Moderate

Abbeylake

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Osakis and similar soils
- Forada and similar soils
- The depressional Forada soils 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

Sybil Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid or rapid;
lower part—rapid

Landform: Outwash plains and valley trains

Parent material: Glacial outwash

Slope range: 2 to 30 percent

Taxonomic class: Coarse-loamy, mixed Mollic
Eutroboralfs

Typical Pedon

Sybil loamy sand, in an area of Sybil-Eagleview complex, 2 to 8 percent slopes, 3,850 feet north and 1,400 feet west of the southeast corner of sec. 16, T. 135 N., R. 39 W., in Otter Tail County, Minnesota:

Ap—0 to 5 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 5/3) dry; weak fine and medium granular structure; very friable; common fine roots; slightly acid; clear smooth boundary.

E—5 to 10 inches; dark yellowish brown (10YR 4/4) loamy sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few fine roots; neutral; clear smooth boundary.

Bt1—10 to 15 inches; dark brown (7.5YR 4/4) sandy loam; moderate fine and medium subangular blocky structure; friable; few fine roots; common moderately thick dark brown (10YR 3/3) clay films on faces of peds and in pores; common distinct white (10YR 8/2) discontinuous sand coatings on faces of peds; neutral; clear smooth boundary.

Bt2—15 to 23 inches; dark brown (7.5YR 4/4) loamy sand; single grain; loose; few fine roots; common thin dark brown (7.5YR 3/4) clay coatings on sand grains and clay bridging between sand grains; neutral; gradual smooth boundary.

Bt3—23 to 32 inches; dark yellowish brown (10YR 4/4) loamy sand; single grain; loose; common thin dark brown (7.5YR 4/4) clay coatings on sand grains and clay bridging between sand grains; neutral; gradual smooth boundary.

C—32 to 60 inches; brown (10YR 5/4) sand; single grain; loose; about 3 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Content of rock fragments: Less than 10 percent gravel throughout

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

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

Bt horizon (upper part):

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—sandy loam, coarse sandy loam, or fine sandy loam

Bt horizon (lower part):

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy sand, loamy fine sand, or sand

2C horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—5 to 7

Chroma—2 to 6

Texture—sand or coarse sand

1195B—Sybil-Eagleview complex, 2 to 8 percent slopes

Composition

Sybil and similar soils: About 60 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Sybil

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.0 inches

Organic matter content: Moderate

Eagleview

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.6 inches

Organic matter content: 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

- Karlstad and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- Nidaros 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

1195C—Sybil-Eagleview complex, 8 to 15 percent slopes

Composition

Sybil and similar soils: About 60 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Sybil

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.6 inches

Organic matter content: Moderate

Eagleview

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.4 inches

Organic matter content: 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

- Karlstad and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- Nidaros 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

1195E—Sybil-Eagleview complex, 15 to 30 percent slopes

Composition

Sybil and similar soils: About 60 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Sybil

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.4 inches

Organic matter content: Moderate

Eagleview

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches
Organic matter content: 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

- Karlstad and similar soils
- Friendship and similar soils
- Meehan and similar soils
- Epoufette and similar soils
- Nidaros 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

Two Inlets Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Upper part—moderately rapid or rapid;
 lower part—very rapid
Landform: Outwash plains and valley trains
Parent material: Glacial outwash
Slope range: 1 to 30 percent
Taxonomic class: Sandy, mixed Psammentic
 Eutroboralfs

Typical Pedon

Two Inlets coarse sandy loam (fig. I-16), in an area of Two Inlets-Sugarbush complex, 15 to 30 percent slopes, 2,600 feet west and 25 feet south of the northeast corner of sec. 2, T. 141 N., R. 39 W.

A—0 to 2 inches; very dark gray (10YR 3/1) coarse sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; about 10 percent gravel; slightly acid; clear wavy boundary.

