



United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Aitkin 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**, 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** can be useful in planning the use and management of small areas.

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

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **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 **Contents** in Part II shows which table has data on a specific land use for each detailed soil map unit. See the **Contents** in Part I and Part II for other sections of this publication that may address your specific needs.

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

Major fieldwork for this soil survey was completed in 1993. Soil names and descriptions were approved in 1996. 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, the Minnesota Agricultural Experiment Station, the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey is part of the technical assistance furnished to the Aitkin Soil and Water Conservation District. Partial funding was provided by the Legislative Commission on Minnesota Resources and by Aitkin County.

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 the Cushing-Mahtomedi general soil map unit. This unit is on rolling moraines and outwash plains and is characterized by scattered wetlands. Forest land is one of the major uses.

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

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Foreword

This soil survey contains information that affects land use planning in this survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, 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.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

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 or the Cooperative Extension Service.

William Hunt
State Conservationist
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Soil Survey of Aitkin County, Minnesota

By Paul Nyberg, Natural Resources Conservation Service

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with Aitkin County, the Aitkin County Soil and Water Conservation District, the Minnesota Department of Natural Resources, the Board of Water and Soil Resources, the Legislative Commission for Minnesota Resources, and 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.

General Nature of the Survey Area

Aitkin County is in east-central Minnesota (fig. 1). It has a total area of 1,276,800 acres. Of this total, 113,500 acres is lakes and rivers. The population of the county in 1980 was 13,404.

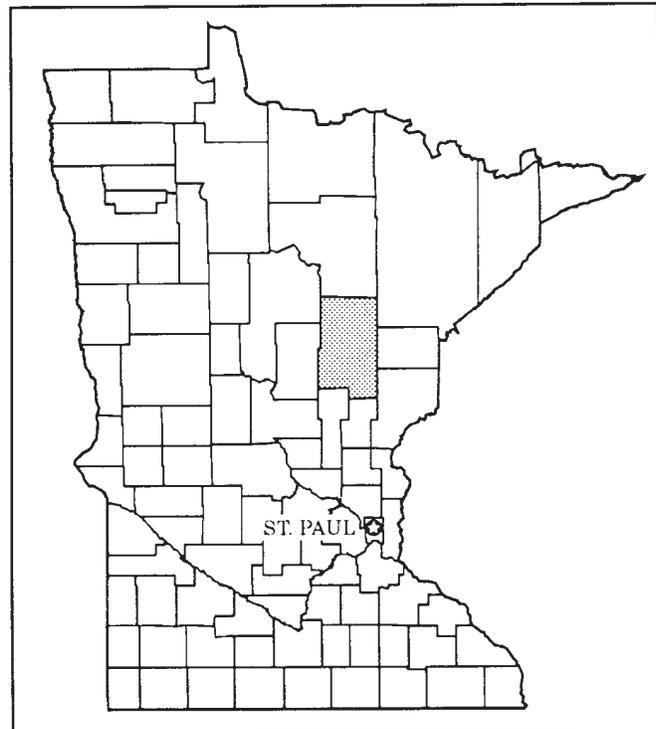


Figure 1.—Location of the survey area in Minnesota.

The county seat and the largest city is Aitkin, which has a population of 1,770. Nearby rural residents bring the total to more than 3,000. Other cities in the county are Hill City, McGregor, Palisade, Tamarack, and McGrath. The county also has smaller, unincorporated communities.

Aitkin County is well known for its lakes. Of the 217 lakes that are larger than 40 acres, 85 are larger than 100 acres and 6 are larger than 1,000 acres. The largest is Mille Lacs Lake. Of its 132,516 acres, 62,580 acres is in Aitkin County.

Forests cover about 70 percent of the county. Organic soils make up about 35 percent of the county. Much of Aitkin County is in public ownership and provides many outdoor recreational opportunities.

History

The recorded history of Aitkin County begins with stories of Native Americans, explorers, the fur trade, and the timber boom. Original inhabitants of the area were the Dakota Indians. Most of the villages in Aitkin County were grouped around Big Sandy Lake, Lake Mille Lacs, and the Snake River. In the 1600's, the Iroquois were being pushed westward by white settlements into Ojibwa territory; in turn, the Dakota

were driven westward by the Ojibwa Indians. Because the Ojibwa were armed by the French with guns, they had an advantage in battle.

The lakes and rivers of the county attracted the early explorers. In about 1679, the first white explorer, Frenchman Daniel Greysolon, Sieur DuLuth, came from the Lake Superior port region via the St. Louis and Savanna Rivers. He portaged from the Savanna River to Big Sandy Lake on a route used for centuries by the Indians. This route came to be known as the Savanna Portage Route and was used extensively by the voyageurs to carry furs to the Lake Superior port area.

The Northwest Trading Company established a post on Big Sandy Lake in 1794. This trading post was sold to the American Fur Company in 1812. It was managed by William Alexander Aitkin (for whom the county and city were named) in partnership with a man by the name of Russian. In 1830, William Alexander Aitkin bought out his co-manager and ran the Aitkin Fur Company until 1838, when the American Fur Company sold the post.

The timber industry reigned in the area from the 1850's until the early 1900's. In 1870, the Northern Pacific Railway reached the city of Aitkin and provided a base for logging operations further north. During the 1882 season, 175 million feet of white pine floated by Aitkin via the Mississippi River and another 8 million feet was cut in the area. More than 2,000 men were reported to have passed through Aitkin in one season. Riverboats were the main transport during these times. The steam-powered boats provided supplies to the logging camps and communities from Aitkin to Grand Rapids. By 1920, most of the big pine had been cut and the era of large-scale lumbering and steamboating was over.

Settlers began farming the county in the 1880's, beginning first on the land along the Mississippi River. When the timber industry waned, pioneers began removing stumps on high land away from the rivers. By 1890, there were 151 farms with 2,689 acres of cropland and pasture. The most common crops were potatoes and oats. In 1900, the settlers cleared and farmed 20,707 acres on 768 farms; in 1982, there were about 742 farms with 183,604 acres of cropland and pasture in the county. Between 1915 and 1920, after most of the high land was settled, the county installed a network of ditches in extensive areas of poorly drained soils and organic soils in hopes of increasing the amount of arable land.

In 1875, the population of the county was 205 permanent residents. By 1895, it had risen to 5,224. The peak population of 17,865 was reached in 1940.

In October 1918, the Cloquet Fire swept through

east-central Aitkin County. About 1,500 acres of forest and cropland was burned, and 453 lives were lost in the area between Lawler and Tamarack.

Aitkin County was designated by the Minnesota Territorial Legislature in 1857 and was organized in 1872. Originally, it was part of Cass and Itasca Counties.

Land Use, Transportation Facilities, and Water Supply

Current land use in Aitkin County is mainly forestry and recreation, but agriculture is still a major economic contributor. The county has beef, turkey, and dairy operations, and small grain and wild rice are produced.

In 1992, according to Minnesota Agriculture Statistics, approximately 110,000 acres in Aitkin County was used for crops. In 1991, about 85,450 acres was used as hayland; 40,000 acres was improved pasture; and 15,300 acres was used for grain crops. Wild rice, a specialty crop, was grown on about 8,800 acres. Oats, wheat, barley, rye, and triticale are common small grain crops. In most years corn is harvested for silage.

Approximately 353,000 acres consists of soils that are suited to crop production. Of this acreage, nearly 225,000 acres is considered prime farmland. Much of the land classed as prime farmland is currently forested. Generally, prime farmland is also prime forest land.

Aitkin County has a good network of highways and local roads that provide access to most parts of the county. The east-west highways are Minnesota 200 across the northern part of the county, Minnesota 210 across the center of the county, and Minnesota 18 across the northern side of Mille Lacs Lake and continuing east across the southern part of the county. The north-south highways are U.S. Highway 169 in the western part of the county, Minnesota 65 in the eastern part, and Minnesota 47 along the eastern side of Mille Lacs Lake and continuing north to the city of Aitkin. U.S. Highway 2 crosses the northeast corner of the county.

The rural road system is well developed. Most roads are on section lines, except for those adjacent to the lakes and rivers. Most roads have a gravel or crushed rock base and are maintained year round.

Air traffic is restricted to small aircraft with public landing strips located near Aitkin, McGregor, and Hill City.

The Burlington Northern railway runs through the center of the county and generally parallels Minnesota Highway 210. It serves the city of Aitkin.

Most railway usage is by the forestry and manufacturing industries.

The water supply for human consumption in Aitkin County is drawn mainly from sand and gravel deposits in the glacial drift. The drift supplies water for city and industrial uses. The drift is 50 feet to more than 400 feet thick. Some water is taken from the Mississippi River and other streams for use in flooding wild rice paddies.

The Big Sandy Reservoir and the Mississippi River Diversion Canal were created to help control flooding. The Big Sandy Dam is used to regulate flow and ensure ample water supplies in the metropolitan area. Much of the water is "hard" and contains significant amounts of iron and manganese and, in some areas, calcium.

Excavated pits and ponds provide water for livestock and wildlife. They are commonly filled by collecting surface runoff or by horizontal subsurface flow in areas where the water table is high.

Physiography, Relief, and Drainage

Aitkin County encompasses a large area (1,828 square miles) of diverse landforms with a variety of water bodies. This diversity is the result of the continental glaciers that advanced many times through the region in the past. The landforms include large and small glacial lake plains and associated beach ridges; moraines (ground, terminal, and recessional); drumlins; pitted outwash (ice-contact stratified drift); eskers and kames; outwash plains; ice-block depressions (modern lakes and bogs); and glacial river valleys. Glacial drift averages about 200 feet thick over bedrock throughout the county. In a few places there are bedrock outcrops. Examples of these outcrops are in section 1, Seavey Township, and Section 12, Idun Township.

Each landform type has a characteristic shape and size determined by the method of deposition and the volume of sediment. For example, lake-laid sediments are commonly 2 to 10 feet thick. They cover an area of 10 to 1,000 acres where they occur as ice-block depressions or an area of many thousands of acres where they occur as glacial lakes Aitkin and Upham. Relief in these areas ranges from 2 to 15 feet. Slopes are generally plane, but there are undulating areas as well. Wave-washed till and beach ridges occur at the margins of lake plains or as islands within them.

By contrast, deposits of ablation till (which are laid down at a melting glacial front) are commonly 10 to 100 feet thick and have relief of as much as 75 feet. Also, slopes are mostly complex—that is, they are

concave or convex in both horizontal and vertical directions. The terminal moraine, which extends from the northwest corner of Mille Lacs Lake to the area east of Big Sandy Lake, is comprised of ablation till from several sources. Ablation till is characterized by its mixture of different-sized particles ranging from large boulders (more than 1 meter in diameter) to clay (less than 0.002 millimeter in diameter); in fact, boulder-clay is another, older term for this material.

Most of the land in Aitkin County that is neither flat nor hilly can be classified as gently rolling ground moraine. Ground moraines are made up of basal till that is generally denser and more homogeneous than ablation till and have relief of 5 to 50 feet. Commonly, basal till, which is deposited at the base of a moving glacier, is molded into drumlins. Drumlins are cigar-shaped hills streamlined in the direction of the ice flow. The southeastern part of Aitkin County is ground moraine.

The abundance of lakes and rivers in the county is a benefit from the repeated glaciations. Deep-water lakes tend to be concentrated in the terminal moraine because of the mounding of till around stranded ice blocks, which left large depressions as they melted. Water also pooled at the margins of glaciers because the weight of the ice actually depressed the earth's crust. The melting ice also created great rivers, which carved valleys now occupied by smaller streams. The deposits left by the glacial rivers are referred to as glacial outwash and are good sources of sand and gravel.

The present-day drainage of surface water in Aitkin County is accomplished by several rivers (notably the Mississippi, Snake, Willow, Rice, Sandy, and Prairie Rivers) and many smaller creeks, brooks, and ditches. The Mississippi River watershed is the most extensive; it drains the northern two-thirds of the county. Generally, surface drainage is impeded by numerous closed depressions or potholes, which, over time, fill with organic material (peat). In some areas of low relief, peat has filled the original potholes and spread over the landscape in a process known as paludification.

Depending on its degree of decomposition, organic matter can hold water up to 30 times its own weight. An average peat bog of 100 acres, 10 feet deep, contains about 334 million gallons of water, which is 300 times more than mineral material could hold. This tremendous water-holding capacity retards natural drainage. Attempts to improve drainage by ditching have been hindered by this characteristic and the lack of adequate outlets. These characteristics are significant because organic soils make up more than 420,000 acres in Aitkin County.

The range in elevation above sea level ranges from 1,083 feet near Pine Lake in Wagner Township in the southeast corner of the county to 1,589 feet in Section 25 of Hill Lake Township, known as Quadna Mountain. The glacial lake plain that the Mississippi River flows through is about 1,200 feet above sea level. The watershed divide between the tributaries of the Mississippi and those of the Snake River is at an elevation of 1,350 feet. The average elevation of the surface of Mille Lacs Lake, the second largest lake that is entirely within the State, is about 1,250 feet above sea level.

Climate

The three tables at the end of this section provide climate data for the survey area as recorded at Isle and at Sandy Lake Dam in the period 1961 to 1990.

In winter, the average temperature is 10 degrees F at Isle and 12 degrees at Sandy Lake Dam. The average daily minimum temperature is -1 degree at Isle and 1 degree at Sandy Lake Dam. The lowest temperature on record at Isle, which occurred on December 18, 1983, is -46 degrees. The lowest temperature on record at Sandy Lake Dam, which occurred on January 15, 1972, is -49 degrees. In summer, the average temperature at Isle and at Sandy Lake Dam is 66 degrees. The average daily maximum temperature is 78 degrees at Isle and 79 degrees at Sandy Lake Dam. The highest temperature at Isle, which occurred on August 19, 1976, is 99 degrees. The highest temperature at Sandy Lake Dam, which occurred on July 28, 1988, is 102 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 at Isle is 28.48 inches. Of this, 21.22 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. The total annual precipitation at Sandy Lake Dam is about 27.81 inches. Of this, 20.45 inches, or about 74 percent, usually falls in April through September. The heaviest 1-day rainfall at Isle during the period of record was 9.8 inches on July 22, 1972. The heaviest 1-day rainfall at Sandy Lake Dam during the period of record was 4.65 inches on July 28, 1972.

Thunderstorms occur on about 34 days each year, and most occur in July.

The average seasonal snowfall is 42.6 inches at Isle and 59.2 inches at Sandy Lake Dam. The greatest snow depth at any one time during the period of record was 57 inches at Isle and 36 inches at Sandy Lake Dam. On the average, 22 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 12 inches at Isle and 14 inches at Sandy Lake Dam.

The average relative humidity in midafternoon is about 63 percent. Humidity is higher at night, and the average at dawn is about 81 percent. The sun shines 61 percent of the time possible in summer and 47 percent in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 12.5 miles per hour, in April.

Temperature and Precipitation

(Recorded in the period 1961-90 at Isle and Sandy Lake Dam, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
°F	°F	°F	°F	°F	Units	In	In	In	In		
ISLE:											
January----	17.9	-5.1	6.4	44	-39	0	0.69	0.16	1.11	2	10.2
February---	24.5	-.2	12.1	48	-35	0	.56	.15	.89	1	6.3
March-----	36.7	13.9	25.3	63	-21	13	1.44	.63	2.14	4	9.5
April-----	53.0	29.7	41.3	81	5	126	2.23	.83	3.40	5	2.8
May-----	66.6	41.0	53.8	87	18	422	2.98	2.03	3.85	7	.2
June-----	75.4	50.5	62.9	91	32	662	4.49	2.16	6.51	8	.0
July-----	80.7	56.2	68.5	94	39	811	4.59	2.20	6.66	7	.0
August-----	77.4	53.6	65.5	93	35	725	3.75	2.00	5.29	6	.0
September--	67.4	44.6	56.0	88	23	452	3.18	1.61	4.55	6	.0
October----	55.6	34.0	44.8	86	12	186	2.17	.60	3.44	4	.5
November---	37.3	20.2	28.7	67	-10	20	1.40	.50	2.24	3	4.3
December---	21.5	1.9	11.7	45	-31	0	.97	.34	1.56	3	8.8
Yearly:											
Average---	51.2	28.4	39.8	---	---	---	---	---	---	---	---
Extreme---	99	-46	---	95	-40	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,418	28.48	19.93	33.02	56	42.6

See footnote at end of table.

Temperature and Precipitation--Continued

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	°F	°F	°F	°F	°F	Units	In	In	In		In
SANDY LAKE DAM:											
January----	19.1	-4.0	7.6	46	-39	0	0.88	0.31	1.36	2	15.2
February---	26.4	1.6	14.0	50	-33	0	.59	.18	.91	1	7.9
March-----	38.5	15.2	26.9	63	-22	15	1.39	.72	1.97	3	11.4
April-----	54.3	29.4	41.8	80	4	141	2.07	.90	3.06	5	3.8
May-----	68.0	41.7	54.8	87	22	464	3.06	1.96	4.06	7	.2
June-----	76.3	50.8	63.6	91	34	705	4.39	2.92	5.74	7	.0
July-----	81.1	56.2	68.7	95	41	888	3.88	2.28	5.31	7	.0
August-----	78.1	54.0	66.0	92	35	807	3.63	1.79	5.23	6	.0
September--	68.2	45.3	56.7	88	25	502	3.42	1.62	4.97	7	.0
October----	56.9	35.4	46.2	80	15	232	2.36	.93	3.55	4	.9
November---	38.2	21.0	29.6	63	-10	24	1.27	.52	1.91	3	7.9
December---	23.0	3.7	13.3	47	-30	1	.88	.48	1.23	2	11.9
Yearly:											
Average---	52.3	29.2	40.8	---	---	---	---	---	---	---	---
Extreme---	102	-49	---	96	-39	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,780	27.81	22.85	32.54	54	59.2

* 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 Isle and Sandy Lake Dam,
Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
ISLE:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 12	June 2	June 5
2 years in 10 later than--	May 7	May 26	June 1
5 years in 10 later than--	Apr. 27	May 12	May 24
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 22	Sept. 14	Sept. 3
2 years in 10 earlier than--	Sept. 29	Sept. 18	Sept. 8
5 years in 10 earlier than--	Oct. 11	Sept. 27	Sept. 16
SANDY LAKE DAM:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 6	May 18	June 1
2 years in 10 later than--	May 1	May 13	May 26
5 years in 10 later than--	Apr. 23	May 5	May 16
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 30	Sept. 14	Sept. 5
2 years in 10 earlier than--	Oct. 6	Sept. 19	Sept. 10
5 years in 10 earlier than--	Oct. 17	Sept. 29	Sept. 20

Growing Season

(Recorded in the period 1961-90 at Isle and Sandy Lake Dam, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
ISLE:			
9 years in 10	131	106	95
8 years in 10	138	115	101
5 years in 10	152	132	112
2 years in 10	166	149	123
1 year in 10	173	158	129
SANDY LAKE DAM:			
9 years in 10	156	127	107
8 years in 10	163	134	113
5 years in 10	177	146	126
2 years in 10	190	158	139
1 year in 10	197	165	145

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General Soil Map Units

The general soil map at the back of this publication 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. The broad groups and the map units in each group are described on the following pages.

Areas Dominated By Soils That Formed in Till and Glaciolacustrine Deposits; on Moraines and Lake Plains

1. Duluth-Dusler

Setting

Landform: Moraines
Slope range: 0 to 25 percent

Composition

Percent of survey area: 9
Extent of components in the map unit (fig. 2):
Duluth soils—35 percent
Dusler soils—30 percent
Soils of minor extent—35 percent

Soil Properties and Qualities

Duluth

Drainage class: Well drained and moderately well drained
Parent material: Till
Surface texture: Fine sandy loam

Dusler

Drainage class: Somewhat poorly drained
Parent material: Till
Surface texture: Silt loam

Minor Soils

- Blackhoof and similar soils
- Mahtowa and similar soils
- Very poorly drained organic soils
- Cutaway and similar soils
- Sandwich and similar soils
- Excessively drained and somewhat excessively drained, sandy soils

Major Uses

Primary uses: Woodland, recreation
Secondary uses: Pasture, hayland, cropland

2. Alstad-Talmoon-Cushing

Setting

Landform: Moraines and lake plains
Slope range: 0 to 12 percent

Composition

Percent of survey area: 8
Extent of components in the map unit (fig. 3):
Alstad soils—25 percent
Talmoon soils—25 percent
Cushing soils—20 percent
Soils of minor extent—30 percent

Soil Properties and Qualities

Alstad

Drainage class: Somewhat poorly drained

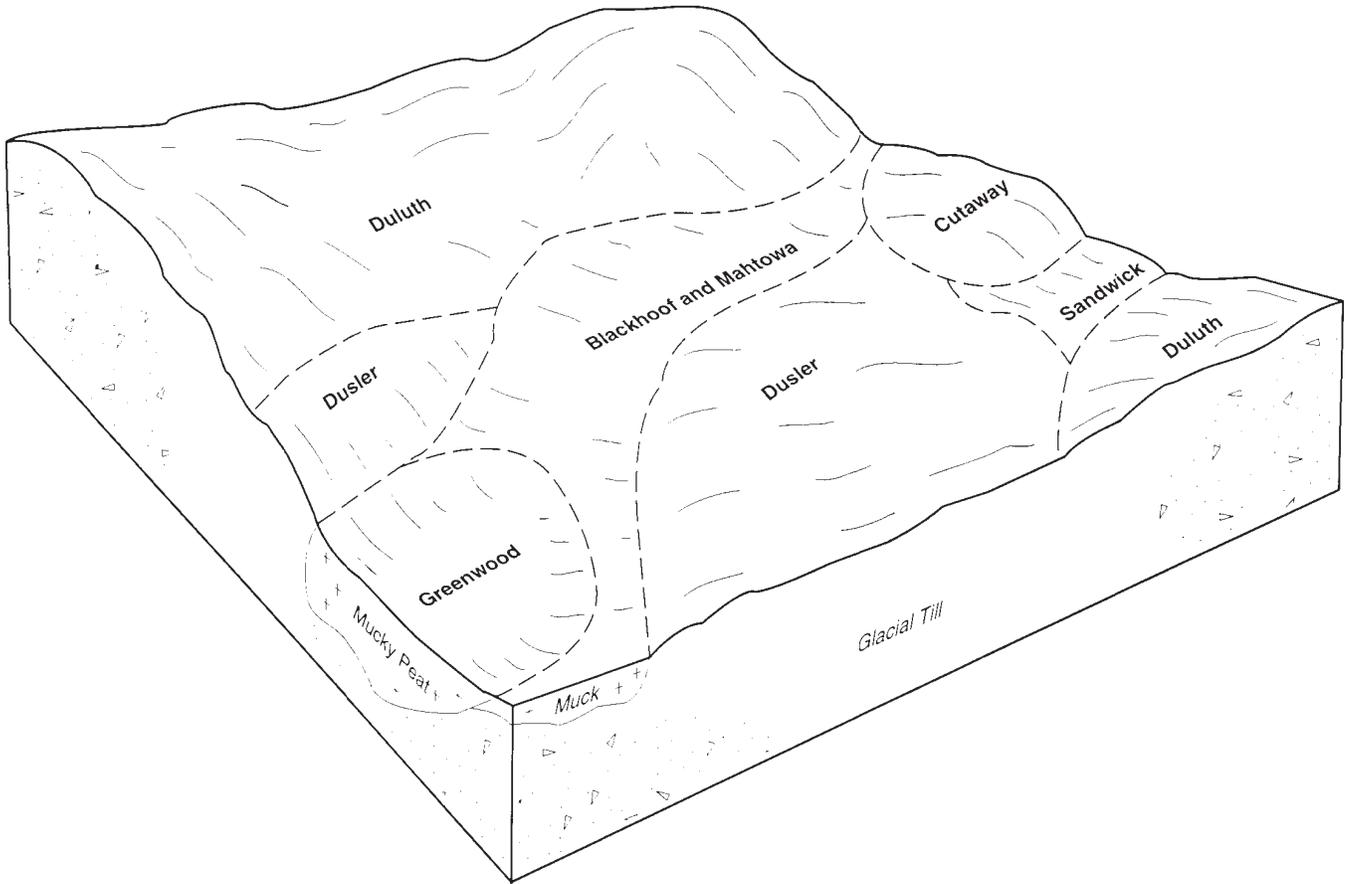


Figure 2.—Typical pattern of soils and underlying material in the Duluth-Dusler general soil map unit.

Parent material: Till
Surface texture: Loam

Talmoon

Drainage class: Poorly drained and very poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Fine sandy loam (poorly drained phase); muck (depressional phase)

Cushing

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Minor Soils

- Very poorly drained organic soils
- Cutaway and similar soils
- Sandwich and similar soils

Major Uses

Primary uses: Woodland

Secondary uses: Cropland, hayland, pasture

3. Stuntz-Talmoon-Warba

Setting

Landform: Moraines
Slope range: 0 to 12 percent

Composition

Percent of survey area: 3
Extent of components in the map unit:
 Stuntz soils—30 percent
 Talmoon soils—30 percent
 Warba soils—20 percent
 Soils of minor extent—20 percent

Soil Properties and Qualities

Stuntz

Drainage class: Somewhat poorly drained
Parent material: Till

Surface texture: Very fine sandy loam

Talmoon

Drainage class: Poorly drained and very poorly drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Fine sandy loam (poorly drained phase); muck (depressional phase)

Warba

Drainage class: Well drained and moderately well drained

Parent material: Till

Surface texture: Very fine sandy loam

Minor Soils

- Very poorly drained organic soils
- Cutaway and similar soils
- Sandwich and similar soils
- Excessively drained, sandy soils

Major Uses

Primary uses: Woodland

Secondary uses: Cropland, hayland, pasture, recreation

Areas Dominated By Soils That Formed in Dense Till; on Moraines

4. Milaca-Mora-Ronneby

Setting

Landform: Moraines

Slope range: 0 to 25 percent

Composition

Percent of survey area: 17

Extent of components in the map unit (fig. 4):

Milaca soils—30 percent

Mora soils—25 percent

Ronneby soils—25 percent

Soils of minor extent—20 percent

Soil Properties and Qualities

Milaca

Drainage class: Well drained

Parent material: Till

Surface texture: Fine sandy loam

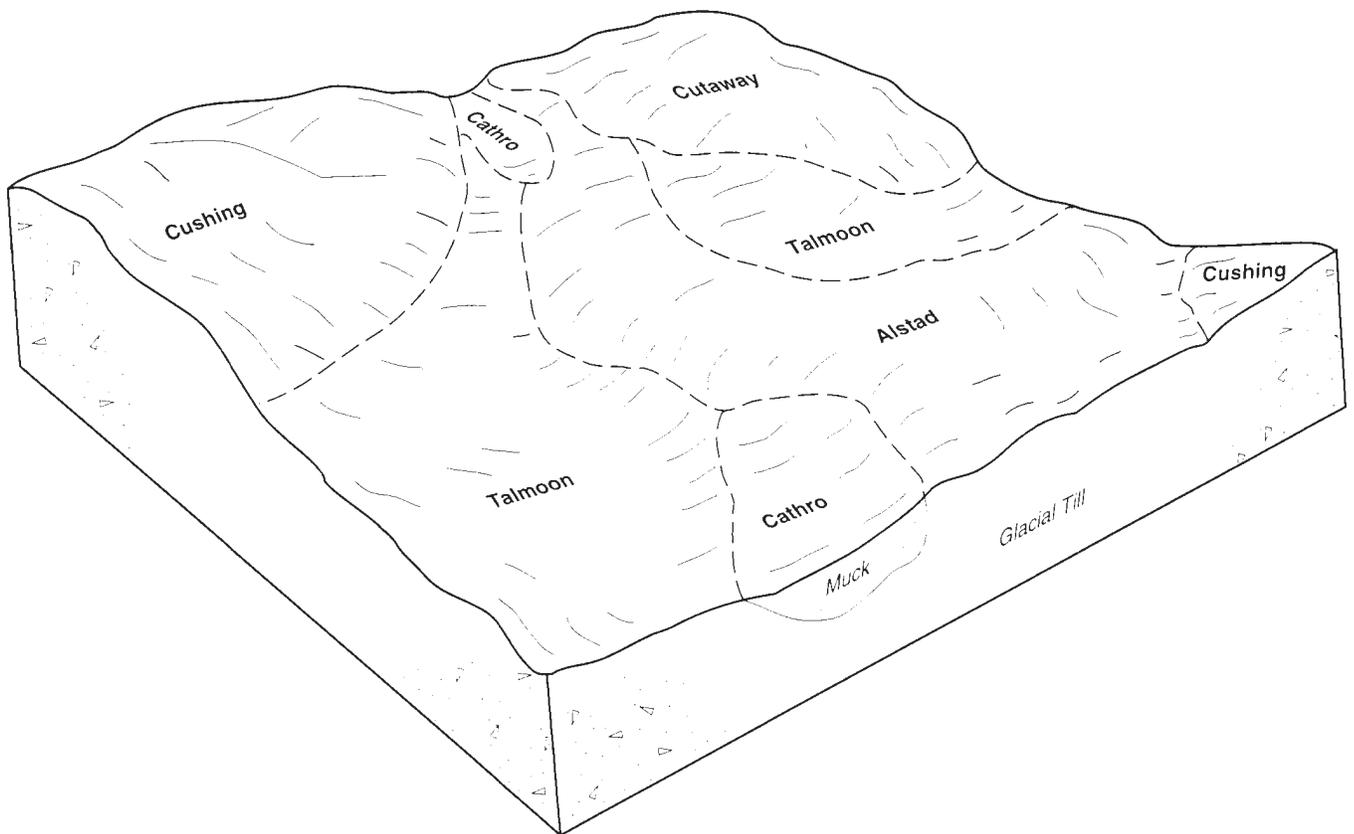


Figure 3.—Typical pattern of soils and underlying material in the Alstad-Talmoon-Cushing general soil map unit.