E—2 to 10 inches; dark yellowish brown (10YR 4/4)

gravelly loamy coarse sand, brown (10YR 5/3) dry; single grain; loose; about 20 percent gravel; slightly acid; gradual wavy boundary.

Bt—10 to 33 inches; dark brown (7.5YR 4/4) gravelly loamy coarse sand; weak fine granular structure; very friable; about 25 percent gravel; common faint clay coatings on sand grains and clay bridging between sand grains; slightly acid; clear smooth boundary.

C—33 to 60 inches; light yellowish brown (10YR 6/4) gravelly coarse sand; single grain; loose; few carbonate coatings on the underside of pebbles; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—coarse sandy loam

Content of rock fragments—0 to 35 percent gravel

E horizon:

Hue—10YR

Value—3 to 5

Chroma—3 or 4

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

Content of rock fragments—0 to 35 percent gravel

Bt horizon:

Hue—7.5YR or 10YR

Value—3 or 4

Chroma—3 or 4

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

Content of rock fragments—0 to 35 percent gravel

C horizon:

Hue—10YR

Value—4 to 6

Chroma—3 to 6

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

Content of rock fragments—15 to 35 percent gravel

1238E—Two Inlets-Sugarbush complex, 15 to 30 percent slopes

Composition

Two Inlets and similar soils: About 55 percent
 Sugarbush and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Two Inlets

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Low

Sugarbush

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Karlstad and similar soils
- Epoufette and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

1015—Udipsamments, cut and fill land

Composition

Udipsamments and similar soils: About 90 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Slope range: 0 to 10 percent

Component Description

Surface layer texture: Sand

Depth class: Very deep (more than 60 inches)

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Very low

Major Uses of the Unit

- Wildlife habitat

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

- Wildlife Habitat section

1016—Udorthents, loamy, cut and fill land

Composition

Udorthents and similar soils: About 90 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Slope range: 0 to 50 percent

Component Description

Surface layer texture: Variable

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits and till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Organic matter content: Very low

Major Uses of the Unit

- Wildlife habitat

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

- Wildlife Habitat section

1027—Udorthents, wet substratum, fill land

Composition

Udorthents and similar soils: About 90 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Major Uses of the Unit

- Wildlife habitat

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

- Wildlife Habitat section

Urness Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow or moderate

Landform: Moraines and outwash plains

Parent material: Coprogenous earth

Slope range: 0 to 1 percent

Taxonomic class: Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents

Typical Pedon

Urness mucky silt loam, 2,500 feet east and 800 feet south of the northwest corner of sec. 15, T. 140 N., R. 42 W.

Ap—0 to 7 inches; very dark gray (5Y 3/1) mucky silt loam (coprogenous earth); weak fine granular structure; very friable; about 5 percent snail-shell fragments; violently effervescent; moderately alkaline; abrupt smooth boundary.

C1—7 to 21 inches; dark gray (5Y 4/1) mucky silt loam (coprogenous earth); weak fine granular soil aggregates; very friable; about 10 percent snail-shell fragments; violently effervescent; moderately alkaline; gradual smooth boundary.

C2—21 to 34 inches; dark gray (5Y 4/1) mucky silt loam (coprogenous earth); weak fine granular soil aggregates; very friable; about 5 percent snail-shell fragments; violently effervescent; moderately alkaline; clear smooth boundary.

C3—34 to 45 inches; dark gray (5Y 4/1) silty clay loam (coprogenous earth); massive; friable; about 5 percent snail-shell fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.

C4—45 to 60 inches; very dark gray (5Y 3/1) silt loam (coprogenous earth); massive; friable; about 5 percent snail-shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the coprogenous earth sediments: 24 to 80 inches

Content of snail shells: 1 to 15 percent

Carbonates: Occurring throughout the profile

A and C horizons:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 to 4

Chroma—0 to 2

Texture—mucky silt loam

Content of rock fragments—none

2C horizon (if it occurs):

Hue—2.5Y or 5Y

Value—3 to 5

Chroma—1 or 2

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

Content of rock fragments—0 to 8 percent

335—Urness mucky silt loam**Composition**

Urness and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines and outwash plains

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Coprogenous earth

Flooding: None

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

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

Organic matter content: 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

- Rushlake and similar soils
- Hangaard and similar soils
- Vallers and similar soils
- Winger and similar soils
- Haslie 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: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, frigid Typic Calciaquolls

Typical Pedon

Vallers silty clay loam, 2,450 feet east and 300 feet north of the southwest corner of sec. 32, T. 141 N., R. 43 W.

Akp—0 to 9 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; about 2 percent gravel; violently effervescent; slightly alkaline; abrupt smooth boundary.

Ak—9 to 15 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg—15 to 23 inches; grayish brown (2.5Y 5/2) clay loam; weak medium subangular blocky structure; friable; few fine distinct olive yellow (2.5Y 6/6) iron concentrations; about 4 percent gravel; violently effervescent with lime disseminated throughout; slightly alkaline; gradual smooth boundary.

Cg1—23 to 39 inches; light brownish gray (2.5Y 6/2) clay loam; massive; friable; many fine distinct olive yellow (2.5Y 6/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

Cg2—39 to 60 inches; light brownish gray (2.5Y 6/2) clay loam; massive; friable; common medium distinct light olive brown (2.5Y 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 9 to 18 inches

Carbonates: Occurring throughout the profile

Content of rock fragments: 2 to 8 percent

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 to 6

Chroma—0 to 2

Texture—clay loam, silty clay loam, or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 7

Chroma—1 to 3

Texture—loam or clay loam

1317—Vallers silty clay loam

Composition

Vallers and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Rims of depressions and flats on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

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

Organic matter content: 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

- Formdale and similar soils
- Hamerly and similar soils
- Quam and similar soils
- Hamre and similar soils
- Cathro 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

1997—Vallers-Hamerly-Winger complex**Composition**

Vallers and similar soils: About 40 percent
 Hamerly and similar soils: About 30 percent
 Winger and similar soils: About 20 percent
 Inclusions: About 10 percent

Setting

Landform: Vallers—rims of depressions and flats on moraines; Hamerly—flats and rises on moraines; Winger—depressions on moraines
Slope range: Vallers—0 to 2 percent; Hamerly—1 to 3 percent; Winger—0 to 1 percent

Component Description**Vallers**

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 11.0 inches
Organic matter content: High

Hamerly

Surface layer texture: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2 to 4 feet
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches
Organic matter content: High

Winger

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits and till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 12.2 inches
Organic matter content: 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

- Barnes and similar soils
- McIntosh and similar soils
- Winger soils that are not in depressions
- Quam 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

Verndale Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Upper part—moderate or moderately rapid; lower part—rapid
Landform: Outwash plains and valley trains
Parent material: Glacial outwash
Slope range: 0 to 12 percent
Taxonomic class: Coarse-loamy, mixed Udic Argiborolls

Typical Pedon

Verndale sandy loam, 0 to 2 percent slopes, 2,100 feet west and 1,850 feet north of the southeast corner of sec. 21, T. 140 N., R. 36 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; strongly acid; abrupt smooth boundary.
 Bt—8 to 15 inches; dark brown (7.5YR 4/4) sandy loam; moderate fine subangular blocky structure; friable; many thick dark brown (10YR 3/3) clay films on faces of peds and in pores; about 2 percent gravel; moderately acid; clear smooth boundary.
 2Bw—15 to 33 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; about 8 percent gravel; neutral; gradual smooth boundary.
 2C—33 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 4 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 24 to more than 60 inches
Thickness of the mollic epipedon: 7 to 16 inches
Thickness of the loamy mantle: 14 to 22 inches

Ap or A horizon:
 Hue—10YR
 Value—2 or 3

Chroma—1
 Texture—coarse sandy loam
 Content of rock fragments—0 to 8 percent gravel

Bt horizon:

Hue—7.5YR or 10YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—sandy loam, fine sandy loam, or loam
 Content of rock fragments—0 to 8 percent gravel

2Bw horizon:

Hue—7.5YR, 10YR, or 2.5Y
 Value—4 or 5
 Chroma—3 to 6
 Texture—loamy sand, loamy coarse sand, sand, or coarse sand
 Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR or 2.5Y
 Value—4 to 7
 Chroma—2 to 4
 Texture—sand or coarse sand
 Content of rock fragments—0 to 15 percent gravel

567A—Verndale sandy loam, 0 to 2 percent slopes**Composition**

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

Setting

Landform: Flats on outwash plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches
Organic matter content: 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

- Abbeylake and similar soils
- Fordville and similar soils

- Oylen and similar soils
- Forada and similar soils
- Nidaros 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

567B—Verndale sandy loam, 2 to 6 percent slopes**Composition**

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

Setting

Landform: Outwash plains and valley trains
Position on the landform: Back slopes and shoulders
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: 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

- Abbeylake and similar soils
- Fordville and similar soils
- Oylen and similar soils
- Forada and similar soils
- Nidaros 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

1126B—Verndale-Nymore complex, 1 to 6 percent slopes

Composition

Verndale and similar soils: About 50 percent

Nymore and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 1 to 6 percent

Component Description

Verndale

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.1 inches

Organic matter content: Moderate

Nymore

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.4 inches

Organic matter content: 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

- Fordville and similar soils
- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils 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

1131B—Verndale-Abbeylake complex, 1 to 6 percent slopes

Composition

Verndale and similar soils: About 60 percent

Abbeylake and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains and valley trains

Position on the landform: Back slopes and shoulders

Slope range: 1 to 6 percent

Component Description

Verndale

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.8 inches

Organic matter content: Moderate

Abbeylake

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.9 inches

Organic matter content: 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

- Fordville and similar soils

- Darnen and similar soils
- Oylen and similar soils
- Forada and similar soils
- The depressional Forada soils and similar soils
- Nidaros 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

Waukon Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 30 percent

Taxonomic class: Fine-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Waukon loam, 8 to 15 percent slopes, 700 feet east and 400 feet north of the southwest corner of sec. 2, T. 138 N., R. 43 W.

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

E—5 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; about 3 percent gravel; neutral; clear smooth boundary.

Bt—8 to 20 inches; dark brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; friable; many thick very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 3 percent gravel; neutral; clear wavy boundary.

Bk—20 to 32 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; friable; many white (10YR 8/2) filaments and threads of segregated lime; about 5 percent gravel; violently effervescent; slightly alkaline; gradual smooth boundary.

C—32 to 60 inches; light yellowish brown (2.5Y 6/4) loam; massive; friable; few white (10YR 8/2) filaments and threads of segregated lime; about 5

percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 48 inches

Content of rock fragments: 2 to 8 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

E horizon:

Hue—10YR

Value—3 to 5

Chroma—2 or 3

Texture—loam, sandy loam, or fine sandy loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—loam or clay loam

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—loam or clay loam

38B—Waukon loam, 2 to 8 percent slopes

Composition

Waukon and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 2 to 8 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: 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

- Beltrami and similar soils
- Smiley and similar soils
- Quam and similar soils
- Hamre and similar soils
- Cathro 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

38C—Waukon loam, 8 to 15 percent slopes***Composition***

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 8 to 15 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Beltrami and similar soils
- Smiley and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

38E—Waukon loam, 15 to 30 percent slopes***Composition***

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

Setting

Landform: Moraines

Position on the landform: Back slopes and shoulders

Slope range: 15 to 30 percent

Component Description

Surface layer texture: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: 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

- Beltrami and similar soils
- Smiley and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro 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

1104B—Waukon-Dorset complex, 1 to 8 percent slopes

Composition

Waukon and similar soils: About 55 percent
Dorset and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 1 to 8 percent

Component Description

Waukon

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: High

Dorset

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.4 inches
Organic matter content: 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