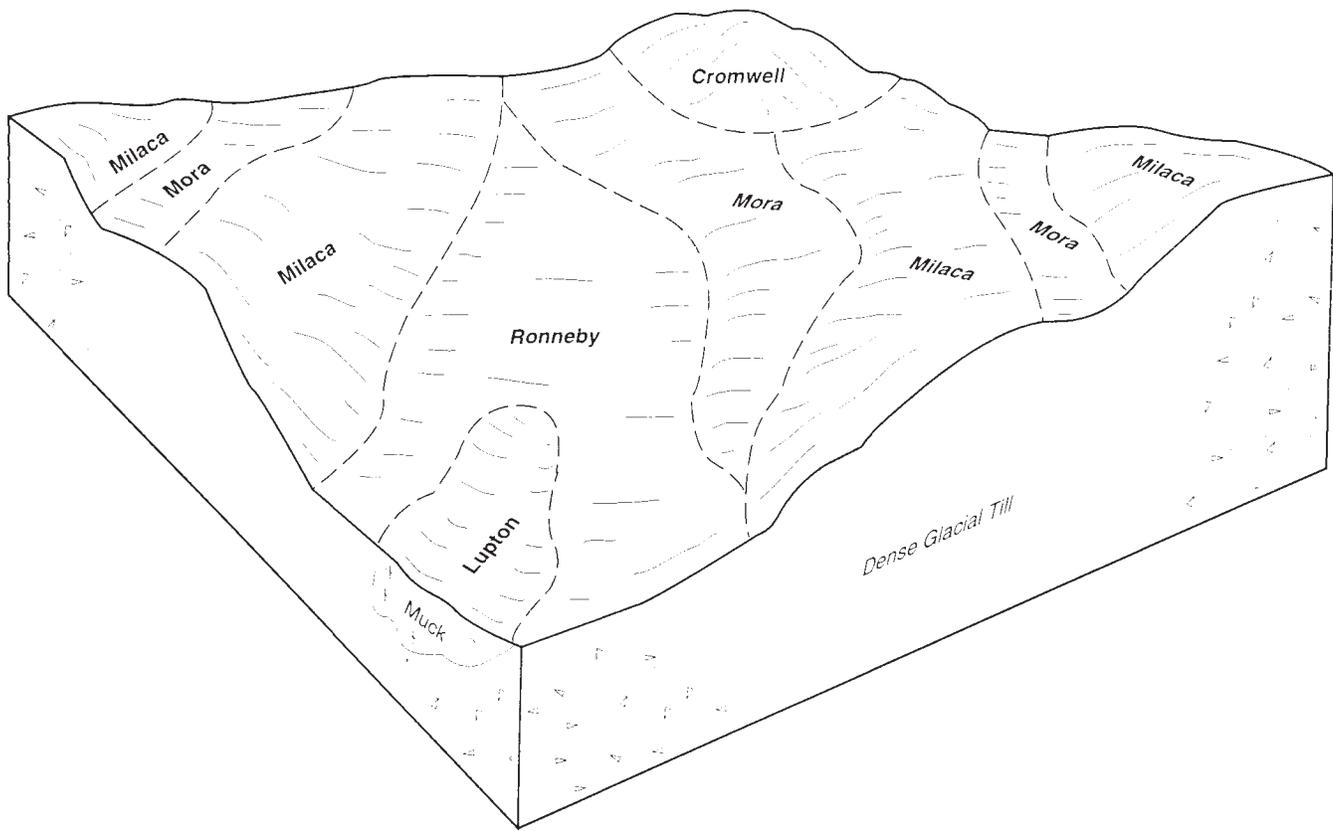


Figure 4.—Typical pattern of soils and underlying material in the Milaca-Mora-Ronneby general soil map unit.

Mora

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Fine sandy loam

Ronneby

Drainage class: Somewhat poorly drained
Parent material: Till
Surface texture: Loam

Minor Soils

- Cromwell and similar soils
- Oesterle and similar soils
- Twig and similar soils
- Giese and similar soils
- Pomroy and similar soils
- Bushville and similar soils
- Watab and similar soils
- Brennyville and similar soils
- Freer and similar soils
- Very poorly drained organic soils

Major Uses

Primary uses: Woodland, recreation

Secondary uses: Cropland, hayland, pasture

5. Flak-Wabedo-Nokay

Setting

Landform: Moraines
Slope range: 0 to 12 percent

Composition

Percent of survey area: 1
Extent of components in the map unit:
 Flak soils—30 percent
 Wabedo soils—25 percent
 Nokay soils—20 percent
 Soils of minor extent—25 percent

Soil Properties and Qualities

Flak

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

Wabedo

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Sandy loam

Nokay

Drainage class: Somewhat poorly drained
Parent material: Till
Surface texture: Fine sandy loam

Minor Soils

- Excessively drained, sandy soils
- Pomroy and similar soils
- Bushville and similar soils
- Watab and similar soils
- Very poorly drained organic soils

Major Uses

Primary uses: Woodland
Secondary uses: Recreation, hayland, pasture

**Areas Dominated By Soils That Formed in
 Glaciolacustrine Deposits, Till, and
 Glacial Outwash; on Moraines and
 Outwash Plains**

6. Cushing-Mahtomedi

Setting

Landform: Moraines and outwash plains
Slope range: 2 to 40 percent

Composition

Percent of survey area: 8
Extent of components in the map unit:
 Cushing soils—40 percent
 Mahtomedi soils—30 percent
 Soils of minor extent—30 percent

Soil Properties and Qualities

Cushing

Drainage class: Well drained

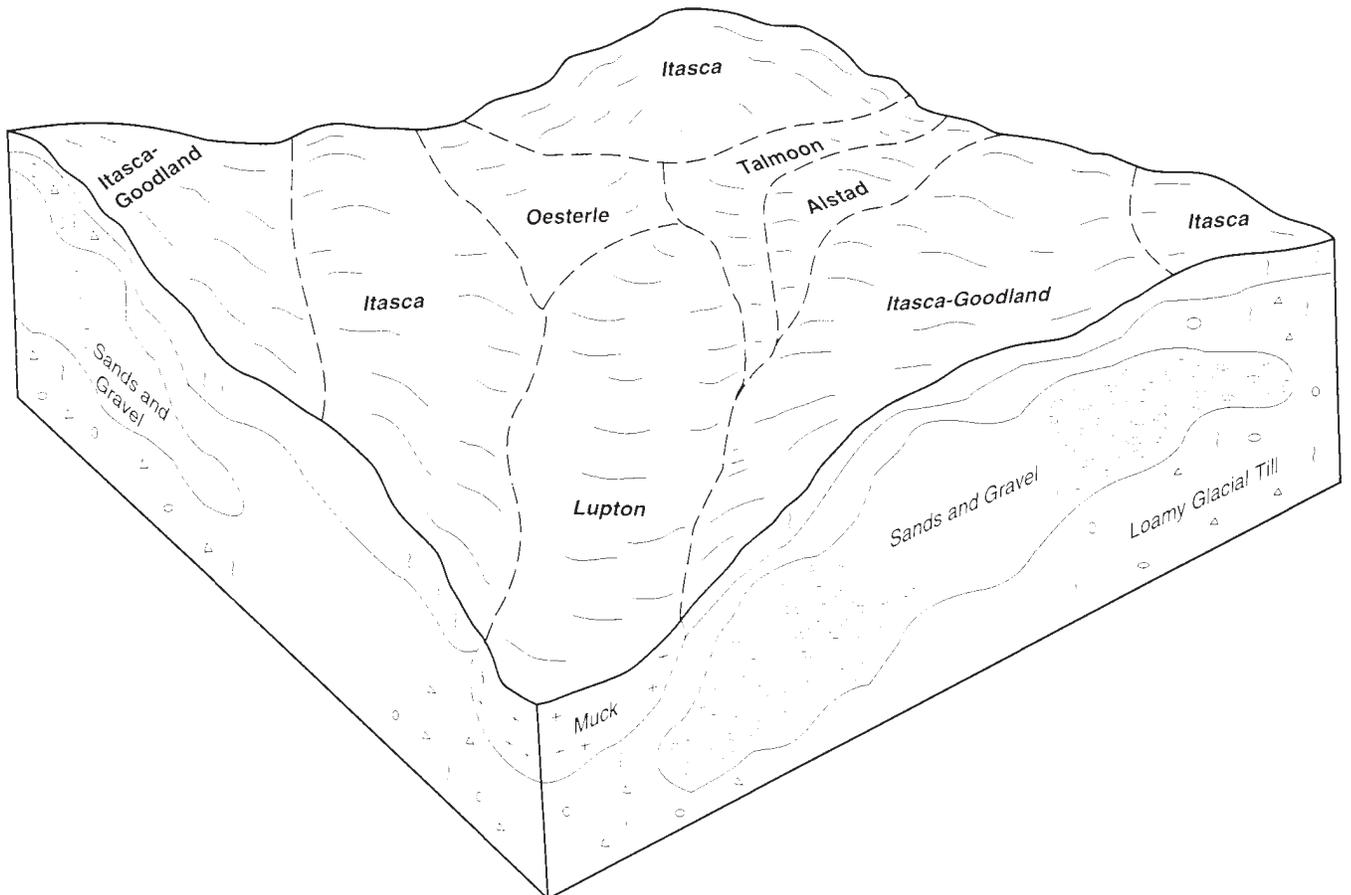


Figure 5.—Typical pattern of soils and underlying material in the Itasca-Goodland general soil map unit.

Parent material: Till
Surface texture: Loam

Mahtomedi

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy coarse sand

Minor Soils

- Cromwell and similar soils
- Alstad and similar soils
- Dusler and similar soils
- Oesterle and similar soils
- Very poorly drained organic soils

Major Uses

Primary uses: Woodland
Secondary uses: Recreation, hayland, pasture

7. Itasca-Goodland

Setting

Landform: Moraines
Slope range: 2 to 25 percent

Composition

Percent of survey area: 4
Extent of components in the map unit (fig. 5):
Itasca soils—45 percent
Goodland soils—30 percent
Soils of minor extent—25 percent

Soil Properties and Qualities

Itasca

Drainage class: Well drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silt loam

Goodland

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Silt loam

Minor Soils

- Alstad and similar soils
- Oesterle and similar soils
- Very poorly drained organic soils
- Cromwell and similar soils
- Talmoon and similar soils

Major Uses

Primary uses: Woodland, recreation

Secondary uses: Hayland, pasture

Areas Dominated By Soils That Formed in Glaciolacustrine Deposits, Alluvium, and Organic Materials Over Glaciolacustrine Deposits; on Lake Plains

8. Brickton-Spooner-Wil提高ssippi

Setting

Landform: Lake plains
Slope range: 0 to 2 percent

Composition

Percent of survey area: 4
Extent of components in the map unit (fig. 6):
Brickton soils—25 percent
Spooner soils—25 percent
Wil提高ssippi soils—25 percent
Soils of minor extent—25 percent

Soil Properties and Qualities

Brickton

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits
Surface texture: Silt loam

Spooner

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits
Surface texture: Silt loam

Wil提高ssippi

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits
Surface texture: Loam

Minor Soils

- Hassman and similar soils
- Sax and similar soils
- Hamre and similar soils
- Waukenabo and similar soils
- Talmoon and similar soils
- Baudette and similar soils
- Dalbo and similar soils

Major Uses

Primary uses: Cropland, hayland
Secondary uses: Woodland

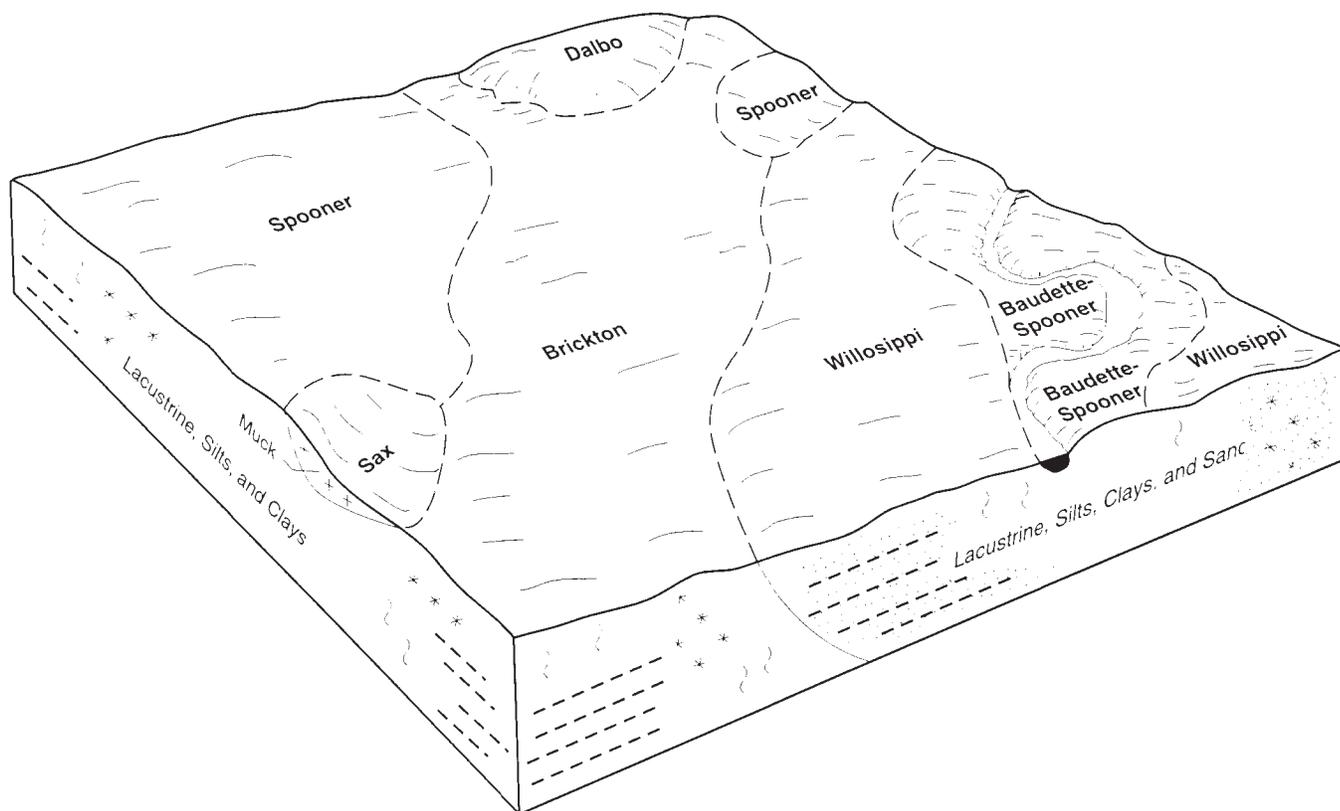


Figure 6.—Typical pattern of soils and underlying material in the Brickton-Spooner-Wilosippi general soil map unit.

9. Waukenabo-Sago

Setting

Landform: Lake plains

Slope range: 0 to 2 percent

Composition

Percent of survey area: 2

Extent of components in the map unit:

Waukenabo soils—45 percent

Sago soils—45 percent

Soils of minor extent—10 percent

Soil Properties and Qualities

Waukenabo

Drainage class: Poorly drained

Parent material: Alluvium and glaciolacustrine deposits

Surface texture: Fine sandy loam

Sago

Drainage class: Very poorly drained

Parent material: Organic materials over glaciolacustrine deposits

Surface texture: Muck

Minor Soils

- Redby and similar soils
- Sandwick and similar soils
- Cormant and similar soils
- Wilosippi and similar soils
- Very poorly drained organic soils

Major Uses

Primary uses: Hayland, cropland

Secondary uses: Woodland

10. Cowhorn-Wawina

Setting

Landform: Lake plains

Slope range: 0 to 10 percent

Composition

Percent of survey area: 3

Extent of components in the map unit (fig. 7):

Cowhorn soils—35 percent

Wawina soils—30 percent

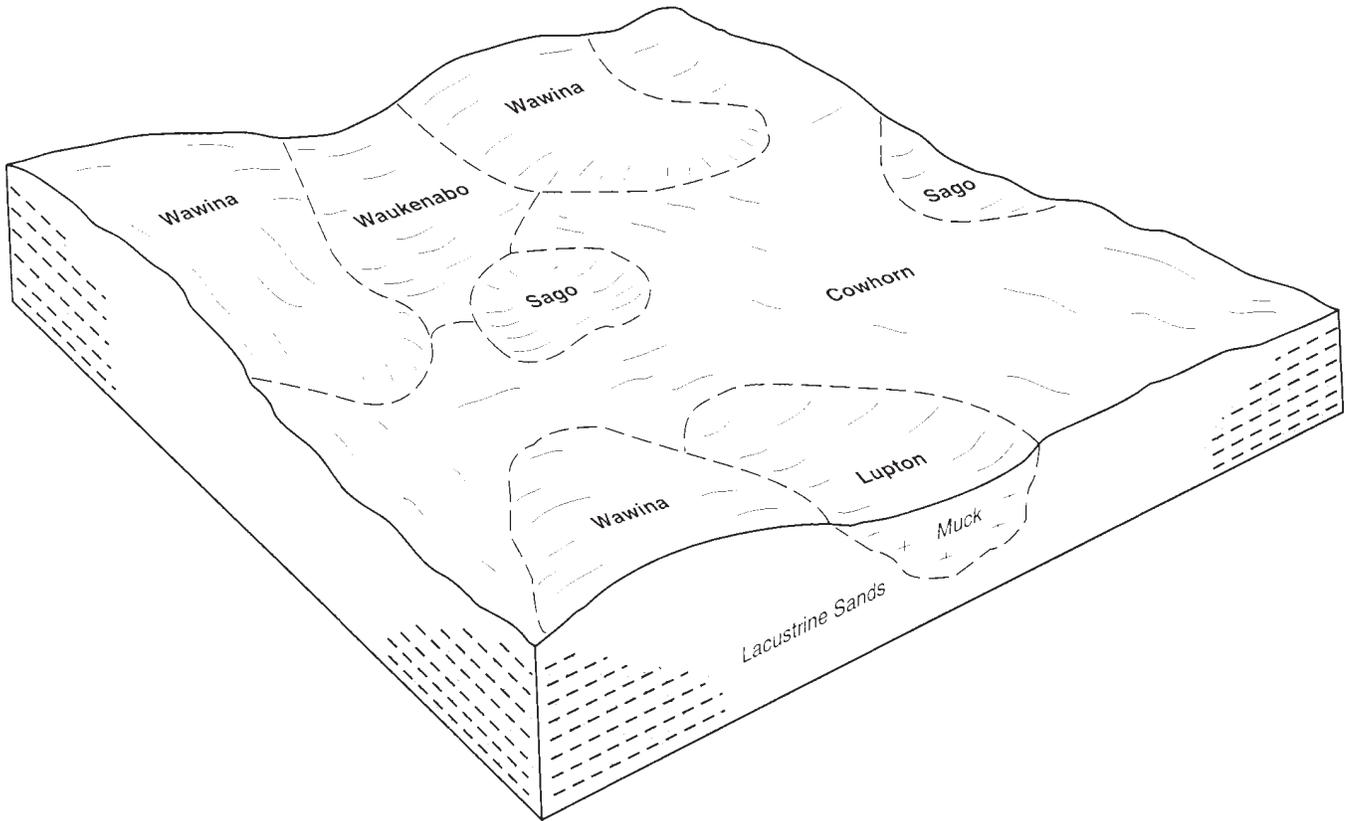


Figure 7.—Typical pattern of soils and underlying material in the Cowhorn-Wawina general soil map unit.

Soils of minor extent—35 percent

Soil Properties and Qualities

Cowhorn

Drainage class: Somewhat poorly drained
Parent material: Glaciolacustrine deposits
Surface texture: Loamy very fine sand

Wawina

Drainage class: Well drained
Parent material: Alluvium and glaciolacustrine deposits
Surface texture: Loamy very fine sand

Minor Soils

- Sago and similar soils
- Itasca and similar soils
- Hillcity and similar soils
- Spooner and similar soils
- Waukenabo and similar soils

Major Uses

Primary uses: Woodland

Secondary uses: Hayland, pasture

Areas Dominated By Soils That Formed in Glacial Outwash, Organic Materials Over Alluvium, Alluvium, and Glaciolacustrine Deposits; on Outwash Plains, Lake Plains, and Moraines

11. Meehan-Markey-Menahga

Setting

Landform: Outwash plains, lake plains, and moraines
Slope range: 0 to 12 percent

Composition

Percent of survey area: 4
Extent of components in the map unit:
 Meehan soils—30 percent
 Markey soils—30 percent
 Menahga soils—20 percent
 Soils of minor extent—20 percent

Soil Properties and Qualities

Meehan

Drainage class: Somewhat poorly drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Markey

Drainage class: Very poorly drained
Parent material: Organic material over alluvium
Surface texture: Muck

Menahga

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Minor Soils

- Newson and similar soils
- Friendship and similar soils
- Sandwich and similar soils
- Cutaway and similar soils

Major Uses

Primary uses: Woodland
Secondary uses: Hayland, pasture, recreation

12. Nemadji-Newson-Omega

Setting

Landform: Outwash plains and lake plains
Slope range: 0 to 12 percent

Composition

Percent of survey area: 2
Extent of components in the map unit:
 Nemadji soils—25 percent
 Newson soils—25 percent
 Omega soils—20 percent
 Soils of minor extent—30 percent

Soil Properties and Qualities

Nemadji

Drainage class: Somewhat poorly drained
Parent material: Glaciolacustrine deposits
Surface texture: Loamy fine sand

Newson

Drainage class: Poorly drained
Parent material: Alluvium and glaciolacustrine deposits

Surface texture: Loamy sand

Omega

Drainage class: Somewhat excessively drained
Parent material: Glaciolacustrine deposits
Surface texture: Loamy fine sand

Minor Soils

- Cromwell and similar soils
- Rosholt and similar soils
- Oesterle and similar soils
- Very poorly drained organic soils

Major Uses

Primary uses: Woodland
Secondary uses: Hayland, pasture, recreation

13. Rosholt-Mahtomedi

Setting

Landform: Moraines and outwash plains
Slope range: 2 to 40 percent

Composition

Percent of survey area: 3
Extent of components in the map unit:
 Rosholt soils—35 percent
 Mahtomedi soils—30 percent
 Soils of minor extent—35 percent

Soil Properties and Qualities

Rosholt

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Fine sandy loam

Mahtomedi

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy coarse sand

Minor Soils

- Cromwell and similar soils
- Oesterle and similar soils
- Very poorly drained organic soils

Major Uses

Primary uses: Woodland, recreation
Secondary uses: Hayland, pasture

Areas Dominated By Soils That Formed in Organic Materials and in Organic Materials Over Alluvium; in Bogs on Lake Plains, Outwash Plains, and Moraines

14. Greenwood-Lupton-Cathro

Setting

Landform: Lake plains, moraines, and outwash plains
Slope range: 0 to 1 percent

Composition

Percent of survey area: 29
Extent of components in the map unit:
Greenwood soils—30 percent
Lupton soils—30 percent
Cathro soils—30 percent
Soils of minor extent—10 percent

Soil Properties and Qualities

Greenwood

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Peat

Lupton

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck

Cathro

Drainage class: Very poorly drained
Parent material: Organic materials over alluvium
Surface texture: Muck

Minor Soils

- Better drained mineral soils

Major Uses

Primary uses: Woodland, native vegetation
Secondary uses: Cropland, peat harvesting

Areas Dominated By Soils That Formed in Glaciolacustrine Deposits and Alluvium; on Lake Plains and Flood Plains

15. Baudette-Spooner-Pengilly

Setting

Landform: Flood plains and lake plains
Slope range: 0 to 5 percent

Composition

Percent of survey area: 3
Extent of components in the map unit:
Baudette soils—30 percent
Spooner soils—25 percent
Pengilly soils—20 percent
Soils of minor extent—25 percent

Soil Properties and Qualities

Baudette

Drainage class: Moderately well drained
Parent material: Glaciolacustrine deposits
Surface texture: Silt loam

Spooner

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits
Surface texture: Silt loam

Pengilly

Drainage class: Poorly drained
Parent material: Alluvium
Surface texture: Silt loam

Minor Soils

- Very poorly drained organic soils
- Willosippi and similar soils
- Brickton and similar soils

Major Uses

Primary uses: Woodland
Secondary uses: Hayland

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.

Formation of the Soils

Soil is a naturally occurring, three-dimensional body of unconsolidated material on the earth's surface which is capable of supporting plant life. Soil is formed by the interaction of five major factors. These are parent material, relief, time, climate, and plants and animals (Jenny, 1941). These factors determine which of the physical, chemical, and biological processes that create different soils will occur at a specific site.

Climate

Climate is the average of weather conditions over many years. Climate can fluctuate greatly over time. Soil formation reflects the average of these fluctuations. Weather is a dynamic force in nature; its agents are precipitation, wind, and temperature.

Precipitation is the source of soil water. Soil water is vital for plant growth as well as many aspects of soil development. Water in soil dissolves and transports minerals. The freeze-thaw and wet-dry cycles help to mix the soil and create soil structure. Also, soils that are frequently saturated have a higher content of organic matter than other soils and have mottled or gray colors.

Temperature influences soil formation in several ways. The cold climate is partially responsible for the formation of peat because the rate of decomposition of organic matter is almost directly controlled by temperature. The rate of chemical reactions in soil increases with soil temperature. Thus, soils in tropical climates are more highly weathered and less fertile than soils in temperate climates.

Living Organisms

Plants, animals, and micro-organisms interact to influence the formation of soils. Plants produce the bulk of the organic matter that darkens and enriches

the topsoil. They also produce substances that break down minerals and release nutrients, which increase the fertility of the soil. Animals also influence soil formation. Burrowing animals mix the soil, other animals spread plant seed, and the waste products and remains of all animals serve as natural fertilizer.

In order for soils to form and plants and animals to exist, there must be micro-organisms. Micro-organisms act as decomposers in the soil and complete the cycle of life from plant to animal to soil and back to plant again. Not all micro-organisms are beneficial, but our forests and crops could not grow without them.

The soils of Aitkin County formed under mixed hardwood and pine forests. However, there were periods after fires or during long dry spells when grasses were the dominant vegetation. As a result, many of the soils have characteristics of both forest and prairie soils. Other soils formed entirely in partially decayed plant remains, such as in swamps and bogs.

Human beings also affect soil formation. Agriculture can expose the soil to accelerated erosion, which changes the physical and chemical properties of soil. Drainage and cultivation of peatland may cause subsidence of the soil.

Relief

Relief is defined as the difference in elevation between two points on the landscape. This concept can be expanded to include the size and shape of a landform and the shape and aspect of the soil surface—that is, landscape position. Soil formation is strongly influenced by landscape position. Relief-related soil properties include soil depth, thickness of the topsoil and content of organic matter, soil drainage, soil color, degree of subsoil development, soil acidity or alkalinity, content of soluble salts, and soil temperature.

The most readily noticeable effect of relief on soils in this area is that of drainage. Natural drainage increases with slope. Drainage, in turn, affects soil formation. The better drained or more sloping soils have less organic matter in the upper soil layers.

Soils that formed in level areas have more pronounced surface and subsurface development. This development is in part a result of a greater amount of water that infiltrates the soil rather than running off the soil.

Two other important considerations related to relief are the water table and microrelief. In this section, water table refers to the upper boundary of a temporary zone of saturation in a soil rather than to the ground-water supply. A soil water table fluctuates according to seasonal precipitation; its depth is determined by the position of the soil on the landscape. The lower lying soils have a higher water table. Microrelief (such as cradle-knolls, tree mounds, and hummocks) is important because it influences the kinds of plants that will grow on a specific site.

Parent Material

Parent material is the original deposit of mineral or organic matter before it is altered into soil. There is a great diversity of soil parent materials in Aitkin County. This diversity is mainly a result of the repeated glaciations in this region during the last ice age. Glaciers can erode the earth's surface to a depth of 20 feet or more. This eroded material is transported by the moving ice and then deposited in various ways. The kind of transported material and method of deposition determine the nature of the parent material. Mineral matter transported and deposited by glaciers is known as drift. At least four glaciers advanced and retreated across what is now Aitkin County during the Wisconsinan ice age. Each deposited drift with different properties. The result is a complex mosaic of parent materials.

The method of deposition of glacial drift determines many of its internal and external properties. The internal characteristics include texture and density; external characteristics are manifested in the size and shape of the landform.

A mixture of all sizes of rock particles from boulders to clay is called till. Till is very common. It is deposited either by advancing or retreating glaciers into gently rolling to hilly landforms, known as moraines. Duluth and Dusler soils formed in till.

Another type of material deposited by glaciers is called outwash. Outwash can occur both on broad plains and in hilly areas. It is always very sandy or gravelly because rapidly moving meltwaters suspend the finer particles and transport them great distances, while coarser material is deposited close to its source. Cromwell and Mahtomedi soils formed in outwash.

Glacial meltwater was often impounded to form temporary lakes, which deposited sediment in layers either on broad flat plains or in pothole depressions. Brickton and Spooner soils formed in this glaciolacustrine sediment.

Other types of parent material in Aitkin County include alluvium and organic material. Alluvium is deposited on flood plains by rivers, and organic material accumulates in landscape depressions. Pengilly soils formed in alluvium, and Greenwood soils formed in organic material.

Time

Time is a significant soil-forming factor because most soil-forming processes take place over hundreds of years; the longer they continue, the more pronounced their effect. For example, forest soils typically have a thin dark surface layer over a grayish subsurface layer and have a subsoil that contains more clay than the overlying layers. If all other things are equal, an older soil will have thicker subsurface and subsoil layers than a younger soil. The passage of time is necessary for the formation of a soil. Fresh mineral deposits are not considered soil until the other factors have acted upon them.

The age of soils in Aitkin County is variable because of the sequence of glaciers and their gradual melting. Most of the ice melted around 10,000 years ago, but the vegetation that dominated soil formation may not have appeared until much later. The vast pineries of this region became established only about 3,000 years ago.

Classification of the Soils

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

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

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 Boralf (*Bor*, meaning cold, plus *alf*, from Alfisol).

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 Eutroboralfs (*Eutro*, meaning rich in base saturation, plus *boralfs*, the suborder of the Alfisols that has a cryic temperature 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. An example is Aquic Eutroboralfs.

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-silty, mixed, Aquic Eutroboralfs.

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
Aftad-----	Oxyaquic Glossoboralfs, coarse-loamy, mixed
Alban-----	Typic Glossoboralfs, coarse-loamy, mixed
Alstad-----	Glossaquic Eutroborafls, fine-loamy, mixed
Baudette-----	Aquic Eutroborafls, fine-silty, mixed
Beseman-----	Terric Borosaprists, loamy, mixed, dysic
Blackhoof-----	Histic Humaquepts, fine-loamy, mixed, nonacid, frigid
Borosaprists-----	Borosaprists
Bowstring-----	Fluvaquentic Borosaprists, euic
Branstad-----	Oxyaquic Eutroborafls, fine-loamy, mixed
Brennyville-----	Glossaquic Eutroborafls, coarse-loamy, mixed
Brickton-----	Vertic Epiaqualfs, fine, montmorillonitic, frigid
Bushville-----	Aquic Arenic Eutroborafls, loamy, mixed
Cathro-----	Terric Borosaprists, loamy, mixed, euic
Cormant-----	Mollic Psammaquents, mixed, frigid
Cowhorn-----	Aeric Endoaquepts, coarse-loamy, mixed, nonacid, frigid
Cromwell-----	Typic Dystrochrepts, sandy, mixed, frigid
Cushing-----	Glossic Eutroborafls, fine-loamy, mixed
Cutaway-----	Arenic Eutroborafls, loamy, mixed
Dalbo-----	Vertic Eutroborafls, fine, montmorillonitic
Duluth-----	Glossic Eutroborafls, fine-loamy, mixed
Dusler-----	Aeric Glossaqualfs, fine-loamy, mixed, frigid
Flak-----	Typic Eutroborafls, coarse-loamy, mixed
Fluvaquents-----	Fluvaquents, loamy
Freer-----	Aeric Glossaqualfs, fine-loamy, mixed, frigid
Friendship-----	Typic Udipsamments, mixed, frigid
Giese-----	Mollic Epiaquepts, coarse-loamy, mixed, frigid
Goodland-----	Glossic Eutroborafls, coarse-loamy, mixed
Greenwood-----	Typic Borohemists, dysic
Hamre-----	Histic Humaquepts, fine-loamy, mixed, nonacid, frigid
Hassman-----	Vertic Endoaquepts, fine, montmorillonitic, nonacid, frigid
Hillcity-----	Oxyaquic Eutroborafls, coarse-silty, mixed
Histosols-----	Histosols
Itasca-----	Glossic Eutroborafls, coarse-loamy, mixed
Jevne-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Leafriver-----	Histic Humaquepts, sandy, mixed, frigid
Lobo-----	Hemic Sphagnofibrists, dysic, frigid
Loxley-----	Typic Borosaprists, dysic
Lupton-----	Typic Borosaprists, euic
Mahtomedi-----	Typic Udipsamments, mixed, frigid
Mahtowa-----	Typic Endoaquolls, fine-loamy, mixed, frigid
Markey-----	Terric Borosaprists, sandy or sandy-skeletal, mixed, euic
Meehan-----	Aquic Udipsamments, mixed, frigid
Menahga-----	Typic Udipsamments, mixed, frigid
Milaca-----	Typic Eutroborafls, coarse-loamy, mixed
Millward-----	Typic Eutroborafls, coarse-loamy, mixed
Mooselake-----	Typic Borohemists, euic
Mora-----	Aquic Eutroborafls, coarse-loamy, mixed
Morph-----	Typic Glossaqualfs, fine-loamy, mixed, frigid
Nemadji-----	Aquentic Haplorthods, sandy, mixed, frigid
Newson-----	Humaqueptic Psammaquents, mixed, frigid
Nokay-----	Udollic Epiaqualfs, coarse-loamy, mixed, frigid
Northwood-----	Histic Humaquepts, sandy over loamy, mixed, nonacid, frigid
Oesterle-----	Aquic Glossoboralfs, coarse-loamy, mixed
Omega-----	Typic Haplorthods, sandy, mixed, frigid
Pengilly-----	Typic Fluvaquents, coarse-loamy, mixed, nonacid, frigid
Pomroy-----	Arenic Eutroborafls, loamy, mixed
Redby-----	Aquic Udipsamments, mixed, frigid
Rifle-----	Typic Borohemists, euic
Ronneby-----	Udollic Epiaqualfs, coarse-loamy, mixed, frigid
Roscommon-----	Mollic Psammaquents, mixed, frigid
Rosholt-----	Typic Glossoboralfs, coarse-loamy, mixed
Sago-----	Histic Humaquepts, coarse-loamy, mixed, nonacid, frigid
Sandwick-----	Arenic Glossaqualfs, loamy, mixed, frigid
Sax-----	Histic Humaquepts, fine-silty, mixed, nonacid, frigid

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Seelyeville-----	Typic Borosaprists, euic
Shooker-----	Typic Endoaqualfs, fine-loamy, mixed, frigid
Spooner-----	Mollic Endoaqualfs, fine-silty, mixed, frigid
Stuntz-----	Aeric Glossaqualfs, fine-loamy, mixed, frigid
Talmoon-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Tawas-----	Terric Borosaprists, sandy or sandy-skeletal, mixed, euic
Twig-----	Histic Humaquepts, coarse-loamy, mixed, acid, frigid
Udipsamments-----	Udipsamments
Udorthents-----	Udorthents
Wabedo-----	Aquic Dystric Eutrochrepts, coarse-loamy, mixed, frigid
Warba-----	Glossic Eutroboralfs, fine-loamy, mixed
Waskish-----	Typic Sphagnofibrists, dysic, frigid
Watab-----	Arenic Epiaqualfs, loamy, mixed, frigid
Waukenabo-----	Mollic Endoaqualfs, coarse-loamy, mixed, frigid
Wawina-----	Typic Dystrochrepts, coarse-loamy, mixed, frigid
Wealthwood-----	Arenic Epiaqualfs, loamy, mixed, frigid
Willosippi-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Winterfield-----	Aquic Udipsamments, mixed, frigid

Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
72	Shooker very fine sandy loam-----	18	*
119C	Pomroy loamy fine sand, 6 to 12 percent slopes-----	783	*
124	Brickton silt loam-----	10,988	0.9
133B	Dalbo very fine sandy loam, 1 to 6 percent slopes-----	943	*
142	Nokay fine sandy loam-----	610	*
144B	Flak sandy loam, 3 to 8 percent slopes-----	806	*
144C	Flak sandy loam, 8 to 15 percent slopes-----	167	*
146B	Wabedo sandy loam, 1 to 6 percent slopes-----	1,369	0.1
147	Spooner silt loam-----	9,945	0.8
152B	Milaca fine sandy loam, 3 to 8 percent slopes-----	21,647	1.7
152C	Milaca fine sandy loam, 8 to 15 percent slopes-----	6,031	0.5
152E	Milaca fine sandy loam, 15 to 25 percent slopes-----	2,469	0.2
164B	Mora fine sandy loam, 1 to 4 percent slopes-----	46,327	3.6
166	Ronneby loam-----	32,699	2.6
167B	Baudette silt loam, 1 to 5 percent slopes-----	933	*
186	Nemadji loamy fine sand-----	6,289	0.5
188B	Omega loamy fine sand, 2 to 6 percent slopes-----	5,996	0.5
188C	Omega loamy fine sand, 6 to 12 percent slopes-----	2,049	0.2
188E	Omega loamy sand, 12 to 25 percent slopes-----	573	*
202	Meehan loamy sand-----	12,895	1.0
204B	Branstad loam, 2 to 6 percent slopes-----	16,882	1.3
204C	Cushing loam, 6 to 12 percent slopes-----	7,174	0.6
204E	Cushing loam, 12 to 25 percent slopes-----	3,433	0.3
218	Watab fine sand-----	5,574	0.4
240B	Warba very fine sandy loam, 1 to 6 percent slopes-----	4,391	0.3
240C	Warba very fine sandy loam, 6 to 12 percent slopes-----	1,478	0.1
243	Stuntz very fine sandy loam-----	6,846	0.5
266	Freer silt loam-----	4,933	0.4
268B	Cromwell fine sandy loam, 1 to 6 percent slopes-----	4,404	0.3
268C	Cromwell sandy loam, 6 to 12 percent slopes-----	6,845	0.5
268E	Cromwell fine sandy loam, 12 to 25 percent slopes-----	5,204	0.4
268F	Cromwell fine sandy loam, 25 to 40 percent slopes-----	1,552	0.1
292	Alstad loam-----	23,150	1.8
302B	Rosholt fine sandy loam, 2 to 6 percent slopes-----	8,273	0.6
302C	Rosholt fine sandy loam, 6 to 12 percent slopes-----	2,082	0.2
346	Talmoon fine sandy loam-----	10,608	0.8
428	Hassman muck-----	4,725	0.4
454B	Mahtomedi loamy coarse sand, 2 to 6 percent slopes-----	4,718	0.4
454C	Mahtomedi loamy coarse sand, 6 to 12 percent slopes-----	4,262	0.3
454E	Mahtomedi loamy coarse sand, 12 to 25 percent slopes-----	3,055	0.2
454F	Mahtomedi gravelly loamy sand, 25 to 40 percent slopes-----	2,398	0.2
458B	Menahga loamy sand, 1 to 6 percent slopes-----	7,061	0.6
458C	Menahga loamy sand, 6 to 12 percent slopes-----	3,055	0.2
458E	Menahga loamy sand, 12 to 25 percent slopes-----	1,712	0.1
464B	Brennyville silt loam, 2 to 5 percent slopes-----	6,057	0.5
469B	Hillcity silt loam, 1 to 6 percent slopes-----	1,238	*
502	Dusler silt loam-----	28,477	2.2
504B	Duluth fine sandy loam, 1 to 6 percent slopes-----	26,077	2.0
504C	Duluth fine sandy loam, 6 to 12 percent slopes-----	11,623	0.9
504E	Duluth fine sandy loam, 12 to 25 percent slopes-----	3,598	0.3
531	Beseman muck-----	7,008	0.5
532	Sago muck-----	16,412	1.3
533	Loxley peat-----	34,924	2.7
540	Seelyeville muck-----	50,807	4.0
541	Rifle peat-----	54,683	4.3
543	Markey muck-----	23,760	1.9
544	Cathro muck-----	71,243	5.6
546	Lupton muck-----	102,158	8.0
549	Greenwood peat-----	76,233	6.0
563	Northwood muck-----	2,496	0.2
564	Friendship loamy sand-----	6,605	0.5
607	Pengilly silt loam-----	8,608	0.7

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
615	Cowhorn loamy very fine sand-----	11,133	0.9
617B	Goodland silt loam, 1 to 10 percent slopes-----	421	*
618B	Itasca silt loam, 1 to 6 percent slopes-----	1,315	0.1
621	Morph very fine sandy loam-----	21	*
625	Sandwick loamy sand-----	22,895	1.8
627	Tawas muck-----	31	*
628	Talmoon muck, depressional-----	12,075	0.9
629B	Wawina loamy very fine sand, 1 to 10 percent slopes-----	6,110	0.5
672	Willossippi loam-----	10,815	0.8
685	Oesterle fine sandy loam-----	12,260	1.0
732B	Bushville loamy fine sand, 1 to 6 percent slopes-----	6,957	0.5
734	Cormant loamy fine sand, stratified substratum-----	3,379	0.3
736	Ronneby-Mora complex-----	13,196	1.0
738B	Milaca-Millward complex, 2 to 8 percent slopes-----	5,897	0.5
738C	Milaca-Millward complex, 8 to 15 percent slopes-----	1,650	0.1
759	Waukenabo fine sandy loam-----	7,652	0.6
795	Redby loamy fine sand, stratified substratum-----	1,748	0.1
797	Mooselake and Lupton mucky peats-----	481	*
798	Sago and Roscommon soils-----	27	*
799	Seelyeville-Bowstring association-----	83	*
869	Lobo and Waskish peats-----	2,569	0.2
870B	Itasca-Goodland complex, 2 to 6 percent slopes-----	3,682	0.3
870C	Itasca-Goodland complex, 6 to 12 percent slopes-----	7,237	0.6
870E	Itasca-Goodland complex, 12 to 25 percent slopes-----	3,900	0.3
872	Pengilly-Winterfield association-----	1,874	0.1
928C	Cushing-Mahtomedi complex, 2 to 10 percent slopes-----	16,573	1.3
928D	Cushing-Mahtomedi complex, 10 to 25 percent slopes-----	14,552	1.1
928F	Cushing-Mahtomedi complex, 25 to 40 percent slopes-----	1,963	0.2
980	Blackhoof and Mahtowa soils-----	7,793	0.6
990	Twig and Giese soils-----	15,678	1.2
1002	Borosaprists and Fluvaquents, frequently flooded-----	18,478	1.4
1030	Pits, gravel-Udipsamments complex-----	850	*
1031	Histosols, ponded-----	11,523	0.9
1072	Udorthents, shallow (sanitary landfill)-----	35	*
1115	Newson loamy sand-----	8,142	0.6
1150	Jevne fine sandy loam-----	10,013	0.8
1154	Sax muck-----	7,627	0.6
1353B	Cutaway loamy fine sand, 1 to 6 percent slopes-----	9,142	0.7
1354A	Aftad fine sandy loam, 0 to 3 percent slopes-----	879	*
1356	Water, miscellaneous-----	30	*
1372	Wealthwood loamy fine sand-----	1,877	0.1
1375B	Alban fine sandy loam, 3 to 8 percent slopes-----	382	*
1878	Hamre muck-----	11,858	0.9
1982	Baudette-Spooner complex-----	10,155	0.8
1983	Cathro muck, stratified substratum-----	30,254	2.4
1984	Leafriver muck-----	8,794	0.7
W	Water-----	113,470	8.9
	Total-----	1,276,800	100.0

* Less than 0.1 percent.

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Soil Series and Detailed Soil Map Units

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

Characteristics of the soil and the material in which it formed are identified for each soil series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 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 soil maps in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given in Part II of this survey.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils 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, 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, Cormant loamy fine sand, stratified substratum, is a phase of the Cormant series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, 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. Ronneby-Mora complex is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map these soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Seelyeville-Bowstring association 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. Lobo and Waskish peats is an undifferentiated group in this survey area.

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

The table "Acreage and Proportionate Extent of the Soils" in Parts I and II of this survey gives the acreage and proportionate extent of each map unit. Other tables (see Contents) 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.

Aftad Series

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed Oxyaquic
Glossoboralfs

Typical Pedon

Aftad fine sandy loam, 0 to 3 percent slopes, 1,040 feet north and 2,580 feet east of the southwest corner of sec. 26, T. 46 N., R. 26 W.

- A—0 to 3 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common fine and very fine roots; slightly acid; clear smooth boundary.
- E—3 to 16 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; few fine roots; slightly acid; clear wavy boundary.
- E/B—16 to 25 inches; about 70 percent brown (7.5YR 5/3) loamy fine sand (E), very pale brown (10YR 7/3) dry; about 30 percent remnants of brown (7.5YR 4/4) fine sandy loam (Bt); weak medium subangular blocky structure; very friable; few faint brown (7.5YR 4/3) clay bridges between sand grains; few fine roots; slightly acid; clear wavy boundary.
- Bt1—25 to 33 inches; brown (7.5YR 4/4) very fine sandy loam; weak medium subangular blocky structure; friable; few faint brown (7.5YR 4/3) clay bridges between sand grains; slightly acid; clear wavy boundary.
- Bt2—33 to 38 inches; brown (7.5YR 4/4) loamy very fine sand; weak medium subangular blocky structure; very friable; few faint brown (7.5YR 4/3) clay bridges between sand grains; slightly acid; clear wavy boundary.
- BC—38 to 44 inches; dark yellowish brown (10YR 4/4) and brown (10YR 5/3) loamy fine sand; few fine distinct strong brown (7.5YR 5/6) iron concentrations; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.
- C—44 to 60 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) fine sand stratified with few thin bands of brown (7.5YR 4/4) loamy fine sand; single grain; loose; moderately acid.

Range in Characteristics*A horizon:*

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

E horizon:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—2 or 3
 Texture—loamy fine sand, loamy sand, sandy loam, fine sandy loam, loam, or silt loam

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR, 7.5YR, or 5YR
 Value—4 or 5
 Chroma—3 to 6
 Texture—very fine sandy loam, loamy very fine sand, sandy loam, or fine sandy loam

BC horizon:

Hue—10YR, 7.5YR, or 5YR
 Value—4 or 5
 Chroma—3 to 6
 Texture—loamy fine sand, sandy loam, fine sandy loam, or very fine sandy loam

C horizon:

Hue—10YR, 7.5YR, or 5YR
 Value—4 to 6
 Chroma—4 to 6
 Texture—stratified fine sand, loamy fine sand, silt, very fine sand, sand, loamy sand, very fine sandy loam, loam, or silt loam

1354A—Aftad fine sandy loam, 0 to 3 percent slopes**Composition**

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

Setting

Landform: Flats and slight rises on lake plains
Slope: 0 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: 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 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

- Oesterle and similar soils
- Omega and similar soils
- Nemadji and similar soils
- Wealthwood and similar soils
- Leafriver 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

Alban Series

Drainage class: Well drained

Permeability: Moderate

Landform: Lake plains and outwash plains

Parent material: Glaciolacustrine deposits

Slope range: 3 to 8 percent

Taxonomic class: Coarse-loamy, mixed Typic Glossoboralfs

Typical Pedon

Alban fine sandy loam, 3 to 8 percent slopes, 1,700 feet south and 200 feet west of the northeast corner of sec. 23, T. 45 N., R. 25 W.

A—0 to 3 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; common medium roots; slightly acid; abrupt smooth boundary.

E—3 to 12 inches; brown (10YR 4/3) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; very friable;

common fine roots; slightly acid; clear wavy boundary.

E/B—12 to 17 inches; about 75 percent brown (10YR 5/3) very fine sandy loam (E), very pale brown (10YR 7/3) dry; about 25 percent remnants of yellowish brown (10YR 5/6) very fine sandy loam (Bt); moderate thin platy structure; very friable; few fine roots; slightly acid; gradual wavy boundary.

B/E—17 to 23 inches; about 80 percent brown (7.5YR 5/4) loamy very fine sand (Bt); brown (7.5YR 5/2) loamy very fine sand (E); massive; very friable; few very fine roots; slightly acid; clear wavy boundary.

Bt—23 to 39 inches; brown (7.5YR 4/4) very fine sandy loam; moderate medium subangular blocky structure; friable; common distinct dark brown (7.5YR 3/4) clay films on faces of peds; slightly acid; clear smooth boundary.

2C—39 to 60 inches; brown (7.5YR 4/4), stratified fine sand; single grain; loose; slightly acid.

Range in Characteristics

Features: A BC horizon in some pedons

A horizon:

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

E horizon:

Hue—10YR or 7.5YR
Value—4 to 6
Chroma—2 or 3
Texture—fine sandy loam, very fine sandy loam, loamy very fine sand, loamy sand, loamy fine sand, sandy loam, loam, or silt loam

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR, 7.5YR, or 5YR
Value—4 or 5
Chroma—3 to 6
Texture—very fine sandy loam, sandy loam, fine sandy loam, or loamy very fine sand

2C horizon:

Hue—10YR, 7.5YR, or 5YR
Value—4 to 6
Chroma—4 to 6
Texture—stratified fine sand, silt, very fine sand, sand, loamy sand, very fine sandy loam, loamy fine sand, loam, or silt loam

1375B—Alban fine sandy loam, 3 to 8 percent slopes

Composition

Alban and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rises on lake plains and outwash plains

Slope: 3 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 8.7 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

- Leafriver and similar soils
- Wealthwood and similar soils
- Nemadji and similar soils
- Omega 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

Alstad Series

Drainage class: Somewhat poorly 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 Glossoaquic
Eutroboralfs

Typical Pedon

Alstad loam, 2,400 feet south and 200 feet east of the northwest corner of sec. 22, T. 48 N., R. 27 W.

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

E—4 to 14 inches; grayish brown (10YR 5/2) sandy loam, light gray (10YR 7/2) dry; common medium prominent reddish brown (5YR 5/4) iron concentrations; weak thin platy structure; very friable; many fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

B/E—14 to 22 inches; about 65 percent brown (7.5YR 5/4) loam (Bt) with about 35 percent tongues of grayish brown (10YR 5/2) fine sandy loam (E), light gray (10YR 7/2) dry; common fine distinct reddish brown (5YR 5/4) iron concentrations and brown (7.5YR 5/2) iron depletions; weak medium and coarse subangular blocky structure; friable; many fine roots; common distinct brown (7.5YR 5/2) clay films on faces of peds; 4 percent gravel; moderately acid; clear wavy boundary.

Bt—22 to 31 inches; brown (7.5YR 5/4) loam; common medium distinct reddish brown (5YR 5/4) iron concentrations; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; continuous distinct dark brown (7.5YR 4/2) and brown (7.5YR 5/2) clay films on faces of peds and in pores; 5 percent gravel; slightly acid; clear wavy boundary.

BC—31 to 52 inches; brown (7.5YR 5/4) loam; common medium faint reddish brown (5YR 5/4) iron concentrations and faint brown (7.5YR 5/2) iron depletions; weak medium subangular blocky structure; firm; few fine roots; few thin clay films on faces of peds in the upper part; 5 percent gravel; neutral; clear wavy boundary.

C—52 to 60 inches; brown (7.5YR 5/4) loam; many large prominent light brownish gray (2.5Y 6/2) iron depletions; massive; friable; 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to more than 60 inches

Other features: Some pedons do not have a BC horizon.

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 3 percent gravel

E horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 or 3

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

Content of rock fragments—0 to 3 percent gravel

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 or 4

Texture—loam, sandy clay loam, or clay loam

Content of rock fragments—2 to 15 percent gravel

C horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—4 to 6

Chroma—2 to 4

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

Content of rock fragments—2 to 15 percent gravel, 0 to 3 percent cobbles

292—Alstad loam

Composition

Alstad and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines

Slope: 0 to 3 percent

Component Description

Surface layer texture: 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: 1.0 to 2.5 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

- Cathro and similar soils
- Hamre and similar soils
- Talmoon and similar soils
- Cushing 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

Baudette Series

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 5 percent

Taxonomic class: Fine-silty, mixed Aquic Eutroboralfs

Typical Pedon

Baudette silt loam, 1 to 5 percent slopes, 1,650 feet north and 1,750 feet east of the southwest corner of sec. 11, T. 51 N., R. 24 W.

Oa—0 to 2 inches; well decomposed leaf litter.

A—2 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure; very friable; many very fine roots; slightly acid; abrupt wavy boundary.

E—4 to 13 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; moderate thin and medium platy structure; very friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—13 to 27 inches; dark yellowish brown (10YR 4/4) silt loam; few medium faint dark grayish brown (10YR 4/2) iron depletions; moderate medium subangular blocky structure; firm; common very fine roots; many distinct dark

brown (10YR 4/3) and dark grayish brown (10YR 4/2) clay films on faces of peds; common distinct brown (10YR 5/3) silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt2—27 to 35 inches; yellowish brown (10YR 5/4) silt loam; few fine faint yellowish brown (10YR 5/6) iron concentrations; moderate coarse subangular blocky structure; firm; common very fine roots; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few distinct brown (10YR 5/3) silt coatings on faces of peds; neutral; clear wavy boundary.

C1—35 to 45 inches; light yellowish brown (2.5Y 6/4), stratified silt loam, very fine sandy loam, and loamy very fine sand; few fine prominent light gray (10YR 7/2) iron depletions and dark brown (10YR 4/3) iron concentrations; weak medium platy soil fragments; very friable; common very fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

C2—45 to 54 inches; light olive brown (2.5Y 5/4) silt loam; few fine prominent light gray (2.5Y 7/2) iron depletions and dark yellowish brown (10YR 4/4) iron concentrations; weak thick platy soil fragments; friable; few very fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

C3—54 to 60 inches; light yellowish brown (2.5Y 6/4), stratified silt loam, very fine sandy loam, and loamy very fine sand; many large faint light olive brown (2.5Y 5/4) iron concentrations, few fine prominent light gray (2.5Y 7/2) iron depletions, and few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; massive; friable; few very fine roots; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 36 inches

Other features: A BE horizon in some pedons

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 or very fine sandy loam

Bt horizon:

Hue—2.5Y or 10YR

Value—4 or 5
 Chroma—2 to 4
 Texture—silt loam, silty clay loam, loam, or clay loam

C horizon:

Hue—2.5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—silt loam, very fine sandy loam, loam, loamy very fine sand, or thin layers of finer or coarser textures

167B—Baudette silt loam, 1 to 5 percent slopes***Composition***

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

Setting

Landform: Flats and slight rises on lake plains
Slope: 1 to 5 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

- Sax and similar soils
- Spooner and similar soils
- Soils that have a loamy till substratum

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

1982—Baudette-Spooner complex***Composition***

Baudette and similar soils: About 55 percent
 Spooner and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Baudette—slight rises on lake plains;
 Spooner—flats and swales on flood plains
Slope: 0 to 2 percent

Component Description***Baudette***

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

Spooner

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: Rare
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 11.7 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

- Sax 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

Beseman Series

Drainage class: Very poorly drained

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

Landform: Bogs

Parent material: Organic material over till

Slope range: 0 to 1 percent

Taxonomic class: Loamy, mixed, dysic Terric Borosaprists

Typical Pedon

Beseman muck, 2,050 feet south and 150 feet east of the northwest corner of sec. 28, T. 50 N., R. 26 W.

Oa1—0 to 14 inches; muck, dark reddish brown (5YR 2.5/2) broken face and pressed, black (5YR 2.5/1) rubbed; 30 percent fiber, 15 percent rubbed; primarily herbaceous fibers; weak medium subangular blocky structure; friable; extremely acid; gradual smooth boundary.

Oa2—14 to 40 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 25 percent fiber, 10 percent rubbed; primarily herbaceous fibers; massive; friable; extremely acid; abrupt smooth boundary.

Cg1—40 to 49 inches; dark gray (5Y 4/1) and gray (5Y 5/1) silt loam; common medium prominent dark brown (7.5YR 4/4) iron concentrations along root channels; massive; friable; 2 percent gravel; slightly acid; gradual wavy boundary.

Cg2—49 to 60 inches; gray (5Y 5/1) silty clay loam; few medium prominent dark brown (7.5YR 4/4) iron concentrations along root channels; massive; friable; 2 percent gravel; slightly acid.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches

Reaction: Extremely acid

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

Cg horizon:

Hue—5Y, 2.5Y, 10YR, 7.5YR, or 5YR

Value—4 or 5

Chroma—1 or 2

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

531—Beseman muck

Composition

Beseman and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Bogs

Slope: 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 material over till

Flooding: None

Seasonal high water table: At the surface to 2 feet above the surface

Available water capacity to 60 inches or root-limiting layer: About 26.9 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

- Dusler and similar soils
- Sandwick and similar soils
- Loxley and similar soils
- Twig and similar soils
- Cathro and similar soils
- Organic soils that are less decomposed than the Beseman soil

Major Uses of the Unit

- Forest land

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

- Forest Land section

Blackhoof Series

Drainage class: Very poorly drained

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

Landform: Moraines

Parent material: Organic material over till

Slope range: 0 to 1 percent

Taxonomic class: Fine-loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Blackhoof muck, in an area of Blackhoof and Mahtowa soils, 1,700 feet north and 150 feet west of the southeast corner of sec. 11, T. 46 N., R. 25 W.

Oa1—0 to 4 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 25 percent fiber, 10 percent rubbed; primarily herbaceous fibers; moderate fine granular structure; very friable; many medium roots; strongly acid; abrupt smooth boundary.