- Sandberg and similar soils
- Gonvick and similar soils
- Oylen and similar soils
- Smiley and similar soils
- Quam and similar soils
- Cathro 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

1104C—Waukon-Dorset complex, 8 to 15 percent slopes

Composition

Waukon and similar soils: About 55 percent
Dorset and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Back slopes and shoulders
Slope range: 8 to 15 percent

Component Description

Waukon

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches
Organic matter content: High

Dorset

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches
Organic matter content: 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

- Sandberg and similar soils
- Gonvick and similar soils
- Oylen and similar soils
- Smiley and similar soils
- Quam and similar soils
- Cathro 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

Winger Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderate; lower part—moderate or moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits and till

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, frigid Typic Calciaquolls

Typical Pedon

Winger silty clay loam, 200 feet south and 1,500 feet west of the northeast corner of sec. 23, T. 141 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) silt clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Ak—10 to 15 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; strongly effervescent with lime disseminated throughout; slightly alkaline; clear smooth boundary.

Bkg—15 to 37 inches; light brownish gray (2.5Y 6/2) silt loam; weak fine subangular blocky structure; friable; common medium distinct light olive brown (2.5Y 5/4) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; violently effervescent; moderately alkaline; clear smooth boundary.

2Cg—37 to 60 inches; pale olive (5Y 6/3) clay loam; massive; friable; common medium prominent light gray (10YR 6/1) iron depletions and yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: Occurring throughout the profile

Thickness of the mollic epipedon: 8 to 24 inches

Depth to till: 24 to 40 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—silt loam or silty clay loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—silt loam or silty clay loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—loam or clay loam

Content of rock fragments—2 to 10 percent

398—Winger silty clay loam, depressional

Composition

Winger and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits and till

Flooding: None

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

Available water capacity to 60 inches or root-limiting layer: About 12.3 inches

Organic matter content: 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

- McIntosh and similar soils
- Vallers and similar soils

- Rockwell and similar soils
- Hamre and similar soils
- Cathro 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

786—Winger-Hamerly-Colvin complex

Composition

Winger and similar soils: About 45 percent
 Hamerly and similar soils: About 25 percent
 Colvin and similar soils: About 20 percent
 Inclusions: About 10 percent

Setting

Landform: Winger—rims of depressions and flats on moraines; Hamerly—flats and rises on moraines; Colvin—depressions on moraines

Slope range: Winger—0 to 2 percent; Hamerly—1 to 3 percent; Colvin—0 to 1 percent

Component Description

Winger

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits and till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

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

Organic matter content: High

Hamerly

Surface layer texture: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1.5 to 3.5 feet

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

Organic matter content: High

Colvin

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

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

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

Organic matter content: 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

- Barnes and similar soils
- McIntosh and similar soils
- Hamre and similar soils
- Quam 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

1246—Winger silty clay loam

Composition

Winger and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on moraines

Position on the landform: Toe slopes

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits and till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 12.3 inches

Organic matter content: 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

- Hamerly and similar soils
- McIntosh and similar soils
- Colvin and similar soils
- Vallerys and similar soils
- The depressional Colvin soils 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

Wolverton Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid or rapid;
lower part—moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits and till

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, frigid Aquic
Calciborolls

Typical Pedon

Wolverton fine sandy loam, 2,200 feet north and 300 feet west of the southeast corner of sec. 22, T. 142 N., R. 42 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; moderate fine granular structure parting to weak very fine subangular blocky; very friable; about 1 percent gravel; strongly effervescent with lime disseminated throughout; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 12 inches; light olive brown (2.5Y 5/3) fine sandy loam; weak very fine subangular blocky structure; very friable; about 1 percent gravel; violently effervescent with lime disseminated throughout; moderately alkaline; gradual smooth boundary.