Oa2—4 to 10 inches; muck, black (N 2/0) broken face, rubbed, and pressed; 20 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak fine subangular blocky structure; very friable; common medium roots; strongly acid; abrupt smooth boundary.

A—10 to 14 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; firm; common medium roots; 5 percent gravel, 1 percent cobbles; strongly acid; clear wavy boundary.

Bg1—14 to 17 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) clay loam; few medium prominent brown (7.5YR 4/4) iron concentrations; weak medium subangular blocky structure; firm; few medium roots; 5 percent gravel, 1 percent cobbles; strongly acid; clear wavy boundary.

Bg2—17 to 26 inches; grayish brown (2.5Y 5/2) loam; many medium prominent strong brown (7.5YR 5/8) iron concentrations; weak medium platy structure; friable; few fine roots; 7 percent gravel, 1 percent cobbles; moderately acid; clear wavy boundary.

Bg3—26 to 41 inches; grayish brown (2.5Y 5/2) loam; many medium prominent brown (7.5YR 4/4), few medium prominent dark greenish gray (5BG 4/1), and few medium prominent greenish gray (5BG 5/1) iron depletions; weak medium platy structure; friable; 7 percent gravel, 1 percent cobbles; moderately acid; clear smooth boundary.

C—41 to 60 inches; reddish brown (5YR 4/4) loam; many medium prominent strong brown (7.5YR 4/6) iron concentrations, few medium prominent

greenish gray (5BG 5/1) iron depletions, and few medium prominent dark greenish gray (5BG 4/1) iron depletions; massive; friable; 7 percent gravel, 1 percent cobbles; neutral.

Range in Characteristics

Depth to mineral material: 8 to 16 inches

Depth to carbonates: 40 to more than 60 inches

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2

Chroma—0 to 2

Texture—muck

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam or clay loam

Content of rock fragments—0 to 5 percent gravel, 0 to 2 percent cobbles

Bg horizon:

Hue—2.5Y, 10YR, 7.5YR, or 5YR

Value—3 to 5

Chroma—1 or 2

Texture—loam or clay loam

Content of rock fragments—0 to 10 percent gravel, 0 to 2 percent cobbles

C horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 or 5

Chroma—1 to 4

Texture—loam or clay loam

Content of rock fragments—0 to 10 percent gravel, 0 to 2 percent cobbles

980—Blackhoof and Mahtowa soils**Composition**

Blackhoof: Variable

Mahtowa: Variable

Inclusions: About 10 percent

Setting

Landform: Blackhoof—depressions on moraines;

Mahtowa—drainageways and flats on moraines

Slope: 0 to 1 percent

Component Description**Blackhoof**

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained
Dominant parent material: Organic material over 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 13.9 inches
Organic matter content: Very high

Mahtowa

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 11.3 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

- Seelyeville and similar soils
- Dusler and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

1002—Borosaprists and Fluvaquents, frequently flooded

Composition

Borosaprists: Variable
 Fluvaquents: Variable
 Inclusions: About 10 percent

Setting

Landform: Flats and swales on flood plains
Slope: 0 to 2 percent

Component Description

Borosaprists

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic material over alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 3 feet below the surface
Available water capacity to 60 inches or root-limiting layer: About 21.2 inches
Organic matter content: Very high

Fluvaquents

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 10.8 inches
Organic matter content: High

Inclusions

- Winterfield and similar soils
- Pengilly and similar soils
- Soils that have thinner organic material

Major Uses of the Unit

- Wildlife habitat

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

- Wildlife Habitat section

Bowstring Series

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

Typical Pedon

Bowstring muck, in an area of Seelyeville-Bowstring association, 2,500 feet south and 2,300 feet west of the northeast corner of sec. 26, T. 59 N., R. 27 W.; in Itasca County;

- Oa1—0 to 11 inches; muck, dark reddish brown (5YR 2.5/2) broken face and rubbed, dark brown (7.5YR 3/2) pressed; 30 percent fiber, 10 percent rubbed; primarily herbaceous fibers; weak medium subangular blocky structure; friable; many coarse and medium roots; very strongly acid; clear smooth boundary.
- Oa2—11 to 17 inches; muck, very dark grayish brown (10YR 3/2) broken face, rubbed, and pressed; 7 percent fiber, 2 percent rubbed; primarily herbaceous fibers; massive; very friable; common fine and medium roots; strongly acid; abrupt smooth boundary.
- Oa3—17 to 28 inches; muck, dark reddish brown (5YR 2.5/2) broken face and rubbed, dark brown (7.5YR 3/2) pressed; 30 percent fiber, 10 percent rubbed; primarily herbaceous fibers; weak medium subangular blocky structure; friable; few fine and medium roots; 5 percent wood fragments; strongly acid; gradual wavy boundary.
- Oa4—28 to 38 inches; muck, very dark gray (10YR 3/1) broken face, very dark grayish brown (10YR 3/2) rubbed, and dark grayish brown (10YR 4/2) pressed; 7 percent fiber, 2 percent rubbed; primarily herbaceous fibers; massive; very friable; strongly acid; gradual smooth boundary.
- C—38 to 43 inches; gray (5Y 5/1) mucky sand; massive; very friable; strongly acid; clear smooth boundary.
- O'a—43 to 50 inches; muck, very dark gray (10YR 3/1) broken face and rubbed, very dark grayish brown (10YR 3/2) pressed; 10 percent fiber, 2 percent rubbed; primarily herbaceous fibers; massive; very friable; 5 percent wood fragments; strongly acid; clear smooth boundary.
- Cg—50 to 52 inches; gray (5Y 5/1) mucky sand; massive; very friable; 10 percent wood fragments; strongly acid; clear smooth boundary.
- O''a—52 to 56 inches; muck, very dark gray (10YR 3/1) broken face and rubbed, very dark grayish brown (10YR 3/2) pressed; 10 percent fiber, 2 percent rubbed; primarily woody fibers; massive; very friable; 20 percent wood fragments; strongly acid; clear smooth boundary.
- C'g—56 to 60 inches; gray (5Y 5/1) mucky sand; massive; friable; strongly acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Depth to the C horizon: 2 to 48 inches

Reaction: Moderately acid to moderately alkaline in the C horizon

Content of wood fragments: 0 to 10 percent throughout

Other features: Thin mineral layers within the organic material

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

C horizon:

Hue—5Y, 2.5Y, 10YR, or 7.5YR

Value—2 to 6

Chroma—1 to 3

Texture—sandy or loamy layers

Branstad Series

Drainage class: Moderately well drained

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

Landform: Moraines

Parent material: Till

Slope range: 2 to 6 percent

Taxonomic class: Fine-loamy, mixed Oxyaquic Eutroboralfs

Typical Pedon

Branstad loam, 2 to 6 percent slopes, 2,900 feet north and 1,150 feet east of the southwest corner of sec. 14, T. 49 N., R. 26 W.

A—0 to 2 inches; black (10YR 2/1) loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; friable; many fine roots; 1 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 3 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; few fine roots; 1 percent gravel; moderately acid; clear irregular boundary.

Bw—3 to 6 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; 2 percent gravel; moderately acid; clear irregular boundary.

E'—6 to 9 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; weak medium platy structure; friable; few fine roots; 6 percent gravel, 2 percent cobbles; moderately acid; clear wavy boundary.

E/B—9 to 17 inches; about 65 percent grayish brown (10YR 5/2) fine sandy loam (E), very pale brown (10YR 8/2) dry; about 35 percent brown (7.5YR

4/4) loam (Bt); moderate medium subangular blocky structure; friable; few distinct dark brown (7.5YR 3/4) clay films on faces of peds and in pores; 6 percent gravel, 2 percent cobbles; moderately acid; gradual wavy boundary.

Bt1—17 to 26 inches; brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; firm; many distinct dark brown (7.5YR 3/4) clay films on faces of peds and in pores; 4 percent gravel; slightly acid; clear smooth boundary.

Bt2—26 to 36 inches; brown (7.5YR 4/4) loam; strong coarse subangular blocky structure; firm; common distinct dark brown (7.5YR 3/4) clay films on faces of peds and in pores; 4 percent gravel; slightly acid; clear smooth boundary.

Bt3—36 to 43 inches; brown (7.5YR 4/4) loam; many medium distinct yellowish brown (10YR 5/4) iron concentrations; moderate coarse prismatic structure; firm; many distinct dark brown (7.5YR 3/4) clay films on faces of peds and in pores; 6 percent gravel; slightly acid; clear smooth boundary.

C—43 to 60 inches; dark yellowish brown (10YR 4/4) loam; common medium distinct grayish brown (10YR 5/2) iron depletions; massive; friable; 6 percent gravel; neutral.

Range in Characteristics

Thickness of the loess mantle: 0 to 20 inches

Content of rock fragments: 0 to 15 percent gravel, 0 to 5 percent cobbles

Content of clay and sand in the Bt horizon: 20 to 30 percent clay, more than 45 percent sand

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam or fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

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

Bw horizon:

Hue—10YR

Value—4 to 6

Chroma—3 or 4

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

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 to 5

Texture—loam, sandy clay loam, or sandy loam

C horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—4 or 5

Chroma—3 or 4

Texture—loam, sandy loam, or sandy clay loam

204B—Branstad loam, 2 to 6 percent slopes

Composition

Branstad and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rises on moraines

Slope: 2 to 6 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 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.2 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

- Hamre and similar soils
- Talmoon and similar soils
- Seelyeville and similar soils
- Alstad and similar soils
- Cromwell and similar soils
- Cutaway 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

Brennyville Series

Drainage class: Moderately well drained

Permeability: Upper part—moderate; next part—slow; dense till—very slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 2 to 5 percent

Taxonomic class: Coarse-loamy, mixed Glossaquic Eutroboralfs

Typical Pedon

Brennyville silt loam, 2 to 5 percent slopes, 20 feet south and 120 feet west of the northeast corner of sec. 34, T. 43 N., R. 23 W.

A—0 to 5 inches; very dark brown (10YR 2/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many medium roots; 1 percent gravel, 1 percent cobbles; strongly acid; abrupt smooth boundary.

E1—5 to 8 inches; grayish brown (10YR 5/2) silt loam; common fine faint yellowish brown (10YR 5/6) iron concentrations; weak medium platy structure; very friable; many fine roots; 1 percent gravel, 1 percent cobbles; very strongly acid; clear wavy boundary.

E2—8 to 18 inches; grayish brown (10YR 5/2) silt loam; common medium faint yellowish brown (10YR 5/6) iron concentrations; moderate medium platy structure; very friable; common fine roots; 2 percent gravel, 1 percent cobbles; very strongly acid; clear wavy boundary.

E/B—18 to 24 inches; about 60 percent grayish brown (10YR 5/2) silt loam (E), light gray (10YR 7/2) dry; about 40 percent remnants of brown (7.5YR 5/4) silt loam (Bt); common medium faint strong brown (7.5YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; common fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of peds and in pores; 3 percent gravel, 1 percent cobbles; very strongly acid; gradual wavy boundary.

2Bt—24 to 32 inches; reddish brown (5YR 4/4) loam; common medium distinct reddish gray (5YR 5/2) iron depletions and common medium distinct yellowish red (5YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; common fine roots; many faint reddish brown (5YR 5/3) clay films on faces of peds and in pores; 8 percent gravel, 2 percent cobbles; very strongly acid; clear wavy boundary.

2BC—32 to 43 inches; dark reddish brown (5YR 3/4) sandy loam; common medium distinct yellowish red (5YR 5/6) iron concentrations; moderate medium platy structure; firm; 10 percent gravel, 2 percent cobbles; strongly acid; clear wavy boundary.

2Cd—43 to 60 inches; reddish brown (5YR 4/4) sandy loam; massive; moderate medium plate-like soil fragments; very firm; 10 percent gravel, 3 percent cobbles; strongly acid.

Range in Characteristics

Thickness of the silty mantle: 15 to 30 inches

Depth to dense till: 40 to 60 inches

Other features: A Bt horizon in some pedons

A horizon:

Hue—10YR

Value—2 to 5

Chroma—1 to 3

Texture—silt loam

Content of rock fragments—0 to 5 percent gravel, 0 to 3 percent cobbles

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 or 3

Texture—silt loam or very fine sandy loam

Content of rock fragments—0 to 5 percent gravel, 0 to 3 percent cobbles

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

2Bt horizon:

Hue—7.5YR, 5YR, or 2.5YR

Value—4 or 5

Chroma—3 to 6

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—3 to 20 percent gravel, 0 to 10 percent cobbles

2BC and 2Cd horizons:

Hue—7.5YR, 5YR, or 2.5YR

Value—3 to 5

Chroma—3 to 5

Texture—sandy loam or fine sandy loam
 Content of rock fragments—3 to 20 percent gravel, 0 to 10 percent cobbles

464B—Brennyville silt loam, 2 to 5 percent slopes

Composition

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

Setting

Landform: Rises on moraines
Slope: 2 to 5 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 over 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 6.9 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

- Twig and similar soils
- Giese and similar soils
- Freer and similar soils
- Milaca 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

Brickton Series

Drainage class: Poorly drained
Permeability: Upper part—moderate; lower part—slow or moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic, frigid Vertic Epiaqualfs

Typical Pedon

Brickton silt loam, 2,300 feet north and 1,200 feet east of the southwest corner of sec. 27, T. 51 N., R. 24 W.

- Oa—0 to 1 inch; well decomposed leaf litter.
 A—1 to 4 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; very friable; common fine roots; slightly acid; clear smooth boundary.
 E—4 to 11 inches; grayish brown (10YR 5/2) silt loam, white (10YR 8/1) dry; moderate thin platy structure; friable; few fine roots; slightly acid; clear wavy boundary.
 Btg1—11 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium distinct light olive brown (2.5Y 5/4) iron concentrations; moderate medium prismatic structure parting to moderate fine angular blocky; firm; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds; neutral; clear smooth boundary.
 Btg2—22 to 32 inches; grayish brown (2.5Y 5/2) clay; common fine distinct olive brown (2.5Y 4/4) iron concentrations; moderate coarse prismatic structure parting to moderate medium angular blocky; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; neutral; clear wavy boundary.
 BCg—32 to 39 inches; grayish brown (2.5Y 5/2) clay; common medium distinct olive brown (2.5Y 4/4) iron concentrations; moderate coarse prismatic structure parting to weak medium angular blocky; firm; few fine soft white (N 8/0) carbonate concretions; slight effervescence; slightly alkaline; clear wavy boundary.
 Cg—39 to 60 inches; grayish brown (2.5Y 5/2) clay; common medium distinct olive brown (2.5Y 4/4) iron concentrations; massive; firm; few fine soft white (N 8/0) carbonate concretions; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the A horizon: 3 to 5 inches
Content of clay and sand in the Bt horizon: 35 to 60 percent clay, less than 20 percent sand

A horizon:

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

E horizon:

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

Btg horizon:

Hue—2.5Y or 10YR
 Value—4 to 6
 Chroma—1 or 2
 Texture—silty clay loam, silty clay, or clay

BCg horizon:

Colors and textures—similar to those of the Btg and Cg horizons

Cg horizon:

Hue—5Y, 2.5Y, or 10YR
 Value—4 to 7
 Chroma—2 to 4
 Texture—silty clay loam, silt loam, silty clay, or clay
 Content of rock fragments—0 to 3 percent gravel

124—Brickton silt loam**Composition**

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

Setting

Landform: Flats on lake plains
Slope: 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: 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 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

- Hassman and similar soils
- Hamre and similar soils
- Dalbo and similar soils
- Soils that have a sandy substratum

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

Bushville Series

Drainage class: Somewhat poorly drained
Permeability: Upper part—rapid; next part—slow to moderate; dense till—very slow
Landform: Moraines
Parent material: Glacial outwash over till
Slope range: 1 to 6 percent
Taxonomic class: Loamy, mixed Aquic Arenic Eutroboralfs

Typical Pedon

Bushville loamy fine sand, 1 to 6 percent slopes, 1,100 feet north and 200 feet west of the southeast corner of sec. 17, T. 45 N., R. 23 W.

- A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; very friable; many fine roots; strongly acid; clear wavy boundary.
- E—2 to 4 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common fine and medium roots; 1 percent gravel; strongly acid; clear wavy boundary.
- Bw1—4 to 11 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; common fine roots;

1 percent gravel; moderately acid; clear wavy boundary.

Bw2—11 to 16 inches; brown (7.5YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; common fine roots; 1 percent gravel, 2 percent cobbles; moderately acid; clear wavy boundary.

BE—16 to 26 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; 8 percent gravel; moderately acid; clear wavy boundary.

2Bt—26 to 31 inches; reddish brown (5YR 4/4) sandy loam; common medium distinct reddish gray (5YR 5/2) iron depletions and few medium distinct yellowish red (5YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; common faint dark reddish brown (5YR 3/4) clay films on faces of ped; 10 percent gravel; moderately acid; clear smooth boundary.

2BC—31 to 50 inches; reddish brown (5YR 4/4) sandy loam; few medium distinct reddish gray (5YR 5/2) and common medium faint reddish brown (5YR 4/3) iron depletions; moderate medium platy structure; firm; 10 percent gravel; slightly acid; clear smooth boundary.

2Cd—50 to 60 inches; reddish brown (5YR 4/4) sandy loam; massive; moderate thick plate-like soil fragments; very firm; 10 percent gravel; slightly acid.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches

Depth to dense till: 40 to 60 inches

Other features: Some pedons do not have a BE horizon.

A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy fine sand

Content of rock fragments—0 to 3 percent gravel

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 or 3

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

Content of rock fragments—0 to 3 percent gravel

Bw horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—4

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

Content of rock fragments—0 to 3 percent gravel

2Bt horizon:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—5 to 15 percent gravel, 0 to 7 percent cobbles

2BC horizon:

Hue—7.5YR or 5YR

Value—3 to 5

Chroma—3 to 6

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

Content of rock fragments—5 to 15 percent gravel, 0 to 7 percent cobbles

2Cd horizon:

Hue—7.5YR or 5YR

Value—3 to 5

Chroma—3 to 6

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

Content of rock fragments—5 to 15 percent gravel, 0 to 3 percent cobbles

732B—Bushville loamy fine sand, 1 to 6 percent slopes

Composition

Bushville and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 1 to 6 percent

Component Description

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

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

- Leafriver and similar soils
- Watab and similar soils
- Pomroy and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Cathro Series

Drainage class: Very poorly drained

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

Landform: Bogs

Parent material: Organic material over alluvium

Slope range: 0 to 1 percent

Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 2,425 feet south and 150 feet east of the northwest corner of sec. 10, T. 48 N., R. 25 W.

Oa1—0 to 8 inches; muck, dark reddish brown (5YR 2.5/2) broken face, rubbed, and pressed; 10 percent fiber, less than 5 percent rubbed; primarily herbaceous fibers; weak medium and fine subangular blocky structure; very friable; moderately acid; clear smooth boundary.

Oa2—8 to 20 inches; muck, dark reddish brown (5YR 3/2) broken face, rubbed, and pressed; 25 percent fiber, 10 percent rubbed; primarily herbaceous fibers; weak thin and medium platy structure; very friable; moderately acid; clear smooth boundary.

Oa3—20 to 38 inches; muck, very dark brown (10YR 2/2) broken face, rubbed, and pressed; 15 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak thin platy structure; very friable; moderately acid; abrupt smooth boundary.

Cg—38 to 60 inches; greenish gray (5GY 6/1) and dark greenish gray (5GY 4/1) loam; common large prominent yellowish red (5YR 4/6) iron concentrations; massive; friable; neutral.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches

Reaction: Strongly acid to slightly alkaline

Other features: An A horizon in some pedons

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

Cg horizon:

Hue—5BG, 5GY, 5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 to 3

Texture—loam, silt loam, sandy loam, silty clay loam, or clay loam; multiple loamy and sandy strata in stratified substratum phase

Content of rock fragments—0 to 15 percent

544—Cathro muck

Composition

Cathro and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Bogs

Slope: 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 material over alluvium

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 20.8 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

- Dusler and similar soils
- Sandwich and similar soils
- Organic soils that are less decomposed than the Cathro soil
- Seelyeville and similar soils
- Blackhoof and similar soils
- Beseman and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

1983—Cathro muck, stratified substratum

Composition

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

Setting

Landform: Bogs

Slope: 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 material over alluvium

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 19.4 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

- Dusler and similar soils
- Sandwich and similar soils
- Blackhoof and similar soils
- Beseman and similar soils

- Seelyeville and similar soils
- Organic soils that are less decomposed than the Cathro soil

Major Uses of the Unit

- Hayland

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

- Agronomy section

Cormant Series

Drainage class: Poorly drained

Permeability: Rapid

Landform: Lake plains

Parent material: Alluvium and glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic class: Mixed, frigid Mollic Psammaquents

Typical Pedon

Cormant loamy fine sand, stratified substratum, 650 feet south and 100 feet west of the northeast corner of sec. 18, T. 47 N., R. 26 W.

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

Cg1—8 to 17 inches; dark grayish brown (2.5Y 4/2) loamy sand; common fine distinct dark yellowish brown (10YR 4/4) iron concentrations; massive; very friable; neutral; clear smooth boundary.

Cg2—17 to 38 inches; light brownish gray (2.5Y 6/2) loamy fine sand; common large prominent yellowish brown (10YR 5/6) iron concentrations; massive; very friable; neutral; clear smooth boundary.

Cg3—38 to 48 inches; light brownish gray (2.5Y 6/2) loamy fine sand; many medium prominent yellowish brown (10YR 5/6) iron concentrations; massive; very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg4—48 to 51 inches; light brownish gray (2.5Y 6/2) silt loam; few medium prominent yellowish brown (10YR 5/6) iron concentrations; massive; friable; strong effervescence; moderately alkaline; clear smooth boundary.

Cg5—51 to 60 inches; light brownish gray (2.5Y 6/2) loamy fine sand; common large prominent yellowish brown (10YR 5/8) iron concentrations; massive; very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 36 to more than 60 inches

Thickness of the A horizon: 5 to 10 inches

Series control section: 0 to 25 percent medium and coarse sand; no rock fragments

Other features: An A horizon in some pedons

Ap horizon:

Hue—2.5Y or 10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

Cg horizon:

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—1 or 2

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

734—Cormant loamy fine sand, stratified substratum

Composition

Cormant and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope: 0 to 2 percent

Component Description

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Alluvium and 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 7.8 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

- Seelyeville and similar soils
- Redby 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

Cowhorn Series

Drainage class: Somewhat poorly drained

Permeability: Moderately rapid

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Aeric Endoaquepts

Typical Pedon

Cowhorn loamy very fine sand, 150 feet south and 650 feet west of the northeast corner of sec. 24, T. 52 N., R. 25 W.

A—0 to 2 inches; black (10YR 2/1) loamy very fine sand, very dark gray (10YR 3/1) dry; moderate fine granular structure; very friable; common very fine roots; strongly acid; abrupt smooth boundary.

E—2 to 7 inches; light brownish gray (10YR 6/2) loamy very fine sand, light gray (10YR 7/2) dry; weak medium platy structure parting to weak very fine subangular blocky; very friable; few fine roots; strongly acid; clear smooth boundary.

Bw1—7 to 10 inches; yellowish brown (10YR 5/4) loamy very fine sand; weak medium subangular blocky structure; very friable; strongly acid; clear smooth boundary.

Bw2—10 to 29 inches; brown (10YR 5/3) loamy very fine sand; common medium distinct olive yellow (2.5Y 6/6) iron concentrations and few fine distinct gray (N 5/0) iron depletions; weak fine subangular blocky structure; very friable, moderately acid; gradual wavy boundary.

Bw3—29 to 39 inches; grayish brown (2.5Y 5/2) very fine sand; common medium prominent strong brown (7.5YR 5/6) and few fine distinct light yellowish brown (2.5Y 6/4) iron concentrations; massive; very friable; moderately acid; gradual smooth boundary.

C1—39 to 52 inches; light olive gray (5Y 6/2) very

fine sand; few fine prominent yellowish brown (10YR 5/6) iron concentrations; massive; very friable; neutral; clear smooth boundary.

C2—52 to 60 inches; light olive gray (5Y 6/2) very fine sand; few fine prominent yellowish brown (10YR 5/6) iron concentrations; single grain; loose; neutral.

Range in Characteristics

Series control section: 2 to 10 percent clay; no rock fragments

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loamy very fine sand

E horizon:

Hue—2.5Y or 10YR

Value—5 to 7

Chroma—1 or 2

Texture—loamy very fine sand or very fine sandy loam

Bw horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 7

Chroma—2 to 4

Texture—loamy very fine sand, very fine sand, and thin strata of very fine sandy loam, silt loam, loamy fine sand, or fine sand

C horizon:

Hue—5Y or 2.5Y

Value—5 to 7

Chroma—1 or 2

Texture—loamy very fine sand, very fine sand, and thin strata of very fine sandy loam, silt loam, loamy fine sand, or fine sand

615—Cowhorn loamy very fine sand

Composition

Cowhorn and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on lake plains

Slope: 0 to 3 percent

Component Description

Surface layer texture: Loamy very fine sand

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 2.5 feet

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

- Sago and similar soils
- Wawina 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

Cromwell Series

Drainage class: Somewhat excessively drained

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

Landform: Outwash plains, lake plains, and moraines

Parent material: Glacial outwash

Slope range: 1 to 40 percent

Taxonomic class: Sandy, mixed, frigid Typic Dystrochrepts

Typical Pedon

Cromwell sandy loam, 6 to 12 percent slopes, 2,550 feet south and 1,100 feet east of the northwest corner of sec. 21, T. 43 N., R. 23 W.

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

Bw1—2 to 6 inches; dark brown (7.5YR 3/4) coarse sandy loam; moderate fine subangular blocky structure; friable; common fine roots; 6 percent gravel; strongly acid; clear smooth boundary.

Bw2—6 to 14 inches; brown (7.5YR 4/4) coarse sandy loam; moderate medium subangular blocky structure; friable; few fine roots; 8 percent gravel; strongly acid; clear smooth boundary.

Bw3—14 to 20 inches; brown (7.5YR 5/4) coarse sandy loam; weak fine subangular blocky structure; very friable; 12 percent gravel; moderately acid; clear wavy boundary.

2Bw4—20 to 30 inches; reddish brown (5YR 4/3) loamy coarse sand; massive; very friable; 14 percent gravel; slightly acid; clear wavy boundary.

2C—30 to 60 inches; reddish brown (5YR 4/4) gravelly coarse sand; single grain; loose; 20 percent gravel; slightly acid.

Range in Characteristics

Depth to loamy sand or coarser: 10 to 24 inches

Series control section: Average texture is loamy sand or coarser.

Other features: An E horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—sandy loam or fine sandy loam

Content of rock fragments—0 to 15 percent gravel

Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 5

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, or coarse sandy loam

Content of rock fragments—0 to 15 percent gravel

2Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 5

Chroma—3 to 6

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

Content of rock fragments—0 to 35 percent

2C horizon:

Hue—10YR, 7.5YR, 5YR, or 2.5YR

Value—4 to 6

Chroma—3 or 4

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

Content of rock fragments—0 to 35 percent

268B—Cromwell fine sandy loam, 1 to 6 percent slopes

Composition

Cromwell and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Summits and backslopes

Slope: 1 to 6 percent

Component Description

Surface layer texture: Fine 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 6.1 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

- Leafriver and similar soils
- Oesterle and similar soils
- Cutaway and similar soils
- Bushville and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

268C—Cromwell sandy loam, 6 to 12 percent slopes

Composition

Cromwell and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Summits and backslopes

Slope: 6 to 12 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 5.8 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

- Leafriver and similar soils
- Oesterle and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

268E—Cromwell fine sandy loam, 12 to 25 percent slopes**Composition**

Cromwell and similar soils: About 85 percent
inclusions: About 15 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Backslopes

Slope: 12 to 25 percent

Component Description

Surface layer texture: Fine 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 5.3 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

- Leafriver and similar soils
- Oesterle and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

268F—Cromwell fine sandy loam, 25 to 40 percent slopes**Composition**

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

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Backslopes

Slope: 25 to 40 percent

Component Description

Surface layer texture: Fine 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 5.6 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

- Leafriver and similar soils
- Oesterle and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Cushing Series

Drainage class: Well drained

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

Landform: Moraines

Parent material: Till

Slope range: 6 to 40 percent

Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Cushing loam, 6 to 12 percent slopes, 2,350 feet south and 450 feet east of the northwest corner of sec. 10, T. 48 N., R. 27 W.

Oa—0 to 3 inches; black (10YR 2/1), well decomposed leaf litter; moderately acid; abrupt smooth boundary.

E—3 to 12 inches; light brownish gray (10YR 6/2) loam, light gray (10YR 7/2) dry; moderate medium platy structure; friable; common fine roots; 1 percent gravel; moderately acid; clear wavy boundary.

B/E—12 to 25 inches; about 75 percent brown (7.5YR 4/4) loam (B) and 25 percent grayish brown (10YR 5/2) loam (E), light gray (10YR 7/2) dry; weak fine subangular blocky structure; friable; few fine roots; 1 percent gravel; moderately acid; clear wavy boundary.

Bt1—25 to 34 inches; brown (7.5YR 4/4) loam; moderate medium subangular blocky structure; firm; many distinct brown (7.5YR 4/3) clay films on faces of peds and in pores; 1 percent gravel; moderately acid; clear smooth boundary.

Bt2—34 to 44 inches; brown (7.5YR 4/4) loam; moderate medium subangular blocky structure;

firm; common distinct brown (7.5YR 4/3) clay films on faces of peds and in pores; 2 percent gravel; moderately acid; clear smooth boundary.

C—44 to 60 inches; brown (7.5YR 4/4) loam; few medium distinct brown (7.5YR 5/3) iron depletions; massive; friable; 3 percent gravel, 1 percent cobbles; slightly acid.

Range in Characteristics

Thickness of the loess mantle: 0 to 20 inches

Content of rock fragments: 0 to 15 percent gravel, 0 to 5 percent cobbles

Content of clay and sand in the Bt horizon: 20 to 30 percent clay, more than 45 percent sand

Other features: An A horizon in some pedons; a Bw horizon in some pedons

O horizon:

Hue—10YR

Value—2

Chroma—1 or 2

A horizon (if it occurs):

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam or fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

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

Bw horizon (if it occurs):

Hue—10YR

Value—4 to 6

Chroma—3 or 4

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

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 to 5

Texture—loam, sandy clay loam, or sandy loam

C horizon:

Hue—7.5YR, 10YR, or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam, sandy loam, or sandy clay loam

204C—Cushing loam, 6 to 12 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 6 to 12 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 9.5 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

- Hamre and similar soils
- Talmoon and similar soils
- Seelyeville and similar soils
- Alstad and similar soils
- Cromwell and similar soils
- Cutaway 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

204E—Cushing loam, 12 to 25 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Backslopes

Slope: 12 to 25 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 9.0 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

- Seelyeville and similar soils
- Alstad and similar soils
- Cutaway and similar soils
- Cromwell and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

928C—Cushing-Mahtomedi complex, 2 to 10 percent slopes

Composition

Cushing and similar soils: About 50 percent
Mahtomedi and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 2 to 10 percent

Component Description**Cushing**

Surface layer texture: Very 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 8.9 inches

Organic matter content: Moderately low

Mahtomedi

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: 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

- Cathro and similar soils
- Sandwich and similar soils
- Meehan and similar soils
- Alstad and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

928D—Cushing-Mahtomedi complex, 10 to 25 percent slopes**Composition**

Cushing and similar soils: About 45 percent

Mahtomedi and similar soils: About 40 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 10 to 25 percent

Component Description**Cushing**

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 9.1 inches

Organic matter content: Moderate

Mahtomedi

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 4.0 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

- Cathro and similar soils
- Alstad and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

928F—Cushing-Mahtomedi complex, 25 to 40 percent slopes

Composition

Cushing and similar soils: About 45 percent
 Mahtomedi and similar soils: About 40 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes
Slope: Cushing—25 to 35 percent; Mahtomedi—25 to 40 percent

Component Description

Cushing

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: Moderately low

Mahtomedi

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: 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

- Cathro and similar soils
- Alstad and similar soils

Major Uses of the Unit

- Hayland

- Forest land

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

- Agronomy section
- Forest Land section

Cutaway Series

Drainage class: Moderately well drained
Permeability: Upper part—rapid; lower part—slow or moderately slow
Landform: Moraines
Parent material: Glacial outwash over till
Slope range: 1 to 6 percent
Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Cutaway loamy fine sand, 1 to 6 percent slopes, 1,750 feet north and 2,050 feet west of the southeast corner of sec. 4, T. 49 N., R. 26 W.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many roots; 2 percent gravel; moderately acid; clear smooth boundary.

E—2 to 3 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common roots; 2 percent gravel; strongly acid; abrupt smooth boundary.

Bw1—3 to 11 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; few roots; 4 percent gravel; strongly acid; clear smooth boundary.

Bw2—11 to 22 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; few roots; 8 percent gravel; strongly acid; clear wavy boundary.

E'—22 to 26 inches; grayish brown (10YR 5/2) loamy sand, light gray (10YR 7/2) dry; weak thin platy structure; friable; 6 percent gravel; moderately acid; clear smooth boundary.

2E/B—26 to 35 inches; about 65 percent grayish brown (10YR 5/2) loamy fine sand (E), light gray (10YR 7/2) dry; about 30 percent remnants of dark yellowish brown (10YR 4/4) loam (Bt); moderate medium subangular blocky structure; friable; few faint dark yellowish brown (10YR 4/4) clay films on faces of peds; 3 percent gravel; moderately acid; gradual wavy boundary.

2B/E—35 to 49 inches; dark yellowish brown (10YR 4/4) loam (Bt) with interfingerings of grayish

brown (10YR 5/2) loamy fine sand (E); moderate coarse subangular blocky structure; firm; common faint dark brown (10YR 4/3) clay films on faces of peds and in pores; 3 percent gravel; slightly acid; gradual wavy boundary.

2C—49 to 60 inches; dark yellowish brown (10YR 4/4) loam; few fine distinct grayish brown (10YR 5/2) iron depletions and few fine prominent dark red (2.5YR 3/6) iron concentrations; massive; friable; 3 percent gravel; slightly acid.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches

Depth to carbonates: 36 to more than 60 inches

Content of rock fragments: 0 to 10 percent gravel, 0 to 2 percent cobbles

A horizon:

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy fine sand

E horizon:

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—1 to 3

Texture—loamy sand or loamy fine sand

Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 6

Chroma—3 to 6

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

E' horizon:

Hue—2.5Y or 10YR

Value—5 or 6

Chroma—2 or 3

Texture—loamy sand or loamy coarse sand

2E/B or 2B/E horizon:

Colors and textures—similar to those of the E' and 2Bt horizons

2Bt horizon (if it occurs):

Hue—2.5Y, 10YR, or 7.5YR

Value—4 or 5

Chroma—3 or 4

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

2C horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—3 to 7

Chroma—2 to 4

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

1353B—Cutaway loamy fine sand, 1 to 6 percent slopes

Composition

Cutaway and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Rises on moraines

Slope: 1 to 6 percent

Component Description

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.8 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

- Northwood and similar soils
- Sandwick and similar soils
- Dusler and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Dalbo Series

Drainage class: Moderately well drained

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

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 1 to 6 percent

Taxonomic class: Fine, montmorillonitic Vertic
Eutroboralfs

Typical Pedon

Dalbo very fine sandy loam, 1 to 6 percent slopes, 1,850 feet north and 2,050 feet east of the southwest corner of sec. 27, T. 51 N., R. 24 W.

Oa—0 to 2 inches; well decomposed leaf litter.

A—2 to 3 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; many fine roots; moderately acid; clear smooth boundary.

E1—3 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, gray (10YR 5/1) dry; weak medium platy structure; friable; few fine roots; strongly acid; clear smooth boundary.

E2—8 to 13 inches; grayish brown (10YR 5/2) very fine sandy loam, light gray (10YR 7/2) dry; moderate medium subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) silt coatings on faces of peds; very strongly acid; clear wavy boundary.

Bt1—13 to 19 inches; dark yellowish brown (10YR 4/4) clay; moderate medium prismatic structure parting to moderate fine angular blocky; firm; many distinct dark brown (10YR 4/3) clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—19 to 24 inches; dark yellowish brown (10YR 4/4) silty clay; few fine distinct dark grayish brown (10YR 4/2) iron depletions; moderate medium prismatic structure parting to moderate medium angular blocky; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; moderately acid; clear smooth boundary.

BC—24 to 35 inches; olive brown (2.5Y 4/4) silty clay; few fine distinct dark grayish brown (2.5Y 4/2) iron depletions; moderate coarse prismatic structure parting to weak medium angular blocky; firm; slight effervescence; slightly alkaline; clear smooth boundary.

C—35 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common medium distinct light olive brown (2.5Y 5/4) iron concentrations; massive; firm; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 42 inches

Series control section: No rock fragments

Content of clay and sand in the Bt horizon: 35 to 60

percent clay, less than 20 percent fine sand and very fine sand

Other features: Some pedons have a B/E horizon; some pedons do not have a BC horizon.

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—very fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 or 2

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

B/E horizon (if it occurs):

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—2.5Y or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—silty clay, clay, or silty clay loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2 to 4

Texture—silty clay loam, silty clay, or clay with thin strata of silt loam

133B—Dalbo very fine sandy loam, 1 to 6 percent slopes

Composition

Dalbo and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains

Slope: 1 to 6 percent

Component Description

Surface layer texture: Very fine 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 5.0 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

- Cathro and similar soils
- Hassman and similar soils
- Brickton and similar soils
- Well drained soils
- Soils that have a sandy substratum

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

Duluth Series

Drainage class: Well drained and moderately well drained

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

Landform: Moraines

Parent material: Till

Slope range: 1 to 25 percent

Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Duluth fine sandy loam, 1 to 6 percent slopes, 125 feet south and 325 feet east of the northwest corner of sec. 11, T. 46 N., R. 24 W.

A—0 to 3 inches; very dark brown (10YR 2/2) fine sandy loam, light brownish gray (10YR 6/2) dry; moderate very fine and fine granular structure; very friable; many fine roots; 1 percent gravel; strongly acid; clear smooth boundary.

E—3 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; friable; common fine roots; 2 percent gravel; strongly acid; clear smooth boundary.

Bw—5 to 9 inches; dark yellowish brown (10YR 4/4) fine sandy loam; moderate fine and medium subangular blocky structure; friable; common fine roots; 2 percent gravel; strongly acid; clear smooth boundary.

E'—9 to 11 inches; brown (10YR 5/3) fine sandy loam, light gray (10YR 7/2) dry; moderate medium platy structure; friable; few fine roots; 2 percent gravel; strongly acid; gradual wavy boundary.

2B/E—11 to 18 inches; about 60 percent reddish brown (5YR 4/3) loam (Bt) with about 40 percent tongues of reddish brown (5YR 5/3) loam (E), pink (7.5YR 7/3) dry; strong medium subangular blocky structure; friable; few fine roots; common faint reddish brown (5YR 4/4) clay films on faces of peds; 4 percent gravel; strongly acid; clear wavy boundary.

2Bt1—18 to 29 inches; reddish brown (5YR 4/4) clay loam; strong coarse prismatic structure parting to strong fine and medium angular blocky; firm; few fine roots; many faint reddish brown (5YR 4/4) clay films on faces of peds; 4 percent gravel, 1 percent cobbles; moderately acid; gradual wavy boundary.

2Bt2—29 to 41 inches; reddish brown (5YR 4/4) clay loam; moderate coarse prismatic structure parting to strong medium subangular blocky; firm; few fine roots; common distinct reddish brown (5YR 4/3) clay films on faces of peds; few black (10YR 2/1) concretions on faces of peds and in pores; 4 percent gravel, 1 percent cobbles; slightly acid; clear wavy boundary.

2C1—41 to 55 inches; dark brown (7.5YR 4/4) loam, massive; friable; 4 percent gravel, 1 percent cobbles; neutral; gradual smooth boundary

2C2—55 to 60 inches; brown (7.5YR 4/4) loam, few fine distinct reddish brown (5YR 4/4) iron concentrations and grayish brown (10YR 5/2) iron depletions; massive; friable; 4 percent gravel, 1 percent cobbles; neutral.

Range in Characteristics

Thickness of the loess mantle: 10 to 24 inches

Content of rock fragments: 0 to 10 percent gravel, 0 to 2 percent cobbles

Content of clay and sand in the Bt horizon: 25 to 35 percent clay, less than 45 percent sand

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR, 7.5YR, or 5YR
 Value—4 or 5
 Chroma—1 or 2
 Texture—silt loam, very fine sandy loam, fine sandy loam, or loam

Bw horizon:

Hue—10YR, 7.5YR, or 5YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—silt loam, very fine sandy loam, fine sandy loam, or loam

E' horizon:

Hue—10YR, 7.5YR, or 5YR
 Value—4 to 6
 Chroma—2 or 3
 Texture—very fine sandy loam, fine sandy loam, sandy loam, loamy fine sand, or loamy very fine sand

2E/B or 2B/E horizon:

Colors and textures—similar to those of the E' and 2Bt horizons

2Bt horizon:

Hue—7.5YR, 5YR, or 2.5YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—clay loam, silty clay loam, or loam

2C horizon:

Hue—7.5YR, 5YR, or 2.5YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—clay loam, loam, silty clay loam, or fine sandy loam

504B—Duluth fine sandy loam, 1 to 6 percent slopes

Composition

Duluth and similar soils: About 85 percent inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 1 to 6 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: 3.5 to 6.0 feet

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

- Rifle and similar soils
- Blackhoof and similar soils
- Mahtowa and similar soils
- Dusler and similar soils
- Cutaway and similar soils
- Cromwell 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

504C—Duluth fine sandy loam, 6 to 12 percent slopes

Composition

Duluth and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 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: 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

- Rifle and similar soils
- Blackhoof and similar soils
- Mahtowa and similar soils
- Dusler and similar soils
- Cutaway and similar soils
- Cromwell 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

504E—Duluth fine sandy loam, 12 to 25 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Backslopes

Slope: 12 to 25 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 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

- Rifle and similar soils
- Blackhoof and similar soils
- Mahtowa and similar soils
- Dusler and similar soils
- Cutaway and similar soils
- Cromwell and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Dusler Series

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; lower part—slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, frigid Aeric Glossaqualfs

Typical Pedon

Dusler silt loam, 100 feet north and 2,500 feet east of the southwest corner of sec. 23, T. 49 N., R. 22 W.

Oe—0 to 1 inch; moderately decomposed leaf litter.

A—1 to 5 inches; black (10YR 2/1) silt loam. dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; many fine roots; strongly acid; clear wavy boundary.

Eg—5 to 15 inches; brown (7.5YR 5/2) fine sandy loam, pinkish gray (7.5YR 7/2) dry; common medium distinct reddish brown (5YR 5/4) iron concentrations; moderate thin platy structure; very friable; many fine roots; 1 percent gravel; strongly acid; gradual wavy boundary.

2B/E—15 to 21 inches; about 75 percent reddish brown (5YR 4/3) loam (Bt) with about 25 percent tongues of gray (5YR 5/1) fine sandy loam (E), pinkish gray (7.5YR 7/2) dry; common fine distinct yellowish red (5YR 4/6) iron concentrations; weak medium subangular blocky structure; firm; many fine roots; common faint brown (7.5YR 4/4) clay films on faces of peds; 2

percent gravel; strongly acid; clear wavy boundary.

2Bt1—21 to 39 inches; reddish brown (5YR 4/3) clay loam; common fine distinct yellowish red (5YR 5/6) iron concentrations; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common faint dark reddish gray (5YR 4/2) clay films on faces of peds; 2 percent gravel; moderately acid; gradual wavy boundary.

2Bt2—39 to 50 inches; reddish brown (5YR 4/3) clay loam; few fine faint yellowish red (5YR 4/6) iron concentrations; moderate medium and fine subangular blocky structure; firm; few faint dark reddish gray (5YR 4/2) clay films on faces of peds; 3 percent gravel; slightly acid; gradual wavy boundary.

2C—50 to 60 inches; reddish brown (5YR 4/3) loam; few fine faint reddish gray (5YR 5/2) iron depletions; massive; friable; 4 percent gravel; neutral.

Range in Characteristics

Content of rock fragments: 1 to 7 percent gravel, 0 to 2 percent cobbles

Content of clay and sand in the Bt horizon: 22 to 35 percent clay, less than 45 percent sand

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

Eg horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—1 or 2

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

2E/B or 2B/E horizon:

Colors and textures—similar to those of the Eg and 2Bt horizons

2Bt horizon:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—3 or 4

Texture—loam or clay loam

2C horizon:

Hue—7.5YR or 5YR

Value—3 or 4

Chroma—3 or 4

Texture—loam or clay loam

502—Dusler silt loam

Composition

Dusler and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt 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 2.5 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

- Blackhoof and similar soils
- Mahtowa and similar soils
- Duluth 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

Flak Series

Drainage class: Well drained

Permeability: Upper part—moderately rapid; next part—slow to moderate; dense till—very slow

Landform: Moraines

Parent material: Till

Slope range: 3 to 15 percent

Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Taxadjunct features: This soil is a taxadjunct because the Bt horizon does not qualify as an argillic horizon.

Typical Pedon

Flak sandy loam, 3 to 8 percent slopes. 2,600 feet south and 2,400 feet east of the northwest corner of sec. 3, T. 50 N., R. 27 W.

A—0 to 3 inches; very dark gray (10YR 3/1) sandy loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; very friable; common medium and fine roots; 2 percent gravel; strongly acid; clear wavy boundary.

E—3 to 13 inches; brown (10YR 5/3) sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; very friable; common fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

Bt—13 to 22 inches; dark brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; few fine roots; many distinct dark brown (7.5YR 3/4) clay films on faces of peds; 5 percent gravel; moderately acid; clear wavy boundary.

BC—22 to 45 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium platy structure; firm; 8 percent gravel; moderately acid; gradual wavy boundary.

Cd—45 to 60 inches; brown (7.5YR 5/4) sandy loam; massive; weak medium plate-like soil fragments; very firm; 8 percent gravel; slightly acid.

Range in Characteristics

Depth to dense till: 40 to 60 inches

Content of rock fragments: 2 to 20 percent gravel, 0 to 3 percent cobbles

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 or 3
Texture—fine sandy loam or sandy loam

Bt horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 or 4

Texture—sandy loam or fine sandy loam

BC horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 to 5
Texture—sandy loam or fine sandy loam

Cd horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 to 5
Texture—sandy loam or fine sandy loam

144B—Flak sandy loam, 3 to 8 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 3 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: 3.5 to 4.0 feet

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

- Cathro and similar soils
- Nokay and similar soils
- Wabedo and similar soils
- Steeper areas

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

144C—Flak sandy loam, 8 to 15 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 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 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

- Cathro and similar soils
- Nokay and similar soils
- Wabedo and similar soils
- Areas that have slopes of less than 8 to 15 percent

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

Freer Series

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; next part—slow; dense till—very slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, frigid Aeric Glossoqualfs

Typical Pedon

Freer silt loam, 25 feet south and 220 feet east of the northwest corner of sec. 26, T. 43 N., R. 23 W.

A—0 to 6 inches; very dark brown (10YR 2/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many medium roots; 1 percent gravel; strongly acid; abrupt smooth boundary.

E1—6 to 11 inches; grayish brown (10YR 5/2) silt loam, pale brown (10YR 6/3) dry; common medium distinct yellowish brown (10YR 5/6) iron concentrations; weak thin platy structure; very friable; many medium roots; 1 percent gravel, 1 percent cobbles; strongly acid; clear smooth boundary.

E2—11 to 14 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; many large yellowish brown (10YR 5/6) iron concentrations; weak medium platy structure; very friable; common medium roots; 1 percent gravel; strongly acid; clear smooth boundary.

E/B—14 to 21 inches; about 60 percent brown (7.5YR 4/2) silt loam (E), very pale brown (10YR 7/3) dry; about 40 percent remnants of brown (7.5YR 5/4) silt loam (Bt); common medium faint strong brown (7.5YR 5/6) iron concentrations; weak medium subangular structure; friable; common fine roots; few faint dark brown (7.5YR 4/3) clay films in pores of peds; 1 percent gravel; strongly acid; clear wavy boundary.

2Bt1—21 to 27 inches; reddish brown (5YR 4/3) loam; many medium distinct reddish gray (5YR 5/2) iron concentrations and common medium distinct strong brown (7.5YR 5/6) iron concentrations; strong medium subangular blocky structure; firm; few fine roots; many faint dark reddish gray (5YR 4/2) clay films in pores of peds; 3 percent gravel; moderately acid; clear smooth boundary.

2Bt2—27 to 35 inches; reddish brown (5YR 4/4) loam; many medium distinct reddish gray (5YR 5/2) iron depletions; strong medium subangular

blocky structure; friable; many faint dark reddish gray (5YR 4/2) clay films in pores of peds; 8 percent gravel; moderately acid; clear smooth boundary.

2BC—35 to 47 inches; dark reddish brown (5YR 3/4) sandy loam; few fine distinct yellowish red (5YR 5/6) iron concentrations; moderate medium platy structure; firm; 10 percent gravel; slightly acid; clear smooth boundary.

2Cd—47 to 60 inches; dark reddish brown (5YR 3/4) sandy loam; massive; moderate medium plate-like soil fragments; very firm; 10 percent gravel; slightly acid.

Range in Characteristics

Thickness of the silty mantle: 15 to 30 inches

Depth to dense till: 40 to 60 inches

A horizon:

Hue—10YR

Value—2 to 5

Chroma—1 to 3

Texture—silt loam

Content of rock fragments—0 to 5 percent gravel, 0 to 3 percent cobbles

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—1 to 3

Texture—silt loam, very fine sandy loam, or loam that has a high content of very fine sand

Content of rock fragments—0 to 5 percent gravel, 0 to 3 percent cobbles

E/B or B/E horizon:

Colors and textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—7.5YR or 5YR

Value—4 to 6

Chroma—2 to 6

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—3 to 15 percent gravel, 1 to 3 percent cobbles

2BC and 2Cd horizons:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—3 to 5

Texture—sandy loam or fine sandy loam

Content of rock fragments—3 to 15 percent gravel, 1 to 3 percent cobbles

266—Freer silt loam

Composition

Freer and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 1 to 2 feet

Available water capacity to 60 inches or root-limiting layer: About 7.7 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

- Twig and similar soils
- Giese and similar soils
- Brennyville and similar soils
- Milaca 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

Friendship Series

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Lake plains, moraines, and outwash plains

Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Friendship loamy sand, 250 feet south and 2,510 feet east of the northwest corner of sec. 12, T. 51 N., R. 26 W.

- Oa—0 to 2 inches; well decomposed leaf litter.
 E—2 to 3 inches; dark grayish brown (10YR 4/2) loamy sand, grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; very friable; few medium roots; strongly acid; abrupt wavy boundary.
 Bw1—3 to 6 inches; dark brown (7.5YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; few fine roots; moderately acid; clear wavy boundary.
 Bw2—6 to 20 inches; yellowish brown (10YR 5/4) sand; single grain; loose; moderately acid; clear smooth boundary.
 Bw3—20 to 27 inches; yellowish brown (10YR 5/4) sand; massive; very friable; moderately acid; clear smooth boundary.
 BC—27 to 39 inches; pale brown (10YR 6/3) sand; common medium distinct yellowish brown (10YR 5/8) iron concentrations; single grain; loose; moderately acid; gradual smooth boundary.
 C1—39 to 50 inches; light yellowish brown (10YR 6/4) sand; common large distinct yellowish brown (10YR 5/8) iron concentrations; single grain; loose; moderately acid; gradual smooth boundary.
 C2—50 to 60 inches; light yellowish brown (10YR 6/4) sand; common large prominent dark red (2.5YR 3/6) and yellowish red (5YR 4/6) iron concentrations; single grain; loose; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel throughout the profile

Other features: Some pedons do not have an O horizon; some pedons have an A horizon.

A horizon (if it occurs):

Hue—10YR or 7.5YR
 Value—2 or 3
 Chroma—1 to 3
 Texture—loamy sand or sand

E horizon:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—2 or 3
 Texture—loamy sand

Bw horizon:

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—3 or more
 Texture—loamy sand or sand

BC and C horizons:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—2 to 6
 Texture—sand

564—Friendship loamy sand

Composition

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

Setting

Landform: Outwash plains, lake plains, and moraines
Position on the landform: Summits and backslopes
Slope: 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 3.8 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

- Leafriver and similar soils
- Meehan and similar soils
- Menahga and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section

- Forest Land section

Giese Series

Drainage class: Very poorly drained

Permeability: Upper part—moderately slow to moderately rapid; lower part (in the dense till)—slow or very slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 1 percent

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

Typical Pedon

Giese muck, in an area of Twig and Giese soils, 50 feet west and 1,900 feet north of the southeast corner of sec. 36, T. 45 N., R. 22 W.

Oa—0 to 4 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; weak thin platy structure; very friable; many coarse and medium roots; strongly acid; clear wavy boundary.

A—4 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 4/1) dry; moderate fine granular structure; friable; common medium and fine roots; 5 percent gravel; strongly acid; gradual wavy boundary.

Eg1—10 to 17 inches; grayish brown (2.5Y 5/2) fine sandy loam, light gray (10YR 7/2) dry; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations and common fine distinct light brownish gray (10YR 6/2) iron depletions; moderate thin platy structure; very friable; common fine and medium roots; 1 percent gravel; strongly acid; gradual wavy boundary.

Eg2—17 to 21 inches; grayish brown (10YR 5/2) loamy fine sand, light gray (10YR 7/2) dry; common medium distinct light brownish gray (2.5Y 6/2) iron depletions and common fine distinct brown (7.5YR 5/3) iron concentrations; weak moderate subangular blocky structure; very friable; few fine and very fine roots; 6 percent gravel; moderately acid; clear wavy boundary.

2Btg1—21 to 28 inches; dark brown (7.5YR 4/3) sandy clay loam; many medium distinct brown (7.5YR 5/2) iron depletions and many medium distinct strong brown (7.5YR 4/6) iron concentrations; moderate medium subangular blocky structure; firm; few very fine roots; common distinct dark reddish gray (5YR 4/2) clay films on faces of peds and in pores; 5 percent gravel; strongly acid; clear wavy boundary.

2Btg2—28 to 43 inches; reddish brown (5YR 4/4) fine sandy loam; common medium distinct reddish gray (5YR 5/2) iron depletions and common medium prominent strong brown (7.5YR 5/6) iron concentrations; moderate medium platy structure; firm; common distinct dark reddish gray (5YR 4/2) clay films on faces of peds and in pores; 8 percent gravel; moderately acid; clear wavy boundary.

2BC—43 to 70 inches; reddish brown (5YR 4/3) fine sandy loam; few fine distinct dark brown (7.5YR 4/4) and few medium faint reddish brown (5YR 5/3) iron concentrations; moderate thin and medium platy structure; very firm; 13 percent gravel; neutral; clear wavy boundary.

2Cd—70 to 80 inches; reddish brown (5YR 4/4) fine sandy loam; massive; moderate medium plate-like soil fragments; very firm; 10 percent gravel; neutral.

Range in Characteristics

Depth to dense till: 40 to 60 inches

Oa horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 4

Texture—muck

A horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 10 percent gravel, 0 to 3 percent cobbles

Eg horizon:

Hue—2.5Y, 10YR, 7.5YR, or 5YR

Value—4 to 6

Chroma—1 or 2

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

Content of rock fragments—0 to 10 percent gravel, 0 to 3 percent cobbles

2Btg horizon:

Hue—2.5Y, 10YR, 7.5YR, or 5YR in the upper part; 5YR in the lower part

Value—upper part, 4 to 6; lower part, 3 to 5

Chroma—upper part, 1 to 3; lower part, 3 to 6

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

Content of rock fragments—5 to 15 percent gravel, 0 to 3 percent cobbles

2BC and 2Cd horizons:

Hue—5YR or 2.5YR
 Value—3 to 6
 Chroma—2 to 4
 Texture—sandy loam or fine sandy loam
 Content of rock fragments—5 to 15 percent gravel, 0 to 8 percent cobbles

Goodland Series

Drainage class: Well drained

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

Landform: Moraines

Parent material: Glacial outwash

Slope range: 1 to 25 percent

Taxonomic class: Coarse-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Goodland silt loam, in an area of Itasca-Goodland complex, 6 to 12 percent slopes, 1,800 feet south and 600 feet east of the northwest corner of sec. 13, T. 52 N., R. 27 W.

- A—0 to 3 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; moderate fine and medium granular structure; very friable; many roots; moderately acid; abrupt wavy boundary.
- E—3 to 5 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak fine subangular blocky structure; very friable; many roots; moderately acid; abrupt wavy boundary.
- Bw—5 to 12 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; very friable; many roots; moderately acid; clear wavy boundary.
- E—12 to 16 inches; light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) very fine sandy loam, very pale brown (10YR 7/3) dry; weak fine and medium subangular blocky structure; very friable; many roots; moderately acid; abrupt wavy boundary.
- 2E/B—16 to 19 inches; about 60 percent light brownish gray (10YR 6/2) sandy loam (E), white (10YR 8/2) dry; about 40 percent remnants of dark yellowish brown (10YR 4/4) sandy loam (Bt); weak medium and coarse subangular blocky structure, friable; many roots; few faint yellowish brown (10YR 5/4) clay bridges between sand grains; 5 percent gravel; moderately acid; clear wavy boundary.
- 2Bt1—19 to 25 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular

blocky structure; firm; common distinct brown (10YR 4/3) clay films on faces of peds; many roots; 5 percent gravel; moderately acid; abrupt wavy boundary.

3Bt2—25 to 33 inches; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; many distinct dark yellowish brown (10YR 4/4) colloidal coatings on sand grains and clay bridges between sand grains; 8 percent gravel; few roots; moderately acid; abrupt wavy boundary.

3C—33 to 60 inches; pale brown (10YR 6/3) coarse sand; single grain; loose; 5 percent gravel; slightly acid.