Bk2—12 to 41 inches; light olive brown (2.5Y 5/4) fine sandy loam; moderate medium granular structure; very friable; few fine distinct yellowish brown (10YR 5/6) iron concentrations and common medium faint light brownish gray (2.5Y 6/2) iron depletions; about 1 percent gravel; violently effervescent with lime

disseminated throughout; moderately alkaline; abrupt wavy boundary.

2C—41 to 60 inches; light olive brown (2.5Y 5/3) clay loam; moderate fine subangular blocky soil aggregates; very friable; many coarse prominent dark yellowish brown (10YR 4/6) iron concentrations and common medium faint light brownish gray (2.5Y 6/2) iron depletions; few light gray (10YR 7/2) filaments and threads of segregated lime; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: Occurring throughout the profile

Thickness of the mollic epipedon: 7 to 16 inches

Depth to till: 20 to 50 inches

Content of rock fragments: Typically none in the glacial lacustrine sediments; 1 to 10 percent in the till sediments

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—1 to 4

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

2C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—1 to 4

Texture—clay loam or loam

1130—Wolverton fine sandy loam

Composition

Wolverton and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits and till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.6 inches

Organic matter content: 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

- Egeland and similar soils
- Hamerly and similar soils
- Rockwell and similar soils
- The depressional Winger soils 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

Wykeham Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate or moderately rapid; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Wykeham fine sandy loam, 1,300 feet north and 1,800 feet east of the southwest corner of sec. 33, T. 138 N., R. 38 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; about 4 percent gravel; moderately acid; abrupt smooth boundary.

E/B—8 to 11 inches; about 90 percent grayish brown (10YR 5/2) sandy loam (E) and 10 percent dark brown (10YR 4/3) sandy loam (Bt); very pale brown (10YR 4/6) dry; weak medium platy structure; friable; about 4 percent gravel; slightly acid; clear smooth boundary.

Bt—11 to 21 inches; dark brown (10YR 4/3) sandy clay loam; weak medium subangular blocky structure;

friable; common fine distinct dark yellowish brown (10YR 4/6) iron concentrations and few fine distinct grayish brown (2.5Y 4/2) iron depletions; many thin dark brown (10YR 3/3) clay films on faces of peds and in pores; about 5 percent gravel; neutral; clear smooth boundary.

Bk—21 to 33 inches; grayish brown (2.5Y 6/2) sandy loam; moderate medium platy structure; friable; common medium distinct light yellowish brown (2.5Y 6/4) and yellowish brown (10YR 5/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—33 to 60 inches; grayish brown (2.5Y 5/2) sandy loam; moderate medium platy soil aggregates; friable; common medium distinct light yellowish brown (2.5Y 6/4) and common coarse distinct yellowish brown (10YR 5/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; about 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches

Content of rock fragments: 2 to 12 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

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

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 8

Texture—sandy clay loam, loam, or sandy loam

Bk and C horizons:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam or fine sandy loam

121—Wykeham fine sandy loam

Composition

Wykeham and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: 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

- Snellman and similar soils
- Egglake and similar soils
- Cathro 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

1225—Wykeham-Karlstad complex**Composition**

Wykeham and similar soils: About 60 percent

Karlstad and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Wykeham—flats and rises on moraines;

Karlstad—flats and slight rises on outwash plains

Slope range: 1 to 3 percent

Component Description**Wykeham**

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.6 inches

Organic matter content: High

Karlstad

Surface layer texture: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 inches

Organic matter content: 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

- Two Inlets and similar soils
- Snellman and similar soils
- Friendship and similar soils
- Egglake and similar soils
- Epoufette and similar soils
- Cathro 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

Wyndmere Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Moderately rapid

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic class: Coarse-loamy, frigid Aeric Calciaquolls

Typical Pedon

Wyndmere fine sandy loam, 2,200 feet east and 300

feet north of the southwest corner of sec. 6, T. 141 N., R. 41 W.

- Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- A—9 to 14 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; slightly effervescent; moderately alkaline; clear smooth boundary.
- Bk—14 to 24 inches; pale brown (10YR 6/3) fine sandy loam; weak fine subangular blocky structure; friable; violently effervescent with lime disseminated throughout; moderately alkaline; gradual smooth boundary.
- C1—24 to 33 inches; light yellowish brown (2.5Y 5/4) fine sandy loam; massive; friable; strongly effervescent with lime disseminated throughout; moderately alkaline; gradual smooth boundary.
- C2—33 to 53 inches; light yellowish brown (2.5Y 6/4) loamy fine sand; massive; very friable; common medium faint light brownish gray (2.5Y 6/2) iron depletions and olive yellow (2.5Y 6/6) iron concentrations; many light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline; clear smooth boundary.
- C3—53 to 60 inches; light olive brown (2.5Y 5/4) silt loam; massive; friable; common medium distinct light brownish gray (2.5Y 6/2) iron depletions and olive yellow (2.5Y 6/6) iron concentrations; few light gray (10YR 7/2) filaments and threads of segregated lime; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Carbonates: Occurring throughout the profile

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—1 to 4

Texture—fine sandy loam or sandy loam

C horizon:

Hue—10YR, 2.5Y or 5Y

Value—4 to 7

Chroma—2 to 4

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

508—Wyndmere fine sandy loam

Composition

Wyndmere and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 0 to 3 percent

Component Description

Surface layer texture: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 1.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 7.6 inches

Organic matter content: 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

- Egeland and similar soils
- Hamerly and similar soils
- Rockwell and similar soils
- The depressional Winger soils 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

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

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	more than 9

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of

many hill slopes. Back slopes in profile are commonly steep and linear and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

Basal till. Compact till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

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.
- California bearing ratio (CBR).** The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.
- 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.
- Catsteps.** Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.
- Channery soil.** A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.
- Chemical treatment.** Control of unwanted vegetation through the use of chemicals.
- Chiseling.** Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- 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.
- 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 plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.
- Coarse textured soil.** Sand or loamy sand.
- Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.
- Cobbly soil material.** Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.
- Colluvium.** Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.
- Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.
- Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.
- Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.
- Conservation cropping system.** Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.
- Conservation tillage.** Any tillage and planting system in which a cover of crop residue is maintained on at

least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where wind erosion is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

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 periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions.

Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under

natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these. *Very poorly drained*.—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

- Drainage, surface.** Runoff, or surface flow of water, from an area.
- Drumlin.** A low, smooth, elongated oval hill, mound, or ridge of compact till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.
- 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 soil material.** 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. The term is more often applied to cliffs resulting from differential erosion.
- Esker.** A long, narrow, sinuous, steep-sided ridge composed of irregularly stratified sand and gravel that were deposited by a subsurface stream flowing between ice walls or through ice tunnels of a retreating glacier and that were left behind when the ice melted. Eskers range from less than 1 mile to more than 100 miles in length and from 10 to 100 feet in height.
- 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 oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.
- Fine textured soil.** Sandy clay, silty clay, or clay.
- Firebreak.** An 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 fire fighters and equipment. Designated roads also serve as firebreaks.
- First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.
- Flaggy soil material.** Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.
- Flagstone.** A thin fragment of sandstone, limestone,

slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

- Flood plain.** A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.
- Foot slope.** The geomorphic component that forms the inner, gently inclined surface at the base of a hill slope. The surface is dominantly concave. In terms of gradational processes, a foot slope is a transition zone between an upslope site of erosion (back slope) and a downslope site of deposition (toe slope).
- Forb.** Any herbaceous plant not a grass or a sedge.
- 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.
- Fragipan.** A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.
- Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.
- Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.
- Glacial drift.** 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.