Range in Characteristics

Depth to sand or gravel: 20 to 40 inches

A horizon:

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

E horizon:

Hue—2.5Y or 10YR
 Value—4 to 6
 Chroma—1 or 2
 Texture—silt loam, very fine sandy loam, fine sandy loam, or loam
 Content of rock fragments—0 to 2 percent gravel

Bw horizon:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—silt loam, very fine sandy loam, fine sandy loam, or loam
 Content of rock fragments—0 to 2 percent gravel

E' horizon:

Hue—2.5Y or 10YR
 Value—5 to 7
 Chroma—2 or 3
 Texture—silt loam, very fine sandy loam, or loam
 Content of rock fragments—0 to 2 percent gravel

E/B or B/E horizon:

Colors and textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—3 to 10 percent gravel, 0 to 2 percent cobbles

3Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 or 4

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

Content of rock fragments—0 to 20 percent gravel, 0 to 7 percent cobbles

3C horizon:

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—2 to 6

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

Content of rock fragments—0 to 20 percent gravel, 0 to 7 percent cobbles

617B—Goodland silt loam, 1 to 10 percent slopes

Composition

Goodland and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 1 to 10 percent

Component Description

Surface layer texture: Silt 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

- Seelyville and similar soils
- Talmoon and similar soils

- Itasca 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

Greenwood Series

Drainage class: Very poorly drained

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

Landform: Bogs

Parent material: Organic material

Slope range: 0 to 1 percent

Taxonomic class: Dysic Typic Borohemists

Typical Pedon

Greenwood peat, 200 feet south and 300 feet west of the northeast corner of sec. 13, T. 48 N., R. 25 W.

Oi—0 to 14 inches; peat, brown (10YR 5/3) broken face, very pale brown (10YR 7/3) rubbed and pressed; 95 percent fiber, 85 percent rubbed; primarily live roots and sphagnum fibers; massive; very friable; extremely acid; clear smooth boundary.

Oe1—14 to 43 inches; mucky peat, dark brown (7.5YR 3/2) broken face, brown (7.5YR 4/2) rubbed and pressed; 65 percent fiber, 35 percent rubbed; primarily herbaceous fibers; weak thick platy structure; very friable; extremely acid; gradual smooth boundary.

Oe2—43 to 60 inches; mucky peat, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; 45 percent fiber, 30 percent rubbed; primarily herbaceous fibers; weak thick platy structure; very friable; extremely acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Reaction: Extremely acid

Oi horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 6

Chroma—1 to 4

Texture—peat

Oe horizon:

Hue—7.5YR or 5YR
 Value—2 to 6
 Chroma—1 to 4
 Texture—mucky peat

549—Greenwood peat**Composition**

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

Setting

Landform: Bogs
Slope: 0 to 1 percent

Component Description

Surface layer texture: Peat
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic material
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 31.4 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

- Meehan and similar soils
- Roscommon and similar soils
- Loxley and similar soils
- Rifle and similar soils
- Thinner organic 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

Hamre Series

Drainage class: Very poorly drained
Permeability: Moderately slow or moderate

Landform: Lake plains and moraines

Parent material: Organic material over glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Fine-loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Hamre muck, 400 feet north and 200 feet west of the southeast corner of sec. 3, T. 48 N., R. 25 W.

Oa—0 to 10 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 15 percent fiber, less than 5 percent rubbed; primarily herbaceous fibers; weak fine granular structure; very friable; many fine roots; neutral; abrupt wavy boundary.

A1—10 to 12 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; few fine prominent strong brown (7.5YR 5/6) iron concentrations along root channels; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common fine roots; 1 percent gravel; neutral; abrupt wavy boundary.

A2—12 to 17 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; common medium faint dark gray (10YR 4/1) iron depletions and few fine prominent strong brown (7.5YR 5/6) iron concentrations along root channels; weak coarse subangular blocky structure parting to weak very fine subangular blocky; friable; common fine roots; 2 percent gravel; neutral; clear wavy boundary.

Bg—17 to 35 inches; grayish brown (2.5Y 5/2) loam; common fine prominent strong brown (7.5YR 5/6) iron concentrations and few fine prominent dark reddish brown (5YR 3/2) iron depletions; weak medium subangular blocky structure; friable; few fine roots; 2 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

Cg1—35 to 48 inches; olive gray (5Y 5/2) loam; few fine faint gray (5Y 6/1) iron depletions and common fine prominent yellowish brown (10YR 5/8) iron concentrations; massive; friable; few fine roots; 2 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg2—48 to 60 inches; olive gray (5Y 5/2) silt loam; few medium distinct light olive brown (2.5Y 5/4) and common fine prominent brownish yellow (10YR 6/6) iron concentrations; massive; friable; few fine roots; 1 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to mineral material: 8 to 16 inches
Depth to carbonates: 18 to 25 inches

Oa horizon:

Hue—10YR or neutral
 Value—2 or 3
 Chroma—0 to 2
 Texture—muck

A horizon:

Hue—5Y, 2.5Y, 10YR, 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 15 percent gravel, 0 to 2 percent cobbles

Bg horizon:

Hue—5Y or 2.5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam, clay loam, sandy clay loam, or silt loam
 Content of rock fragments—0 to 15 percent gravel, 0 to 2 percent cobbles

Cg horizon:

Hue—5Y or 2.5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam, clay loam, silt loam, silty clay loam, or fine sandy loam
 Content of rock fragments—0 to 15 percent gravel, 0 to 2 percent cobbles

1878—Hamre muck**Composition**

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

Setting

Landform: Depressions on lake plains and moraines
Slope: 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 material over 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 13.2 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

- Talmoon and similar soils
- Willosippi and similar soils
- Cathro and similar soils
- Warba and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Hassman Series

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow to moderately rapid; lower part—slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope range: 0 to 1 percent
Taxonomic class: Fine, montmorillonitic, nonacid, frigid Vertic Endoaquepts

Typical Pedon

Hassman muck, 1,800 feet north and 300 feet east of the southwest corner of sec. 33, T. 48 N., R. 25 W.

- Oa—0 to 4 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 20 percent fiber, 10 percent rubbed; primarily herbaceous fibers; moderate fine granular structure; very friable; many fine roots; moderately acid; abrupt smooth boundary.
- A—4 to 8 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; many fine roots; slightly acid; abrupt wavy boundary.
- Bg—8 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent yellowish brown (10YR 5/6) iron concentrations; moderate medium subangular blocky structure parting to weak fine subangular blocky; firm; common fine roots; neutral; clear wavy boundary.
- BCg—26 to 45 inches; grayish brown (2.5Y 5/2) silty

clay; common medium prominent yellowish brown (10YR 5/6) iron concentrations; weak medium subangular blocky soil fragments that part to weak fine subangular blocky structure; firm; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

Cg—45 to 60 inches; light brownish gray (2.5Y 6/2) and light gray (2.5Y 7/2) silty clay loam; common medium prominent yellowish brown (10YR 5/4) iron concentrations; massive; friable; few medium rounded white (2.5Y 8/2), soft masses of carbonate; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 22 to 45 inches

Content of sand in the particle-size control section: 2 to 15 percent fine sand or coarser

Other features: An E horizon in some pedons

Oa horizon:

Hue—10YR

Value—2

Chroma—1

Texture—muck

A horizon:

Hue—10YR or neutral

Value—2

Chroma—0 or 1

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

Bg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 or 5

Chroma—1 or 2

Texture—silty clay, silty clay loam, or clay

Cg horizon:

Hue—5Y or 2.5Y

Value—4 to 7

Chroma—1 or 2

Texture—silty clay loam, silty clay, or clay

428—Hassman muck

Composition

Hassman and similar soils: About 90 percent inclusions: About 10 percent

Setting

Landform: Depressions on lake plains

Slope: 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: 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 10.0 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

- Cathro and similar soils
- Dalbo and similar soils
- Brickton and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Hillcity Series

Drainage class: Moderately well drained

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

Landform: Moraines

Parent material: Eolian deposits over till

Slope range: 1 to 6 percent

Taxonomic class: Coarse-silty, mixed Oxyaquic Eutroboralfs

Typical Pedon

Hillcity silt loam, 1 to 6 percent slopes, 1,000 feet north and 900 feet east of the southwest corner of sec. 15, T. 52 N., R. 25 W.

Oe—0 to 2 inches; well decomposed organic litter.

E—2 to 6 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium and thin platy structure; very friable;

many fine roots; moderately acid; clear wavy boundary.

- Bw—6 to 17 inches; brown (10YR 4/3) silt loam; weak coarse subangular blocky structure; very friable; many fine roots; moderately acid; clear smooth boundary.
- E'—17 to 20 inches; light brownish gray (10YR 6/2) very fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; many very fine roots; slightly acid; clear wavy boundary.
- B/E—20 to 24 inches; about 70 percent dark yellowish brown (10YR 4/4) silt loam (Bt) with about 30 percent tongues of pale brown (10YR 6/3) silt loam (E), light gray (10YR 7/2) dry; weak coarse subangular blocky structure; very friable; common very fine roots; few faint brown (10YR 4/3) clay films on faces of peds; common faint pale brown (10YR 6/3) silt coatings on faces of peds; moderately acid; clear wavy boundary.
- Bt—24 to 32 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium and coarse subangular blocky structure; friable; common very fine roots; common distinct dark brown (10YR 4/3) clay films on faces of peds; moderately acid; clear smooth boundary.
- E and Bt—32 to 43 inches; pale brown (10YR 6/3) very fine sandy loam (E), light gray (10YR 7/2) dry; lamellae of yellowish brown (10YR 5/4) very fine sandy loam (Bt); few fine distinct yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) iron concentrations; weak very thick and thick platy structure; very friable; few faint yellowish brown (10YR 5/4) clay films in pores of peds; common very fine roots; neutral; clear wavy boundary.
- 2C—43 to 60 inches; light olive brown (2.5Y 5/3) loam; few fine prominent strong brown (7.5YR 5/8) iron concentrations and few fine faint light brownish gray (2.5Y 6/2) iron depletions; massive; friable; few very fine roots; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 35 to more than 70 inches

Other features: Some pedons have an A horizon, an E' and Bt horizon, a BC or 2BC horizon, or a C horizon.

E horizon:

Hue—10YR
Value—4 to 6
Chroma—1 or 2
Texture—silt loam

Bw horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 or 4
Texture—silt loam, very fine sandy loam, or loam

E' horizon:

Hue—10YR
Value—5 to 7
Chroma—2 or 3
Texture—silt loam, very fine sandy loam, or loamy very fine sand

E/B or B/E horizon:

Colors and textures—similar to those of the E, E', and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 or 4
Texture—silt loam, very fine sandy loam, or loam

C horizon (if it occurs):

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

2C horizon:

Hue—2.5Y, 10YR, 7.5YR, or 5YR
Value—4 to 6
Chroma—2 to 5
Texture—loam, sandy clay loam, fine sandy loam, or sandy loam

469B—Hillcity silt loam, 1 to 6 percent slopes

Composition

Hillcity and similar soils: About 95 percent
Inclusions: About 5 percent

Setting

Landform: Rises on moraines

Slope: 1 to 6 percent

Component Description

Surface layer texture: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Eolian deposits over till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.3 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

- Sax and similar soils
- Spooner and similar soils
- Itasca 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

1031—Histosols, ponded

Composition

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

Setting

Landform: Depressions
Slope: 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 material over glaciolacustrine deposits
Flooding: None
Seasonal high water table: 2 feet above to 1 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 17.3 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

- Soils that have thinner organic materials
- Poorly drained mineral 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

Itasca Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 1 to 25 percent
Taxonomic class: Coarse-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Itasca silt loam, in an area of Itasca-Goodland complex, 6 to 12 percent slopes, 1,700 feet south and 550 feet west of the northeast corner of sec. 1, T. 52 N., R. 26 W.

- A—0 to 2 inches: black (10YR 2/1) silt loam, light gray (10YR 6/1) dry; weak very fine granular structure; very friable; many fine roots; moderately acid; clear wavy boundary.
- E—2 to 4 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; many fine roots; moderately acid; clear wavy boundary.
- Bw—4 to 10 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; very friable; common fine roots; moderately acid; clear wavy boundary.
- E—10 to 14 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak fine subangular blocky structure; very friable; common fine and medium roots; moderately acid; clear smooth boundary.
- 2B/E—14 to 21 inches; about 70 percent dark brown (10YR 4/3) sandy loam (Bt) with about 30 percent tongues of grayish brown (10YR 5/2) silt loam (E), very pale brown (10YR 7/3) dry; weak medium and coarse subangular blocky structure;

friable; common fine and medium roots; common faint dark brown (10YR 4/3) clay films on faces of peds and in pores; moderately acid; clear wavy boundary.

2Bt—21 to 49 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; firm; few fine and medium roots; many distinct dark brown (7.5YR 3/4) clay films on faces of peds; 5 percent gravel; slightly acid; gradual smooth boundary.

2C—49 to 60 inches; brown (10YR 5/3) sandy loam; massive; friable; common medium distinct strong brown (7.5YR 4/6 and 5/6) iron stains; 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the loess mantle: 10 to 32 inches
Depth to carbonates: 48 to more than 72 inches

A horizon:

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

E horizon:

Hue—2.5Y or 10YR
Value—4 to 6
Chroma—2 or 3
Texture—silt loam, very fine sandy loam, or fine sandy loam

Bw horizon:

Hue—10YR or 7.5YR
Value—3 to 6
Chroma—3 or 4
Texture—silt loam, very fine sandy loam, or fine sandy loam

E' horizon:

Hue—2.5Y or 10YR
Value—5 or 6
Chroma—2 or 3
Texture—silt loam, very fine sandy loam, fine sandy loam, or loamy very fine sand
Content of rock fragments—0 to 2 percent gravel

2E/B or 2B/E horizon:

Colors and textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 or 4
Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—2 to 8 percent gravel, 0 to 2 percent cobbles

2C horizon:

Hue—2.5Y, 10YR, or 7.5YR
Value—4 or 5
Chroma—3 or 4
Texture—fine sandy loam, sandy loam, or loam
Content of rock fragments—2 to 8 percent gravel, 0 to 2 percent cobbles

618B—Itasca silt loam, 1 to 6 percent slopes

Composition

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

Setting

Landform: Rises on moraines
Slope: 1 to 6 percent

Component Description

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

- Mooselake and similar soils
- Talmoon and similar soils
- Alstad and similar soils
- Goodland and similar soils
- Hillcity 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

870B—Itasca-Goodland complex, 2 to 6 percent slopes

Composition

Itasca and similar soils: About 55 percent
Goodland and similar soils: About 30 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope: 2 to 6 percent

Component Description

Itasca

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

Goodland

Surface layer texture: Silt 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 7.2 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

- Cathro and similar soils
- Talmoon and similar soils

- Cromwell 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

870C—Itasca-Goodland complex, 6 to 12 percent slopes

Composition

Itasca and similar soils: About 55 percent
Goodland and similar soils: About 30 percent
Inclusions: About 15 percent

Setting

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

Component Description

Itasca

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

Goodland

Surface layer texture: Silt 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 6.5 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

- Cathro and similar soils
- Talmoon and similar soils
- Cromwell 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

870E—Itasca-Goodland complex, 12 to 25 percent slopes

Composition

Itasca and similar soils: About 50 percent
Goodland and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes

Slope: 12 to 25 percent

Component Description

Itasca

Surface layer texture: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: Greater than 6.0 feet

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

Organic matter content: Moderately low

Goodland

Surface layer texture: Silt 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 6.1 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

- Cathro and similar soils
- Alstad and similar soils
- Cromwell and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Jevne Series

Drainage class: Poorly drained

Permeability: Moderately rapid to moderately slow in the loamy strata and rapid in the sandy strata

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

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

Typical Pedon

Jevne fine sandy loam, 800 feet west and 150 feet north of the southeast corner of sec. 27, T. 49 N., R. 25 W.

A—0 to 6 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fine and very fine roots; 2 percent gravel; moderately acid; abrupt smooth boundary.

Eg1—6 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; few fine distinct yellowish brown (10YR 5/4) iron concentrations; weak thin platy structure; friable; many fine roots; 3 percent gravel; moderately acid; abrupt smooth boundary.

Eg2—11 to 19 inches; grayish brown (10YR 5/2) loam, light gray (10YR 7/2) dry; common fine distinct dark yellowish brown (10YR 4/4) iron

concentrations; weak medium platy structure; friable; common roots; few remnants of Bt material in the lower part; 2 percent gravel; moderately acid; clear wavy boundary.

Btg1—19 to 26 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) iron concentrations; moderate medium subangular blocky structure; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; 2 percent gravel; moderately acid; abrupt smooth boundary.

Btg2—26 to 31 inches; grayish brown (2.5Y 5/2) silt loam; many medium prominent strong brown (7.5YR 5/6) iron concentrations; weak coarse subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; slightly acid; abrupt smooth boundary.

Btg3—31 to 43 inches; grayish brown (2.5Y 5/2) loam; many medium prominent dark yellowish brown (10YR 4/4) iron concentrations; weak coarse subangular blocky structure; friable; few faint dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; 3 percent gravel; slightly acid; abrupt smooth boundary.

Cg1—43 to 52 inches; brown (10YR 5/3), stratified sandy loam and loamy sand; few fine faint grayish brown (10YR 5/2) iron depletions; massive; friable; slightly acid; abrupt smooth boundary.

Cg2—52 to 60 inches; brown (10YR 5/3) loam; common fine faint grayish brown (10YR 5/2) iron depletions; massive; friable; few large light gray (10YR 7/1) carbonate concretions; 3 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

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

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Eg horizon:

Hue—2.5Y or 10YR

Value—5 or 6

Chroma—1 or 2

Texture—very fine sandy loam, fine sandy loam, loam, silt loam, or sandy loam; thin subhorizons of loamy sand or loamy fine sand

Btg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

Texture—clay loam, loam, silt loam, or sandy clay loam; thin subhorizons of silty clay loam, sandy loam, loamy sand, loamy fine sand, or sand

Cg horizon:

Hue—5Y, 2.5Y, 10YR, or 7.5YR

Value—4 to 7

Chroma—1 to 4

Texture—stratified loam, clay loam, silty clay loam, sandy loam, loamy sand, or sand

1150—Jevne fine sandy loam

Composition

Jevne and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats on lake plains

Slope: 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 over 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 10.2 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

- Hamre and similar soils
- Sandwick and similar soils
- Dusler 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

Leafriver Series

Drainage class: Very poorly drained

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

Landform: Outwash plains and lake plains

Parent material: Organic material over glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Sandy, mixed, frigid Histic Humaquepts

Typical Pedon

Leafriver muck, 2,550 feet south and 1,700 feet east of the northwest corner of sec. 28, T. 48 N., R. 23 W.

Oa1—0 to 10 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 20 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak medium subangular blocky structure; very friable; many fine and very fine roots; strongly acid; abrupt wavy boundary.

Oa2—10 to 13 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 10 percent fiber, less than 5 percent rubbed; primarily herbaceous fibers; weak medium platy structure; friable; few very fine roots; strongly acid; abrupt wavy boundary.

A—13 to 17 inches; black (10YR 2/1) sand, dark gray (10YR 4/1) dry; single grain; loose; 1 percent gravel; moderately acid; clear wavy boundary.

Cg1—17 to 26 inches; grayish brown (10YR 5/2) sand; single grain; loose; 1 percent gravel; moderately acid; clear wavy boundary.

Cg2—26 to 33 inches; grayish brown (2.5Y 5/2) sand; common medium distinct yellowish brown (10YR 5/6) iron concentrations; single grain; loose; 1 percent gravel; moderately acid; clear wavy boundary.

Cg3—33 to 48 inches; grayish brown (2.5Y 5/2) sand; common medium prominent yellowish red (5YR 5/6) iron concentrations and few medium faint light brownish gray (2.5Y 6/2) iron depletions; single grain; loose; 2 percent gravel; moderately acid; clear smooth boundary.

Cg4—48 to 60 inches; gray (5Y 5/1) sand; single grain; loose; 2 percent gravel; slightly acid.

Range in Characteristics

Depth to mineral material: 8 to 16 inches

Depth to carbonates: Greater than 60 inches

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

A horizon:

Hue—5Y, 2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—sand, loamy sand, fine sand, loamy fine sand, sandy loam, fine sandy loam, or the mucky analogs of these textures

Content of rock fragments—0 to 3 percent gravel

Cg horizon:

Hue—5GY, 5Y, 2.5Y, or 10YR

Value—4 to 7

Chroma—1 or 2

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

Content of rock fragments—0 to 15 percent gravel

1984—Leafriver muck

Composition

Leafriver and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Swales on outwash plains and lake plains

Slope: 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 material over 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 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

- Meehan and similar soils
- Roscommon and similar soils
- Markey and similar soils
- Twig 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

Lobo Series

Drainage class: Very poorly drained

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

Landform: Bogs

Parent material: Organic material

Slope range: 0 to 1 percent

Taxonomic class: Dysic, frigid Hemic Sphagnofibrists

Typical Pedon

Lobo peat, in an area of Lobo and Waskish peats, 2,400 feet north and 600 feet east of the southwest corner of sec. 1, T. 52 N., R. 22 W.; in Itasca County:

Oi1—0 to 2 inches; peat, light yellowish brown (10YR 6/4) broken face, rubbed, and pressed; 100 percent fiber, 95 percent rubbed; primarily sphagnum fibers; massive; very friable; extremely acid; clear smooth boundary.

Oi2—2 to 10 inches; peat, dark reddish gray (5YR 4/2) broken face, pink (7.5YR 7/3) rubbed and pressed; 85 percent fiber, 50 percent rubbed; primarily sphagnum fibers; massive; very friable; extremely acid; clear smooth boundary.

Oi3—10 to 15 inches; peat, reddish brown (5YR 5/4) broken face, brown (7.5YR 5/4) rubbed, and light brown (7.5YR 6/4) pressed; 95 percent fiber, 75 percent rubbed; primarily sphagnum fibers; weak thick platy structure; very friable; extremely acid; clear smooth boundary.

Oi4—15 to 49 inches; peat, dark reddish brown (5YR 3/4) broken face, dark reddish brown (5YR 3/3) rubbed, and pink (7.5YR 7/3) pressed; 85 percent fiber, 60 percent rubbed; primarily sphagnum

fibers; weak thick platy structure; very friable; extremely acid; clear smooth boundary.

Oe—49 to 63 inches; mucky peat, dark brown (7.5YR 3/2) broken face, dark reddish brown (5YR 2.5/2) rubbed and pressed; 55 percent fiber, 30 percent rubbed; primarily herbaceous fibers; weak medium platy structure; very friable; extremely acid.

Range in Characteristics

Thickness of the organic material: Greater than 63 inches

Reaction: Extremely acid

Oi horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 7

Chroma—2 to 4

Texture—peat

Oe horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 or 3

Chroma—1 or 2

Texture—mucky peat

869—Lobo and Waskish peats

Composition

Lobo: Variable

Waskish: Variable

Inclusions: About 10 percent

Setting

Landform: Bogs

Slope: 0 to 1 percent

Component Description

Lobo

Surface layer texture: Peat

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic material

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 34.4 inches

Organic matter content: Very high

Waskish

Surface layer texture: Peat

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained
Dominant parent material: Organic material
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 36.0 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

- Soils that have a thinner or thicker sphagnum cap

Major Uses of the Unit

- Forest land

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

- Forest Land section

Loxley Series

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Bogs
Parent material: Organic material
Slope range: 0 to 1 percent
Taxonomic class: Dysic Typic Borosaprists

Typical Pedon

Loxley peat, 1,200 feet north and 2,400 feet west of the southeast corner of sec. 22, T. 49 N., R. 25 W.

- Oi—0 to 3 inches; peat, brown (10YR 5/3) broken face, light gray (10YR 7/2) rubbed and pressed; 90 percent fiber, 80 percent rubbed; primarily sphagnum fibers; massive; very friable; many very fine and fine roots; extremely acid; clear smooth boundary.
- Oa1—3 to 12 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 25 percent fiber, less than 10 percent rubbed; primarily herbaceous fibers; weak fine granular structure; friable; common fine and very fine roots; extremely acid; clear smooth boundary.
- Oa2—12 to 47 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 20 percent fiber, less than 10 percent rubbed; primarily herbaceous fibers; massive; friable; few fine and

very fine roots; extremely acid; clear smooth boundary.

- Oa3—47 to 60 inches; muck, black (5YR 2.5/1) broken face, black (10YR 2/1) rubbed and pressed; 20 percent fiber, less than 10 percent rubbed; primarily herbaceous fibers; massive; friable; extremely acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Reaction: Extremely acid

Oi horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 to 5

Chroma—0 to 4

Texture—peat

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 to 5

Chroma—0 to 4

Texture—muck

533—Loxley peat

Composition

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

Setting

Landform: Bogs

Slope: 0 to 1 percent

Component Description

Surface layer texture: Peat

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic material

Flooding: None

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

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 24.3 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

- Meehan and similar soils
- Roscommon and similar soils
- Beseman and similar soils
- Seelyville 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

Lupton Series

Drainage class: Very poorly drained

Permeability: Moderately slow to moderately rapid

Landform: Bogs

Parent material: Organic material

Slope range: 0 to 1 percent

Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Lupton muck, 2,300 feet south and 1,100 feet east of the northwest corner of sec. 22, T. 52 N., R. 26 W.

Oa1—0 to 13 inches; muck, black (5YR 2.5/1) broken face, very dark gray (5YR 3/1) rubbed and pressed; 20 percent fiber, 5 percent rubbed; primarily woody fibers; moderate fine and medium granular structure; very friable; 5 percent wood fragments; moderately acid; clear smooth boundary.

Oa2—13 to 60 inches; muck, dark reddish brown (5YR 2.5/2) broken face, rubbed, and pressed; 25 percent fiber, 10 percent rubbed; primarily woody fibers; massive; very friable; 10 percent wood fragments; moderately acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Reaction: Very strongly acid to moderately acid

Content of wood fragments: 5 to 30 percent

Other features: An Oi horizon in some pedons

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

546—Lupton muck

Composition

Lupton and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Bogs

Slope: 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 material

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

- Meehan and similar soils
- Roscommon and similar soils
- Mooselake and similar soils
- Tawas and similar soils
- Soils that are more acid than the Lupton soil

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Mahtomedi Series

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains, lake plains, and moraines

Parent material: Glacial outwash

Slope range: 2 to 40 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Mahtomedi loamy coarse sand, 6 to 12 percent slopes, 1,500 feet north and 2,600 feet east of the southwest corner of sec. 33, T. 50 N., R. 26 W.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy coarse sand, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; very friable; 10 percent gravel; moderately acid; clear smooth boundary.

E—2 to 4 inches; brown (7.5YR 5/2) loamy coarse sand, pinkish gray (7.5YR 6/2) dry; weak fine granular structure; very friable; 10 percent gravel; moderately acid; clear smooth boundary.

Bw1—4 to 17 inches; dark brown (7.5YR 4/4) gravelly coarse sand; single grain; loose; 20 percent gravel; moderately acid; clear smooth boundary.

Bw2—17 to 38 inches; brown (7.5YR 5/4) gravelly coarse sand; single grain; loose; 25 percent gravel; moderately acid; gradual wavy boundary.

C—38 to 60 inches; light brown (7.5YR 6/4) gravelly sand; single grain; loose; 15 percent gravel; moderately acid.

Range in Characteristics

A horizon:

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 or 2

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

Content of rock fragments—10 to 35 percent gravel, 0 to 2 percent cobbles

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—1 to 3

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

Content of rock fragments—10 to 35 percent gravel, 0 to 2 percent cobbles

Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 5

Chroma—4 to 6

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

Content of rock fragments—10 to 35 percent gravel, 0 to 10 percent cobbles

C horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 to 6

Chroma—3 or 4

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

Content of rock fragments—10 to 35 percent gravel, 0 to 10 percent cobbles

454B—Mahtomedi loamy coarse sand, 2 to 6 percent slopes

Composition

Mahtomedi and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Summits and backslopes

Slope: 2 to 6 percent

Component Description

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: 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

- Leafriver and similar soils
- Newson and similar soils
- Meehan and similar soils
- Soils that contain less gravel or more gravel than the Mahtomedi soil

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section

- Forest Land section

454C—Mahtomedi loamy coarse sand, 6 to 12 percent slopes

Composition

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

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Summits and backslopes

Slope: 6 to 12 percent

Component Description

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 4.0 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

- Leafriver and similar soils
- Meehan and similar soils
- Newson and similar soils
- Soils that contain less gravel or more gravel than the Mahtomedi soil

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

454E—Mahtomedi loamy coarse sand, 12 to 25 percent slopes

Composition

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

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Backslopes

Slope: 12 to 25 percent

Component Description

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 4.0 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

- Soils that contain more gravel or less gravel than the Mahtomedi soil
- Newson and similar soils
- Meehan and similar soils
- Leafriver and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

454F—Mahtomedi gravelly loamy sand, 25 to 40 percent slopes

Composition

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

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Backslopes

Slope: 25 to 40 percent

Component Description

Surface layer texture: Gravelly 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: 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

- Leafriver and similar soils
- Newson and similar soils
- Meehan and similar soils
- Soils that contain less gravel or more gravel than the Mahtomedi soil

Major Uses of the Unit

- Forest land

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

- Forest Land section

Mahtowa Series

Drainage class: Very poorly drained

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

Landform: Moraines

Parent material: Till

Slope range: 0 to 1 percent

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

Typical Pedon

Mahtowa muck, in an area of Blackhoof and Mahtowa soils, 1.800 feet north and 100 feet west of the southeast corner of sec. 11, T. 46 N., R. 25 W.