- Graded stripcropping.** Growing crops in strips that grade toward a protected waterway.
- Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.
- Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.
- Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.
- Green manure crop** (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.
- Ground water.** Water filling all the unblocked pores of underlying material below the water table.
- Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.
- Hard bedrock.** Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.
- 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.** Zones having chroma of 3 or more. Typical color in areas of iron concentrations.
- High-residue crops.** Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.
- Hill.** A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.
- Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter

represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly

impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	.....	very low
0.2 to 0.4	.....	low
0.4 to 0.75	.....	moderately low
0.75 to 1.25	.....	moderate
1.25 to 1.75	.....	moderately high
1.75 to 2.5	.....	high
More than 2.5	.....	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay

content similar to that of the adjacent matrix. A type of redoximorphic depletion.

- Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are:
- Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
- Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
- Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
- Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
- Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
- Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
- Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
- Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
- Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.
- Kame.** A moundlike hill of glacial drift, composed chiefly of stratified sand and gravel.
- Karst** (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.
- 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.
- Landslide.** The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.
- Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.
- Leaching.** The removal of soluble material from soil or other material by percolating water.
- Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

- Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.
- Loess.** Fine grained material, dominantly of silt-sized particles, deposited by the wind.
- Low-chroma zones.** Zones having chroma of 2 or less. Typical color in areas of iron depletions.
- Low-residue crops.** Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.
- Low strength.** The soil is not strong enough to support loads.
- Marl.** An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.
- Masses.** Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.
- Mechanical treatment.** Use of mechanical equipment for seeding, brush management, and other management practices.
- Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.
- Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.
- Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.
- Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.
- Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.
- Moderately coarse textured soil.** Coarse sandy loam, sandy loam, or fine sandy loam.
- Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.
- Mollic epipedon.** A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.
- Moraine.** An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. An extensive area of glaciofluvial material that was deposited by meltwater streams.

Parent material. The unconsolidated organic and mineral material in which soil forms.

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.

Pediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

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.

Percolates slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile.

Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

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. Burning an area under conditions of weather and soil moisture and at the time of day that will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	less than 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic

concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the 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.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk

- density, and the lowest water content at saturation of all organic soil material.
- Saprolite.** Unconsolidated residual material underlying the soil and grading to hard bedrock below.
- Saturation.** Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.
- Scarification.** The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.
- Second bottom.** The first terrace above the normal flood plain (or first bottom) of a river.
- Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.
- Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.
- Sequum.** A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)
- Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.
- Shale.** Sedimentary rock formed by the hardening of a clay deposit.
- Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.
- Shrink-swell** (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.
- Silica.** A combination of silicon and oxygen. The mineral form is called quartz.
- Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.
- Siltstone.** Sedimentary rock made up of dominantly silt-sized particles.
- 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.
- Sinkhole.** A depression in the landscape where limestone has been dissolved.
- Site index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.
- 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.
- Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.
- Sloughed till.** Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.
- Slow intake** (in tables). The slow movement of water into the soil.
- Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.
- Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.
- Soft bedrock.** Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.
- Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.
- Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:
- | | |
|----------------------------|--------------|
| Very coarse sand | 2.0 to 1.0 |
| Coarse sand | 1.0 to 0.5 |
| Medium sand | 0.5 to 0.25 |
| Fine sand | 0.25 to 0.10 |

Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

- Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.
- Stone line.** A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.
- Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.
- Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.
- Stripcropping.** Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.
- Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).
- Stubble mulch.** Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.
- Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.
- Subsoiling.** Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.
- Substratum.** The part of the soil below the solum.
- Subsurface layer.** Any surface soil horizon (A, E, AB, or EB) below the surface layer.
- 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.
- Terminal moraine.** A belt of thick glacial drift that generally marks the termination of important glacial advances. It commonly is a massive, arcuate ridge or complex of ridges underlain by till and other types of drift.
- Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.
- Terrace (geologic).** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.
- Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."
- Thin layer (in tables).** Otherwise suitable soil material too thin for the specified use.
- Till.** Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
- Till plain.** An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.
- Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.
- Toe slope.** The outermost inclined surface at the base of a hill. Toe slopes are commonly gentle and linear in profile.
- Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.
- Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.
- Upland (geology).** Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.
- Valley fill.** In glaciated regions, material deposited in

stream valleys by glacial meltwater. In nonglaciaded regions, alluvium deposited by heavily loaded streams.

Variation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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