Oa—0 to 3 inches; muck, black (10YR 2/1) broken

face, rubbed, and pressed; 10 percent fiber, 5 percent rubbed; primarily herbaceous fibers; moderate fine granular structure; very friable; strongly acid; abrupt smooth boundary.

A1—3 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; firm; 3 percent gravel; strongly acid; clear smooth boundary.

A2—7 to 11 inches; dark brown (10YR 3/2) loam, brown (7.5YR 4/2) dry; moderate fine and very fine subangular blocky structure; firm; 4 percent gravel; strongly acid; clear wavy boundary.

Bg1—11 to 16 inches; dark grayish brown (10YR 4/2) loam; many medium distinct dark brown (7.5YR 4/4) iron concentrations; moderate fine subangular blocky structure; firm; 5 percent gravel; strongly acid; clear wavy boundary.

Bg2—16 to 28 inches; grayish brown (10YR 5/2) loam; many medium prominent reddish brown (5YR 4/3) and common fine prominent strong brown (7.5YR 4/6) iron concentrations; weak medium and fine subangular blocky structure; friable; 6 percent gravel, 1 percent cobbles; moderately acid; clear wavy boundary.

Bw—28 to 46 inches; dark reddish brown (5YR 3/4) loam; common medium prominent gray (5Y 5/1) iron depletions; weak medium subangular blocky structure; friable; 6 percent gravel, 1 percent cobbles; moderately acid; clear smooth boundary.

C—46 to 60 inches; reddish brown (5YR 4/4) loam; common large prominent gray (5Y 5/1) iron depletions; massive; friable; 6 percent gravel, 1 percent cobbles; neutral.

Range in Characteristics

Depth to carbonates: 36 to more than 60 inches

Oa horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2

Chroma—1 or 2

Texture—muck

A horizon:

Hue—2.5Y or 10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 3 percent gravel

Bg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

Texture—loam, clay loam, or silt loam

Content of rock fragments—3 to 10 percent

gravel, 0 to 1 percent cobbles

Bw horizon:

Hue—5YR or 2.5YR
Value—3 or 4
Chroma—3 or 4
Texture—loam or clay loam
Content of rock fragments—3 to 10 percent
gravel, 0 to 1 percent cobbles

C horizon:

Hue—5YR or 2.5YR
Value—3 or 4
Chroma—3 or 4
Texture—loam or clay loam

Markey Series

Drainage class: Very poorly drained

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

Landform: Bogs

Parent material: Organic material over alluvium

Slope range: 0 to 1 percent

Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Markey muck, 1,850 feet south and 1,700 feet west of the northeast corner of sec. 31, T. 48 N., R. 23 W.

Oa1—0 to 8 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 20 percent fiber, less than 10 percent rubbed; primarily herbaceous fibers; weak medium granular structure; very friable; many fine roots; strongly acid; gradual smooth boundary.

Oa2—8 to 35 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 15 percent fiber, less than 5 percent rubbed; primarily herbaceous fibers; weak medium subangular blocky structure; very friable; few fine roots; very strongly acid; abrupt smooth boundary.

Cg1—35 to 52 inches; gray (5Y 6/1) sand; single grain; loose; moderately acid; gradual smooth boundary.

Cg2—52 to 60 inches; gray (5Y 6/1) sand; common medium distinct olive (5Y 5/3) and few fine prominent strong brown (7.5YR 5/6) iron concentrations; single grain; loose; moderately acid.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches

Reaction: Very strongly acid or strongly acid

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral
Value—2 to 4
Chroma—0 to 3
Texture—muck

C horizon:

Hue—5Y, 2.5Y, 10YR, 7.5YR, or neutral
Value—4 to 6
Chroma—0 to 4
Texture—sand, fine sand, or loamy sand
Content of rock fragments—0 to 10 percent
gravel

543—Markey muck

Composition

Markey and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Bogs

Slope: 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 material over alluvium

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 15.4 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

- Roscommon and similar soils
- Meehan and similar soils
- Cathro and similar soils
- Soils that are less decomposed than the Markey soil
- Organic soils that are thinner than the Markey soil
- Seelyeville and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Meehan Series

Drainage class: Somewhat poorly drained

Permeability: Rapid

Landform: Lake plains and outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Meehan loamy sand, 2,390 feet south and 30 feet west of the northeast corner of sec. 24, T. 51 N., R. 26 W.

Oi—0 to 1 inch; slightly decomposed leaf litter.

A—1 to 4 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; many very fine roots; moderately acid; abrupt wavy boundary.

E—4 to 7 inches; dark grayish brown (10YR 4/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine and medium subangular blocky structure; very friable; many very fine roots; moderately acid; clear wavy boundary.

Bw1—7 to 15 inches; dark brown (7.5YR 4/4) sand; weak medium and coarse subangular blocky structure; very friable; many very fine roots; strongly acid; clear smooth boundary.

Bw2—15 to 23 inches; brown (7.5YR 5/4) sand; common medium distinct yellowish red (5YR 4/6) iron concentrations; weak coarse subangular blocky structure; very friable; common very fine roots; strongly acid; clear smooth boundary.

Bw3—23 to 28 inches; brown (10YR 5/3) sand; common medium distinct strong brown (7.5YR 5/6) iron concentrations; single grain; loose; moderately acid; clear smooth boundary.

Cg—28 to 46 inches; light brownish gray (10YR 6/2) sand; few large distinct dark yellowish brown (10YR 4/4) iron concentrations; single grain; loose; moderately acid; gradual smooth boundary.

C—46 to 60 inches; brown (10YR 5/3) sand; few large faint light yellowish brown (2.5Y 6/4) iron

concentrations; single grain; loose; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel throughout the profile

Content of sand in the particle-size control section: Less than 50 percent fine sand or very fine sand, more than 30 percent medium, coarse, and very coarse sand

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

E horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 or 3

Texture—loamy sand or sand

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 8

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

C horizon:

Hue—10YR or 7.5YR

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: Flats and rises on lake plains and outwash plains

Slope: 0 to 2 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: 1.0 to 2.5 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

- Seelyeville and similar soils
- Leafriver and similar soils
- Roscommon and similar soils
- Friendship 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

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains, lake plains, and moraines

Parent material: Glacial outwash

Slope range: 1 to 25 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Menahga loamy sand, 1 to 6 percent slopes, 1,200 feet south and 400 feet east of the northwest corner of sec. 23, T. 51 N., R. 26 W.

Oa—0 to 2 inches; well decomposed leaf litter.

A—2 to 3 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; very friable; many very fine and fine roots; strongly acid; abrupt wavy boundary.

E—3 to 4 inches; dark grayish brown (10YR 4/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine and medium granular structure; very friable; many very fine and fine roots, strongly acid; abrupt broken boundary.

Bw1—4 to 14 inches; dark yellowish brown (10YR 3/4) loamy sand; weak medium and coarse

subangular blocky structure; very friable; many very fine and fine roots; strongly acid; clear wavy boundary.

Bw2—14 to 25 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; common fine and very fine roots; moderately acid; gradual smooth boundary.

C1—25 to 38 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few fine and very fine roots; moderately acid; gradual smooth boundary.

C2—38 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few fine and very fine roots; moderately acid.

Range in Characteristics

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

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

E horizon:

Hue—10YR

Value—4 or 5

Chroma—1 or 2

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

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 6

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

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 6

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

458B—Menahga loamy sand, 1 to 6 percent slopes

Composition

Menahga and similar soils: About 85 percent inclusions: About 15 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Position on the landform: Summits and backslopes

Slope: 1 to 6 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 4.3 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

- Leafriver and similar soils
- Rifle and similar soils
- Newson and similar soils
- Meehan and similar soils
- Friendship and similar soils
- Gravelly soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

458C—Menahga loamy sand, 6 to 12 percent slopes

Composition

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

Setting

Landform: Outwash plains, lake plains, and moraines
Position on the landform: Summits and backslopes
Slope: 6 to 12 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 3.8 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

- Gravelly soils
- Meehan and similar soils
- Newson and similar soils
- Rifle and similar soils
- Leafriver and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

458E—Menahga loamy sand, 12 to 25 percent slopes

Composition

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

Setting

Landform: Outwash plains, lake plains, and moraines
Position on the landform: Backslopes
Slope: 12 to 25 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 4.1 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

- Meehan and similar soils
- Gravelly soils
- Newson and similar soils
- Rifle and similar soils
- Leafriver and similar soils

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Milaca Series

Drainage class: Well drained and moderately well drained

Permeability: Upper part—moderate or moderately rapid; next part—very slow or slow; dense till—very slow

Landform: Moraines

Parent material: Till

Slope range: 3 to 25 percent

Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Milaca fine sandy loam, 3 to 8 percent slopes, 12 feet south and 2,100 feet east of the northwest corner of sec. 24, T. 43 N., R. 23 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; common medium roots; 3 percent gravel; strongly acid; abrupt smooth boundary.

E1—3 to 6 inches; brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak thin platy structure; very friable; common medium roots; 5 percent gravel; strongly acid; clear smooth boundary.

E2—6 to 15 inches; brown (10YR 5/3) fine sandy loam, very pale brown (10YR 7/3) dry; moderate

thin platy structure; very friable; common medium roots; 5 percent gravel; strongly acid; clear smooth boundary.

2E/B—15 to 22 inches; brown (7.5YR 5/2) sandy loam (E); remnants of reddish brown (5YR 4/3) sandy loam (Bt); weak medium subangular blocky structure; very friable; common fine roots; 4 percent gravel; strongly acid; clear wavy boundary.

2B/E—22 to 27 inches; about 75 percent dark reddish brown (5YR 3/4) sandy loam (Bt) with about 25 percent tongues of brown (7.5YR 5/2) sandy loam (E), pinkish gray (7.5YR 7/2) dry; strong medium subangular blocky structure; friable; few fine roots; common faint dark reddish brown (5YR 3/3) clay films on faces of peds; 5 percent gravel; slightly acid; clear smooth boundary.

2Bt—27 to 32 inches; reddish brown (5YR 4/4) sandy loam; strong medium subangular blocky structure; firm; few fine roots; many faint dark reddish brown (5YR 3/3) clay films on faces of peds; 5 percent gravel; slightly acid; clear smooth boundary.

2BC—32 to 48 inches; reddish brown (5YR 4/4) sandy loam; few fine distinct yellowish red (5YR 5/6) iron concentrations; moderate medium platy structure; firm; 7 percent gravel; neutral; clear wavy boundary.

2Cd—48 to 60 inches; dark reddish brown (5YR 3/4) sandy loam; massive; moderate medium plate-like soil fragments; very firm; 7 percent gravel; neutral.

Range in Characteristics

Depth to dense till: 40 to 60 inches

Content of rock fragments: 2 to 15 percent gravel, 0 to 3 percent cobbles

Other features: An EB or BE horizon in most pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—fine sandy loam or sandy loam

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 to 4

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

EB or BE horizon (if it occurs):

Colors and textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—7.5YR or 5YR

Value—3 to 5

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, or loam

2BC horizon:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

2Cd horizon:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

152B—Milaca fine sandy loam, 3 to 8 percent slopes***Composition***

Milaca and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Summits and backslopes*Slope:* 3 to 8 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:* 3 to 5 feet*Available water capacity to 60 inches or root-limiting layer:* About 6.5 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

- Twig and similar soils
- Giese and similar soils
- Ronneby and similar soils
- Soils that have stones on the surface
- Mora and similar soils
- Steeper areas

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

152C—Milaca fine sandy loam, 8 to 15 percent slopes***Composition***

Milaca and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Summits and backslopes*Slope:* 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 4.9 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

- Twig and similar soils
- Giese and similar soils
- Ronneby and similar soils
- Soils that have stones on the surface
- Mora and similar soils
- Cromwell 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

152E—Milaca fine sandy loam, 15 to 25 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 15 to 25 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 4.7 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

- Twig and similar soils
- Giese and similar soils
- Cromwell and similar soils
- Soils that have stones on the surface
- Less sloping areas

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

738B—Milaca-Millward complex, 2 to 8 percent slopes

Composition

Milaca and similar soils: About 50 percent
Millward and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: Milaca—3 to 8 percent; Millward—2 to 8 percent

Component Description

Milaca

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: 3 to 5 feet

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

Organic matter content: Low

Millward

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 7.4 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

- Twig and similar soils
- Giese and similar soils
- Mora and similar soils
- Pomroy and similar soils
- Sandy soils

Major Uses of the Unit

- Cropland
- Hayland

- Forest land

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

- Agronomy section
- Forest Land section

738C—Milaca-Millward complex, 8 to 15 percent slopes

Composition

Milaca and similar soils: About 50 percent
Millward and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 8 to 15 percent

Component Description

Milaca

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 4.6 inches

Organic matter content: Low

Millward

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 7.6 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

- Twig and similar soils
- Giese and similar soils

- Pomroy and similar soils
- Sandy soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Millward Series

Drainage class: Well drained

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

Landform: Moraines

Parent material: Till

Slope range: 2 to 15 percent

Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Millward fine sandy loam, in an area of Milaca-Millward complex, 2 to 8 percent slopes, 200 feet east and 100 feet south of the northwest corner of sec. 17, T. 45 N., R. 22 W.

Oe—0 to 1 inch; organic litter derived from leaves and twigs.

E—1 to 4 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; very friable; many fine and medium roots; 5 percent gravel; very strongly acid; abrupt smooth boundary.

Bw1—4 to 21 inches; brown (10YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; common fine and medium roots; 5 percent gravel; strongly acid; clear smooth boundary.

2Bw2—21 to 25 inches; dark brown (7.5YR 4/3) loamy sand; massive; very friable; few fine and medium roots; 6 percent gravel; strongly acid; clear smooth boundary.

2Bw3—25 to 34 inches; dark brown (7.5YR 4/4) sand; single grain; loose; few fine roots; 2 percent gravel; slightly acid; clear smooth boundary.

3Bt1—34 to 39 inches; dark reddish brown (5YR 3/4) sandy loam; moderate medium subangular blocky structure; friable; few faint reddish brown (5YR 3/3) clay films on ped exteriors; few fine roots; 10

percent gravel; slightly acid; clear smooth boundary.

3Bt2—39 to 46 inches; reddish brown (5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; few faint reddish brown (5YR 3/3) clay films on ped exteriors; few fine roots; 8 percent gravel; slightly acid; clear smooth boundary.

3Cd—46 to 60 inches; reddish brown (5YR 4/4) sandy loam; massive; moderate medium plate-like soil fragments; firm; 10 percent gravel; neutral.

Range in Characteristics

Depth to dense till: 40 to 70 inches

Content of rock fragments: 1 to 15 percent gravel; 0 to 3 percent cobbles in the loamy material, 0 to 25 percent in the sandy layer

Thickness of the 2Bw horizon: 10 to 30 inches

Other features: An A, EB, or BE horizon in some pedons

E horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 to 6

Chroma—2 or 3

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

Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 6

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or loam

2Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 6

Chroma—3 to 6

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

3Bt horizon:

Hue—7.5YR, 5YR, or 2.5YR

Value—3 to 5

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, or loam

3BC or 3Cd horizon:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or loam

Mooselake Series

Drainage class: Very poorly drained

Permeability: Moderately rapid

Landform: Bogs

Parent material: Organic material

Slope range: 0 to 1 percent

Taxonomic class: Euic Typic Borohemists

Typical Pedon

Mooselake mucky peat, in an area of Mooselake and Lupton mucky peats, 2,550 feet south and 1,900 feet east of the northwest corner of sec. 10, T. 146 N., R. 25 W.; in Itasca County:

Oi—0 to 3 inches; fibric material, pale brown (10YR 6/3) broken face and rubbed, light gray (10YR 7/2) pressed; 95 percent fiber, 85 percent rubbed; primarily sphagnum fibers; loose; strongly acid; clear wavy boundary.

Oe1—3 to 15 inches; mucky peat, black (5YR 2.5/1) broken face, dark reddish brown (5YR 2.5/2) rubbed and pressed; 55 percent fiber, 25 percent rubbed; primarily woody fibers; weak medium granular structure; friable; slightly acid; clear smooth boundary.

Oe2—15 to 44 inches; mucky peat, dark reddish brown (5YR 2.5/2, 3/2, and 3/3) broken face, rubbed, and pressed; 60 percent fiber, 25 percent rubbed; primarily woody fibers; weak fine and medium subangular blocky structure; friable; 10 percent wood fragments; moderately acid; clear smooth boundary.

Oe3—44 to 63 inches; mucky peat, dark reddish brown (5YR 2.5/2 and 3/3) broken face, rubbed, and pressed; 50 percent fiber, 20 percent rubbed; woody and herbaceous fibers; weak fine and medium subangular blocky structure; friable; moderately acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Thickness of peat or muck material: Less than 10 inches

Reaction: Very strongly acid to moderately acid

Content of wood fragments: 0 to 10 percent

Oi horizon:

Hue—10YR or 7.5YR

Value—5 to 7

Chroma—2 to 4

Texture—peat

Oe horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 or 3
 Chroma—1 to 3
 Texture—mucky peat

797—Mooselake and Lupton mucky peats

Composition

Mooselake: Variable
 Lupton: Variable
 Inclusions: About 10 percent

Setting

Landform: Bogs
 Slope: 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 material
 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 27.0 inches
 Organic matter content: Very high

Lupton

Surface layer texture: Mucky peat
 Depth class: Very deep (more than 60 inches)
 Drainage class: Very poorly drained
 Dominant parent material: Organic material
 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 24.8 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

- Dusler and similar soils
- Sandwich and similar soils
- Tawas and similar soils
- More acid soils
- Less decomposed soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Mora Series

Drainage class: Moderately well drained
 Permeability: Upper part—moderate or moderately rapid; dense till—very slow
 Landform: Moraines
 Parent material: Till
 Slope range: 1 to 4 percent
 Taxonomic class: Coarse-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Mora fine sandy loam, 1 to 4 percent slopes, 500 feet south and 200 feet east of the northwest corner of sec. 32, T. 43 N., R. 23 W.

- A—0 to 3 inches; black (10YR 2/1) fine sandy loam, gray (10YR 6/1) dry; moderate medium granular structure; friable; many medium roots; 3 percent gravel; slightly acid; abrupt smooth boundary.
- E1—3 to 12 inches; brown (10YR 5/3) fine sandy loam, very pale brown (10YR 7/3) dry; weak thin platy structure; very friable; common medium roots; 6 percent gravel; slightly acid; clear wavy boundary.
- E2—12 to 15 inches; dark brown (10YR 4/3) fine sandy loam, very pale brown (10YR 7/3) dry; moderate thin platy structure; very friable; common medium roots; 8 percent gravel; slightly acid; clear wavy boundary.
- 2B/E—15 to 19 inches; about 60 percent dark reddish brown (5YR 3/4) sandy loam (Bt) with about 40 percent tongues of brown (10YR 4/3) sandy loam (E), very pale brown (10YR 7/3) dry; moderate medium platy structure; friable; common fine roots; few faint reddish brown (5YR 4/3) clay films on faces of peds; 10 percent gravel; slightly acid; clear smooth boundary.
- 2Bt1—19 to 23 inches; reddish brown (5YR 4/4) sandy loam; common medium distinct reddish gray (5YR 5/2) iron depletions; moderate medium subangular blocky structure; friable; few fine roots; common faint dark reddish brown (5YR 3/3) clay films on faces of peds; 10 percent gravel; slightly acid; clear wavy boundary.

2Bt2—23 to 28 inches; reddish brown (5YR 4/4) sandy loam; common fine distinct reddish gray (5YR 5/2) iron depletions; moderate medium platy structure; friable; few fine roots; common faint dark reddish brown (5YR 3/3) clay films on faces of peds; 12 percent gravel; slightly acid; clear smooth boundary.

2BC—28 to 42 inches; reddish brown (5YR 4/4) sandy loam; moderate medium platy structure; firm; 10 percent gravel; slightly acid; clear smooth boundary.

2Cd—42 to 60 inches; reddish brown (5YR 4/4) sandy loam; massive; moderate medium plate-like soil fragments; very firm; 14 percent gravel; slightly acid.

Range in Characteristics

Depth to dense till: 40 to 60 inches

Content of rock fragments: 1 to 15 percent gravel, 0 to 3 percent cobbles

Content of sand and clay in the Bt horizon: 8 to 18 percent clay and 50 to 60 percent fine sand or coarser; 20 to 30 percent fine sand

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—fine sandy loam

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

Texture—fine sandy loam, sandy loam, or loam

2B/E horizon:

Colors and textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or loam

2BC horizon:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—3 to 6

Texture—sandy loam or fine sandy loam

2Cd horizon:

Hue—5YR or 2.5YR

Value—3 or 4

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

164B—Mora fine sandy loam, 1 to 4 percent slopes

Composition

Mora and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 1 to 4 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: 2.0 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 5.6 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

- Twig and similar soils
- Giese and similar soils
- Ronneby and similar soils
- Milaca and similar soils
- Soils that have stones on the surface

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

Morph Series

Drainage class: Poorly drained

Permeability: Moderate

Landform: Lake plains and outwash plains

Parent material: Alluvium and lacustrine sediments

Slope range: 0 to 2 percent

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

Typical Pedon

Morph very fine sandy loam, 75 feet south and 2,400 feet west of the northeast corner of sec. 7, T. 148 N., R. 28 W.

A—0 to 4 inches; very dark gray (10YR 3/1) very fine sandy loam, dark gray (10YR 4/1) dry; moderate very fine and fine subangular blocky structure; very friable; many fine and medium roots; slightly acid; clear wavy boundary.

Eg—4 to 13 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) very fine sandy loam; common medium prominent strong brown (7.5YR 5/6) iron concentrations; moderate thin platy structure; very friable; many fine and medium roots; moderately acid; clear smooth boundary.

B/E—13 to 23 inches; about 70 percent grayish brown (2.5Y 5/2) fine sandy loam (Bt) with about 30 percent interfingerings and ped coatings of light brownish gray (2.5Y 6/2) loamy fine sand (E), light gray (2.5Y 7/2) dry; common medium prominent strong brown (7.5YR 5/6) iron concentrations; moderate medium and coarse angular blocky structure; firm; many fine and medium roots; common thin grayish brown (2.5Y 5/2) clay films on faces of peds and in pores; strongly acid; clear smooth boundary.

Btg1—23 to 30 inches; grayish brown (2.5Y 5/2) fine sandy loam; few fine prominent yellowish brown (10YR 5/8) and common medium distinct light olive brown (2.5Y 5/6 and 5/4) iron concentrations; weak coarse angular blocky structure; firm; common fine roots; common faint dark gray (5Y 4/1) clay films on faces of peds; slightly acid; abrupt wavy boundary.

Btg2—30 to 33 inches; olive gray (5Y 5/2) loam; common fine prominent yellowish brown (10YR 5/6 and 5/8) and common medium distinct light olive brown (2.5Y 5/4) iron concentrations; moderate medium and fine angular blocky structure; firm; common fine roots; many distinct dark gray (5Y 4/1) clay films on faces of peds; neutral; abrupt wavy boundary.

Bcg—33 to 40 inches; grayish brown (2.5Y 5/2) sandy loam; few medium faint light olive brown (2.5Y 5/4) iron concentrations; weak coarse and very coarse subangular blocky structure; friable; common fine roots; discontinuous clay films; slight effervescence; slightly alkaline; clear wavy boundary.

Cg1—40 to 46 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) very fine sandy loam; common large and medium faint olive brown (2.5Y 5/4) iron concentrations; massive; friable; few fine roots; few medium soft rounded light gray (2.5Y 7/2) lime masses; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cg2—46 to 55 inches; light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2) loamy fine sand; common medium light olive brown (2.5Y 5/4) iron concentrations; massive; friable; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cg3—55 to 60 inches; light brownish gray (2.5Y 6/2 and 6/1) and grayish brown (2.5Y 5/2) silt loam; common medium faint light olive brown (2.5Y 5/4) and prominent yellowish brown (10YR 5/6 and 5/8) iron concentrations; massive; firm; many light gray (2.5Y 7/2) and white (2.5Y 8/2), soft rounded masses of carbonates; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 22 to more than 60 inches

Content of rock fragments: 0 to 3 percent gravel throughout the profile

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—very fine sandy loam

Eg horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—1 or 2

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

Btg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

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

BC horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

Texture—stratified loamy sand to silty clay loam

C horizon:

Hue—5Y or 2.5Y

Value—4 to 7

Chroma—1 or 2

Texture— stratified loamy sand to silty clay loam

621—Morph very fine sandy loam

Composition

Morph and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on lake plains and outwash plains

Slope: 0 to 2 percent

Component Description

Surface layer texture: Very fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Alluvium and 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 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

- Sago and similar soils
- Somewhat poorly drained 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

Nemadji Series

Drainage class: Somewhat poorly drained

Permeability: Rapid

Landform: Lake plains and outwash plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic class: Sandy, mixed, frigid Aquentic Haplorthods

Typical Pedon

Nemadji loamy fine sand, 2,450 feet south and 400 feet east of the northwest corner of sec. 20, T. 45 N., R. 25 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loamy fine sand, brown (7.5YR 5/2) dry; weak medium platy structure parting to weak very fine subangular blocky; friable; many fine roots; very strongly acid; abrupt smooth boundary.

E—6 to 11 inches; dark brown (7.5YR 4/2) loamy fine sand; common medium distinct strong brown (7.5YR 5/6) iron concentrations; weak medium platy structure; friable; few fine roots; strongly acid; clear wavy boundary.

Bw1—11 to 17 inches; brown (7.5YR 5/4) fine sand; common medium distinct strong brown (7.5YR 5/6) iron concentrations; weak medium subangular blocky structure; friable; moderately acid; clear smooth boundary.

Bw2—17 to 27 inches; reddish brown (5YR 4/4) fine sand; weak medium subangular blocky structure; very friable; few weakly cemented peds; moderately acid; abrupt smooth boundary.

Bhs—27 to 34 inches; dark reddish brown (5YR 3/3) fine sand; common medium distinct reddish brown (5YR 5/4) iron concentrations; massive; firm; weakly cemented; few very dark gray (5YR 3/1), soft masses in ped interiors; moderately acid; abrupt smooth boundary.

C1—34 to 47 inches; reddish brown (5YR 4/4) fine sand; single grain; loose; moderately acid; clear wavy boundary.

C2—47 to 60 inches; dark brown (7.5YR 4/4) fine sand; common medium distinct reddish brown (5YR 5/4) iron concentrations; single grain; loose; moderately acid.

Range in Characteristics

Depth to carbonates: Greater than 80 inches

Other features: An A horizon in some pedons

Ap or A horizon (if it occurs):

Hue—10YR, 7.5YR, or 5YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

E horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 or 5

Chroma—1 or 2

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

Bw horizon:

Hue—2.5YR to 7.5YR

Value—3 to 5

Chroma—3 or 4

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

Bhs horizon:

Hue—7.5YR, 5YR, or 2.5YR

Value—3 to 5

Chroma—3 to 6

Texture—sand or fine sand

C horizon:

Hue—7.5YR, 5YR, or 2.5YR

Value—4 or 5

Chroma—2 to 4

Texture—sand or fine sand

186—Nemadji loamy fine sand

Composition

Nemadji and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and rises on lake plains and outwash plains

Slope: 0 to 3 percent

Component Description

Surface layer texture: Loamy fine sand

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 3.0 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

- Newson and similar soils
- Leafriver and similar soils

- Omega 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

Newson Series

Drainage class: Poorly drained

Permeability: Rapid

Landform: Lake plains and outwash plains

Parent material: Alluvium and glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic class: Mixed, frigid Humaqueptic Psammaquents

Typical Pedon

Newson loamy sand, 1,800 feet north and 1,400 feet west of the southeast corner of sec. 20, T. 48 N., R. 23 W.

A—0 to 6 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many very fine roots; very strongly acid; clear smooth boundary.

Bg—6 to 16 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; common very fine roots; very strongly acid; clear smooth boundary.

BCg—16 to 23 inches; grayish brown (10YR 5/2) sand; common medium distinct yellowish brown (10YR 5/6) iron concentrations and few fine faint light brownish gray (10YR 6/2) iron depletions; single grain; loose; very strongly acid; clear smooth boundary.

Cg—23 to 60 inches; grayish brown (2.5Y 5/2) sand; few fine faint light brownish gray (10YR 6/2) iron depletions; single grain; loose; very strongly acid.

Range in Characteristics

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

A horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand

Bg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 7

Chroma—1 or 2

Texture—loamy sand or sand

BCg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—5 or 6

Chroma—1 or 2

Texture—loamy sand or sand

Cg horizon:

Hue—2.5Y or 10YR

Value—2 to 8

Chroma—1 to 6

Texture—loamy sand or sand

1115—Newson loamy sand**Composition**

Newson and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Flats and swales on lake plains and outwash plains*Slope:* 0 to 2 percent**Component Description***Surface layer texture:* Loamy sand*Depth class:* Very deep (more than 60 inches)*Drainage class:* Poorly drained*Dominant parent material:* Alluvium and glaciolacustrine deposits*Flooding:* None*Seasonal high water table:* 1 foot above to 1 foot below the surface*Ponding duration:* Brief*Available water capacity to 60 inches or root-limiting layer:* About 4.8 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

- Leafriver and similar soils
- Meehan and similar soils
- Nemadji 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

Nokay Series*Drainage class:* Somewhat poorly drained*Permeability:* Upper part—moderate or moderately rapid; dense till—very slow*Landform:* Moraines*Parent material:* Till*Slope range:* 0 to 3 percent*Taxonomic class:* Coarse-loamy, mixed, frigid Udollic Epiaqualfs**Typical Pedon**

Nokay fine sandy loam, 150 feet south and 780 feet east of the northwest corner of sec. 33, T. 51 N., R. 27 W.

A1—0 to 2 inches; black (10YR 2/1) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak very fine and fine granular structure; very friable; many roots; 2 percent gravel; strongly acid; abrupt wavy boundary.

A2—2 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; few fine distinct yellowish brown (10YR 5/4) iron concentrations; weak very fine and fine subangular blocky structure; very friable; many roots; 2 percent gravel; strongly acid; clear wavy boundary.

E1—6 to 12 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/6) iron concentrations; weak thin platy structure; very friable; many roots; 6 percent gravel; strongly acid; clear wavy boundary.

E2—12 to 19 inches; grayish brown (10YR 5/2) sandy loam, light gray (10YR 7/2) dry; common medium distinct dark brown (7.5YR 4/4) iron concentrations; weak medium platy structure; friable; many roots; 6 percent gravel; strongly acid; clear wavy boundary.

Bt—19 to 32 inches; dark brown (7.5YR 4/4) sandy loam; few medium prominent light brownish gray

(10YR 6/2) iron depletions and yellowish red (5YR 4/6) iron concentrations; weak medium and coarse subangular blocky structure; firm; few roots; common distinct brown (7.5YR 5/2) clay films on faces of peds; 6 percent gravel; moderately acid; gradual wavy boundary.

BC—32 to 44 inches; dark brown (7.5YR 4/4) sandy loam; common medium prominent light brownish gray (10YR 6/2) iron depletions and reddish brown (5YR 4/4) iron concentrations; moderate medium platy structure; firm; few roots; 8 percent gravel; slightly acid; clear wavy boundary.

Cd—44 to 60 inches; brown (7.5YR 5/3) sandy loam; few medium faint brown (7.5YR 5/2) iron depletions; massive; weak medium plate-like soil fragments; very firm; 8 percent gravel; slightly acid.

Range in Characteristics

Depth to dense till: 40 to 60 inches

Content of clay and sand in the Bt horizon: 8 to 18 percent clay and 45 to 65 percent fine sand or coarser; 15 to 25 percent coarse and very coarse sand

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Content of rock fragments—2 to 10 percent gravel, 0 to 2 percent cobbles

E horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam, sandy loam, loam, or thin subhorizons of loamy sand

Content of rock fragments—2 to 10 percent gravel, 0 to 2 percent cobbles

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 to 6

Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—3 to 10 percent gravel, 0 to 5 percent cobbles

BC and Cd horizons:

Hue—7.5YR

Value—4 or 5

Chroma—3 to 5

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

Content of rock fragments—5 to 15 percent gravel, 0 to 5 percent cobbles

142—Nokay fine sandy loam

Composition

Nokay and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines

Slope: 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: Till

Flooding: None

Depth to the water table: 1.0 to 2.5 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

- Leafriver and similar soils
- Cathro and similar soils
- Wabedo 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

Northwood Series

Drainage class: Very poorly drained

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

Landform: Lake plains and moraines

Parent material: Glaciolacustrine deposits
Slope range: 0 to 1 percent
Taxonomic class: Sandy over loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Northwood muck, 200 feet south and 1,500 feet west of the northeast corner of sec. 11, T. 51 N., R. 26 W.

- Oa—0 to 9 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 25 percent fiber, 10 percent rubbed; primarily herbaceous fibers; weak fine subangular blocky structure; very friable; common fine and very fine roots; moderately acid; clear wavy boundary.
- A—9 to 13 inches; black (5Y 2.5/1) and very dark gray (5Y 3/1) mucky loamy sand, very dark gray (5Y 3/1) dry; weak fine granular structure; very friable; few very fine and fine roots; 1 percent gravel; moderately acid; abrupt irregular boundary.
- Bg1—13 to 26 inches; dark grayish brown (2.5Y 4/2) coarse sand; few medium distinct dark yellowish brown (10YR 4/4) iron concentrations; single grain; loose; 5 percent gravel; slightly acid; clear wavy boundary.
- Bg2—26 to 35 inches; grayish brown (2.5Y 5/2) sand; few medium prominent strong brown (7.5YR 5/6) iron concentrations; single grain; loose; slightly acid; abrupt wavy boundary.
- 2Cg—35 to 60 inches; light olive gray (5Y 6/2) loam; common medium prominent strong brown (7.5YR 5/6) iron concentrations and greenish gray (5GY 6/1) iron depletions; massive; friable; few white (10YR 8/1) carbonate threads; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches
Depth to carbonates: 20 to 60 inches

Oa horizon:
 Hue—5Y, 2.5Y, or 10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—muck
 Content of rock fragments—0 to 10 percent gravel

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

Content of rock fragments—0 to 15 percent gravel

Bg horizon:
 Hue—5Y or 2.5Y
 Value—4 to 7
 Chroma—1 or 2
 Texture—loamy sand, loamy fine sand, loamy coarse sand, sand, fine sand, or coarse sand
 Content of rock fragments—0 to 15 percent gravel

2Cg horizon:
 Hue—5GY, 5Y, or 2.5Y
 Value—4 to 7
 Chroma—1 or 2
 Texture—loam, clay loam, fine sandy loam, or silty clay loam
 Content of rock fragments—0 to 8 percent gravel, 0 to 3 percent cobbles

563—Northwood muck

Composition

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

Setting

Landform: Depressions on lake plains and moraines
Slope: 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: 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 10.1 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

- Stuntz and similar soils
- Sandwick and similar soils
- Markey and similar soils
- Leafriver and similar soils

- Soils that are less decomposed than the Northwood soil

Major Uses of the Unit

- Pasture

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

- Agronomy section

Oesterle Series

Drainage class: Somewhat poorly drained

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

Landform: Outwash plains, lake plains, and moraines

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed Aquic Glossoboralfs

Typical Pedon

Oesterle fine sandy loam, 2,400 feet south and 200 feet east of the northwest corner of sec. 28, T. 46 N., R. 25 W.

A—0 to 2 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine and coarse roots; 2 percent gravel; very strongly acid; abrupt wavy boundary.

E1—2 to 3 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; few medium prominent strong brown (7.5YR 5/6) iron concentrations; weak thin platy structure; very friable; many fine and coarse roots; 4 percent gravel; very strongly acid; clear smooth boundary.

E2—3 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/1) dry; common medium prominent strong brown (7.5YR 4/6) iron concentrations; moderate thin platy structure; very friable; common fine and coarse roots; 7 percent gravel; strongly acid; clear smooth boundary.

E/B—10 to 15 inches; about 60 percent brown (7.5YR 4/2) sandy loam (E), pinkish gray (7.5YR 6/2) dry; about 40 percent remnants of dark brown (7.5YR 4/4) sandy loam (Bt); few fine distinct strong brown (7.5YR 5/6) iron concentrations; moderate thin platy structure; friable; few medium roots; few faint dark brown (7.5YR 3/4) clay films on faces of peds; 5 percent gravel; strongly acid; clear wavy boundary.

B/E—15 to 18 inches; about 75 percent dark brown (7.5YR 4/4) sandy loam (Bt) with about 25 percent tongues of brown (7.5YR 4/2) sandy loam (E); few fine distinct strong brown (7.5YR 5/6) iron concentrations; weak medium subangular blocky structure; friable; few medium roots; 5 percent gravel; strongly acid; clear wavy boundary.

Bt1—18 to 21 inches; dark brown (7.5YR 4/4) sandy loam; common fine distinct brown (7.5YR 4/2) iron depletions; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark brown (7.5YR 3/4) clay films on faces of peds; 7 percent gravel; strongly acid; abrupt wavy boundary.

Bt2—21 to 34 inches; dark brown (7.5YR 4/4), stratified gravelly sandy loam and gravelly loamy sand; few medium distinct brown (7.5YR 5/2) iron depletions and few fine faint strong brown (7.5YR 4/6) iron concentrations; weak medium and coarse subangular blocky structure; friable; common distinct dark brown (7.5YR 3/2) clay films on faces of peds; 15 percent gravel, 2 percent cobbles; strongly acid; abrupt wavy boundary.

2C—34 to 60 inches; dark brown (7.5YR 4/4) gravelly coarse sand; single grain; loose; 30 percent gravel, 5 percent cobbles; moderately acid.

Range in Characteristics

Depth to sand or gravel: 20 to 40 inches

Content of clay and sand in the Bt horizon: 7 to 17 percent clay, more than 40 percent fine sand or coarser

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—fine sandy loam

Content of rock fragments—0 to 15 percent gravel, 0 to 5 percent cobbles

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

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

Content of rock fragments—0 to 15 percent gravel, 0 to 5 percent cobbles

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—4 to 6

Texture—sandy loam, fine sandy loam, or loam in the upper part; loamy sand, sandy loam, or the gravelly analogs of these textures in the lower part

Content of rock fragments—0 to 20 percent gravel, 0 to 5 percent cobbles

2Bt horizon (if it occurs):

Hue—10YR, 7.5YR, or 5YR

Value—4 to 6

Chroma—2 to 8

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

Content of rock fragments—3 to 30 percent gravel, 0 to 5 percent cobbles

2C horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 to 6

Chroma—1 to 8

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

Content of rock fragments—3 to 35 percent gravel, 0 to 5 percent cobbles

685—Oesterle fine sandy loam**Composition**

Oesterle and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Outwash plains, lake plains, and moraines*Position on the landform:* Footslopes and toeslopes*Slope:* 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:* Glacial outwash*Flooding:* None*Depth to the water table:* 1 to 3 feet*Available water capacity to 60 inches or root-limiting layer:* About 5.5 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

- Leafriver and similar soils
- Meehan and similar soils
- Nemadji and similar soils
- Soils that have a loamy till substratum

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

Omega Series*Drainage class:* Somewhat excessively drained*Permeability:* Rapid*Landform:* Outwash plains*Parent material:* Glaciolacustrine deposits*Slope range:* 2 to 25 percent*Taxonomic class:* Sandy, mixed, frigid Typic Haplorthods**Typical Pedon**

Omega loamy fine sand, 2 to 6 percent slopes, 2,450 feet south and 2,600 feet east of the northwest corner of sec. 23, T. 45 N., R. 24 W.

E—0 to 2 inches; reddish gray (5YR 5/2) loamy fine sand, pinkish gray (7.5YR 6/2) dry; weak fine subangular blocky structure; very friable; many roots; very strongly acid; abrupt wavy boundary.

Bs1—2 to 11 inches; reddish brown (5YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; common roots; common iron oxide coatings on sand grains; very strongly acid; clear wavy boundary.

Bs2—11 to 21 inches; reddish brown (5YR 4/4) fine sand; single grain; loose; few roots; common iron oxide coatings on sand grains; strongly acid; clear wavy boundary.

C1—21 to 49 inches; light reddish brown (5YR 6/4) fine sand; single grain; loose; moderately acid; abrupt wavy boundary.

C2—49 to 60 inches; reddish brown (5YR 5/4) fine sand; single grain; loose; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 5 percent gravel throughout the profile

Series control section: Average texture is sand or fine sand.

Other features: An A horizon in some pedons

E horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 or 5

Chroma—1 or 2

Texture—loamy fine sand or loamy sand

Bs horizon:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—3 or 4

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

C horizon:

Hue—5YR or 2.5YR

Value—5 or 6

Chroma—3 to 5

Texture—sand or fine sand

188B—Omega loamy fine sand, 2 to 6 percent slopes**Composition**

Omega and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains

Position on the landform: Summits and backslopes

Slope: 2 to 6 percent

Component Description

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively 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 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

- Leafriver and similar soils
- Newson and similar soils
- Nemadji and similar soils
- Soils that contain more than 10 percent gravel
- Bushville and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

188C—Omega loamy fine sand, 6 to 12 percent slopes**Composition**

Omega and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Outwash plains

Position on the landform: Summits and backslopes

Slope: 6 to 12 percent

Component Description

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively 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 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

- Leafriver and similar soils
- Newson and similar soils
- Nemadji and similar soils
- Soils that contain more than 10 percent gravel
- Pomroy and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

188E—Omega loamy sand, 12 to 25 percent slopes

Composition

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

Setting

Landform: Outwash plains

Position on the landform: Backslopes

Slope: 12 to 25 percent

Component Description

Surface layer texture: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively 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 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

- Leafriver and similar soils
- Newson and similar soils
- Nemadji and similar soils
- Soils that contain more than 10 percent gravel

Major Uses of the Unit

- Hayland
- Forest land

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

- Agronomy section

- Forest Land section

Pengilly Series

Drainage class: Poorly drained

Permeability: Moderate

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Typic Fluvaquents

Typical Pedon

Pengilly silt loam, 300 feet north and 1,700 feet east of the southwest corner of sec. 7, T. 50 N., R. 24 W.

A—0 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; many fine roots; moderately acid; clear wavy boundary.

Cg1—4 to 38 inches; grayish brown (2.5Y 5/2), stratified very fine sandy loam, silt loam, fine sandy loam, and loamy fine sand; common fine prominent dark brown (7.5YR 4/4) iron concentrations and common medium distinct very dark gray (10YR 3/1) iron depletions; massive; friable; common fine roots; 2 percent gravel; slightly acid; clear wavy boundary.

Cg2—38 to 51 inches; gray (5Y 5/1), stratified fine sandy loam, loamy fine sand, very fine sandy loam, and silt loam; common medium prominent dark brown (7.5YR 4/4) iron concentrations and common medium distinct very dark gray (10YR 3/1) iron depletions; massive; friable; few fine roots; 2 percent gravel; neutral; clear wavy boundary.

Cg3—51 to 60 inches; dark gray (5Y 4/1), stratified loamy sand, loamy fine sand, fine sandy loam, and very fine sandy loam; few medium faint dark grayish brown (2.5Y 4/2) iron concentrations; massive; very friable; few fine roots; 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Content of rock fragments: 0 to 5 percent gravel throughout the profile

Content of clay in the series control section: 5 to 18 percent

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 to 5

Chroma—0 to 2

Texture—silt loam

Cg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

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

607—Pengilly silt loam

Composition

Pengilly and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats on flood plains

Slope: 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

Depth to the water table: 0.5 foot to 1.5 feet

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

- Seelyeville and similar soils
- Nemadji and similar soils
- Baudette and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

872—Pengilly-Winterfield association

Composition

Pengilly and similar soils: About 60 percent

Winterfield and similar soils: About 25 percent

Inclusions: About 15 percent

Setting

Landform: Pengilly—flats on flood plains;

Winterfield—flats and slight rises on flood plains

Slope: Pengilly—0 to 2 percent; Winterfield—0 to 4 percent

Component Description

Pengilly

Surface layer texture: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Depth to the water table: 0.5 foot to 1.5 feet

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

Organic matter content: Moderate

Winterfield

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Alluvium

Flooding: Frequent

Depth to the water table: 0.5 foot to 3.0 feet

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

- Seelyeville and similar soils
- Sago and similar soils
- Friendship and similar soils
- Well drained soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

1030—Pits, gravel-Udipsamments complex

Composition

Pits: About 50 percent

Udipsamments and similar soils: About 45 percent

Setting

Landform: Outwash plains, lake plains, and moraines

Slope: 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

Pomroy Series

Drainage class: Well drained

Permeability: Upper part—rapid; next part—slow or moderately slow; dense till—very slow

Landform: Moraines

Parent material: Glacial outwash over till

Slope range: 6 to 12 percent

Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Pomroy loamy fine sand, 6 to 12 percent slopes, 1,700 feet east and 1,750 feet south of the northwest corner of sec. 16, T. 45 N., R. 23 W.

A—0 to 4 inches; black (10YR 2/1) loamy fine sand, gray (10YR 5/1) dry; weak medium subangular blocky structure; very friable; many medium roots; 2 percent gravel; strongly acid; abrupt smooth boundary.

E—4 to 9 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2)

dry; weak thin platy structure; very friable; common fine roots; 1 percent gravel; strongly acid; clear wavy boundary.

Bw1—9 to 15 inches; dark yellowish brown (10YR 4/4) loamy fine sand; weak fine subangular blocky structure; very friable; common fine roots; 1 percent gravel; strongly acid; clear smooth boundary.

Bw2—15 to 22 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; few fine roots; 2 percent gravel; moderately acid; clear smooth boundary.

2Bt—22 to 28 inches; reddish brown (5YR 4/3) sandy loam; moderate medium subangular blocky structure; friable; few fine roots; common faint dark reddish brown (5YR 3/2) clay films on faces of peds and in pores; 10 percent gravel; moderately acid; clear wavy boundary.

2BC—28 to 44 inches; reddish brown (5YR 4/4) sandy loam; weak medium platy structure; firm; 12 percent gravel; moderately acid; clear wavy boundary.

2Cd—44 to 60 inches; reddish brown (5YR 4/4) sandy loam; massive; moderate medium plate-like soil fragments; very firm; 12 percent gravel; moderately acid.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches

Depth to dense till: 40 to 60 inches

Other features: Some pedons do not have a 2BC horizon.

A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy fine sand

Content of rock fragments—0 to 2 percent gravel

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 or 3

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

Content of rock fragments—0 to 2 percent gravel

Bw horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—4

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

Content of rock fragments—0 to 2 percent gravel

2Bt horizon:

Hue—7.5YR or 5YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—sandy loam or fine sandy loam
 Content of rock fragments—5 to 15 percent
 gravel, 0 to 7 percent cobbles

2Cd horizon:

Hue—7.5YR or 5YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—sandy loam, fine sandy loam, or loamy
 sand
 Content of rock fragments—5 to 15 percent
 gravel, 0 to 3 percent cobbles

119C—Pomroy loamy fine sand, 6 to 12 percent slopes

Composition

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

Setting

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

Component Description

Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash over till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 2.7 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

- Leafriver and similar soils
- Markey and similar soils
- Watab and similar soils
- Bushville and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Redby Series

Drainage class: Somewhat poorly drained

Permeability: Rapid

Landform: Lake plains

Parent material: Alluvium and glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Redby loamy fine sand, stratified substratum, 1,900 feet north and 1,150 feet east of the southwest corner of sec. 8, T. 47 N., R. 26 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak very fine and fine granular structure; very friable; many fine and medium roots; moderately acid; abrupt smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/2) fine sand, pale brown (10YR 6/3) dry; few fine prominent reddish brown (5YR 4/4) iron concentrations; single grain; loose; few fine and medium roots; moderately acid; clear wavy boundary.

Bw—11 to 25 inches; brown (10YR 5/3) sand; few medium prominent reddish brown (5YR 4/4) iron concentrations; single grain; loose; few fine roots; slightly acid; clear wavy boundary.

Cg1—25 to 42 inches; light brownish gray (10YR 6/2) fine sand; few medium distinct dark yellowish brown (10YR 4/4) iron concentrations; single grain; loose; slightly acid; abrupt smooth boundary.

Cg2—42 to 44 inches; grayish brown (2.5Y 5/2) fine sandy loam; few medium prominent reddish brown (5YR 4/4) iron concentrations; massive; friable; neutral; abrupt smooth boundary.

Cg3—44 to 60 inches; grayish brown (10YR 5/2), stratified fine sand and loamy fine sand; few medium distinct dark yellowish brown (10YR 4/4 and 4/6) iron concentrations; massive; very friable; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Content of rock fragments: 0 to 3 percent gravel throughout the profile

Texture of the particle-size control section: Fine sand with 25 percent or less medium sand or coarser and less than 15 percent coarse sand or coarser

Other features: An A horizon in some pedons

Ap or A horizon (if it occurs):

Hue—10YR

Value—3 or 4

Chroma—1 to 3

Texture—loamy fine sand

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 to 3

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

Bw horizon:

Hue—10YR

Value—4 to 6

Chroma—3 to 6

Texture—fine sand or sand

C horizon:

Hue—2.5Y or 10YR

Value—5 to 7

Chroma—2 or 3

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

795—Redby loamy fine sand, stratified substratum

Composition

Redby and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope: 0 to 3 percent

Component Description

Surface layer texture: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Alluvium and glaciolacustrine deposits

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Available water capacity to 60 inches or root-limiting layer: About 5.2 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

- Markey and similar soils
- Cormant 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

Rifle Series

Drainage class: Very poorly drained

Permeability: Moderately rapid

Landform: Bogs

Parent material: Organic material

Slope range: 0 to 1 percent

Taxonomic class: Euic Typic Borohemists

Typical Pedon

Rifle peat, 500 feet south and 150 feet east of the northwest corner of sec. 16, T. 50 N., R. 25 W.

Oi1—0 to 3 inches; peat, yellowish brown (10YR 5/4) broken face, light gray (10YR 7/2) rubbed and pressed; 95 percent fiber, 95 percent rubbed; primarily sphagnum fibers; massive; very friable; extremely acid; clear smooth boundary.

Oi2—3 to 10 inches; peat, brown (7.5YR 4/2) broken face, pale brown (10YR 6/3) rubbed and pressed; 95 percent fiber, 75 percent rubbed; primarily sphagnum fibers; massive; very friable; many fine roots; extremely acid; clear smooth boundary.

Oe1—10 to 34 inches; mucky peat, dark brown (7.5YR 3/2) broken face and pressed, very dark brown (10YR 2/2) rubbed; 55 percent fiber, 30 percent rubbed; primarily herbaceous fibers;

weak thick platy structure; very friable; very strongly acid; clear smooth boundary.

Oe2—34 to 54 inches; mucky peat, very dark brown (10YR 2/2) broken face, rubbed, and pressed; 45 percent fiber, 20 percent rubbed; weak thick platy structure; very friable; primarily herbaceous fibers; very strongly acid; clear smooth boundary.

Oe3—54 to 60 inches; mucky peat, very dark grayish brown (10YR 3/2) broken face, rubbed, and pressed; 55 percent fiber, 35 percent rubbed; primarily herbaceous fibers; weak very thick platy structure; friable; very strongly acid.

Range in Characteristics

Thickness of the organic material: Greater than 51 inches

Reaction: Extremely acid or very strongly acid in the Oi horizon; very strongly acid to moderately acid in the Oe horizon

Oi horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 6

Chroma—1 to 4

Texture—peat

Oe horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 5

Chroma—2 to 5

Texture—mucky peat

541—Rifle peat

Composition

Rifle and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Bogs

Slope: 0 to 1 percent

Component Description

Surface layer texture: Peat

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic material

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 32.9 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

- Nokay and similar soils
- Waukenabo and similar soils
- Organic soils that are thinner than the Rifle soil
- Greenwood and similar soils
- Seelyeville 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

Ronneby Series

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate or moderately rapid; next part—slow; dense till—very slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, frigid Udollic Epiaqualfs

Typical Pedon

Ronneby loam, 1,100 feet north and 25 feet east of the southwest corner of sec. 4, T. 43 N., R. 23 W.

A—0 to 4 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many medium roots; 6 percent gravel, 1 percent cobbles; strongly acid; abrupt smooth boundary.

E1—4 to 10 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; common fine faint grayish brown (10YR 5/2) iron depletions; weak thin platy structure; very friable; common medium roots; 5 percent gravel; strongly acid; clear smooth boundary.

E2—10 to 15 inches; dark brown (7.5YR 4/2) sandy loam, pinkish gray (7.5YR 6/2) dry; common medium faint grayish brown (10YR 5/2) iron depletions and common medium distinct dark yellowish brown (10YR 4/6) iron concentrations; moderate medium platy structure; very friable; common medium roots; 3 percent gravel; moderately acid; clear smooth boundary.

EB—15 to 22 inches; brown (7.5YR 4/2) sandy loam (E); remnants of brown (7.5YR 5/4) sandy loam (Bt); common medium distinct brown (7.5YR 5/2) iron depletions and common medium distinct strong brown (7.5YR 4/6) iron concentrations; moderate medium platy structure; friable; common fine roots; 3 percent gravel; strongly acid; clear wavy boundary.

Bt1—22 to 28 inches; reddish brown (5YR 4/4) sandy loam; many medium distinct brown (7.5YR 5/2) iron depletions and common medium distinct yellowish red (5YR 5/6) iron concentrations; strong medium subangular blocky structure; friable; medium fine roots; many distinct dark reddish gray (5YR 4/2) clay films in pores of peds; 5 percent gravel; moderately acid; clear smooth boundary.

Bt2—28 to 35 inches; reddish gray (5YR 5/2) fine sandy loam; common medium faint pinkish gray (5YR 6/2) iron depletions and common medium prominent strong brown (7.5YR 5/6) iron concentrations; strong medium subangular blocky structure; firm; few fine roots; common distinct dark reddish brown (5YR 3/2) clay films in pores of peds; 6 percent gravel; moderately acid; clear smooth boundary.

BC—35 to 45 inches; dark reddish brown (5YR 3/4) sandy loam; common medium distinct reddish gray (5YR 5/2) iron depletions; moderate medium platy structure; firm; 6 percent gravel; slightly acid; clear smooth boundary.

Cd—45 to 60 inches; reddish brown (5YR 4/4) sandy loam; massive; moderate medium plate-like soil fragments; very firm; 8 percent gravel; slightly acid.

Range in Characteristics

Depth to dense till: 40 to 60 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam or fine sandy loam

Content of rock fragments—1 to 12 percent gravel, 0 to 3 percent cobbles

E horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—1 or 2

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

Content of rock fragments—3 to 12 percent

gravel, 0 to 3 percent cobbles

EB or BE horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—2 to 4

Texture—loam, fine sandy loam, or sandy loam

Content of rock fragments—5 to 15 percent gravel, 0 to 3 percent cobbles

BC horizon:

Hue—5YR or 2.5YR

Value—3 or 4

Chroma—2 to 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—5 to 15 percent gravel, 0 to 3 percent cobbles

Cd horizon:

Hue—5YR or 2.5YR

Value—3 or 4

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—5 to 15 percent gravel, 0 to 3 percent cobbles

166—Ronneby loam

Composition

Ronneby and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and footslopes

Slope: 0 to 2 percent

Component Description

Surface layer texture: 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 to 2 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

- Twig and similar soils
- Giese and similar soils
- Mora and similar soils
- Soils that have stones on the surface

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

736—Ronneby-Mora complex

Composition

Ronneby and similar soils: About 50 percent

Mora and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Ronneby—backslopes and footslopes; Mora—summits and backslopes

Slope: Ronneby—0 to 2 percent; Mora—1 to 4 percent

Component Description

Ronneby

Surface layer texture: Fine sandy 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 to 2 feet

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

Organic matter content: High

Mora

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: 2.0 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 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

- Twig and similar soils
- Seelyeville and similar soils
- Giese and similar soils
- Milaca 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

Roscommon Series

Drainage class: Very poorly drained

Permeability: Rapid

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Mixed, frigid Mollic Psammaquents

Typical Pedon

Roscommon mucky loamy sand, in an area of Sago and Roscommon soils, 950 feet north and 1,200 feet east of the southwest corner of sec. 16, T. 149 N., R. 23 W.; in Itasca County:

A—0 to 6 inches; black (10YR 2/1) mucky loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; moderately acid; abrupt smooth boundary.

Cg1—6 to 19 inches; olive gray (5Y 5/2) and light olive gray (5Y 6/2) loamy sand; common fine prominent yellowish brown (10YR 5/8) iron concentrations; massive; very friable; slightly acid; abrupt smooth boundary.

Cg2—19 to 32 inches; light olive gray (5Y 6/2) and light gray (5Y 6/1) loamy coarse sand; few fine

distinct light olive brown (2.5Y 5/4) iron concentrations; massive; very friable; neutral; abrupt wavy boundary.

Cg3—32 to 60 inches; light gray (5Y 6/1) sand; single grain; loose; slightly alkaline.

Range in Characteristics

Reaction: Moderately acid to slightly alkaline

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

Other features: An Oa horizon in some pedons

A horizon:

Hue—10YR, 7.5YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—mucky loamy sand

C horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 to 3

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

Rosholt Series

Drainage class: Well drained

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

Landform: Outwash plains

Parent material: Glacial outwash

Slope range: 2 to 12 percent

Taxonomic class: Coarse-loamy, mixed Typic Glossoboralfs

Typical Pedon

Rosholt fine sandy loam, 2 to 6 percent slopes, 1,600 feet east and 2,450 feet north of the southwest corner of sec. 35, T. 43 N., R. 23 W.

Oa—0 to 3 inches; well decomposed leaf litter.

E—3 to 9 inches; brown (10YR 4/3) fine sandy loam, very pale brown (10YR 7/3) dry; weak medium platy structure; very friable; common medium roots; 1 percent gravel; moderately acid; clear wavy boundary.

E/B—9 to 15 inches; about 80 percent brown (10YR 5/3) fine sandy loam (E), very pale brown (10YR 7/3) dry; about 20 percent remnants of dark brown (7.5YR 4/4) fine sandy loam (Bt); moderate medium platy structure; very friable; common medium roots; few faint dark brown (7.5YR 3/4) clay bridges between sand grains; 1

percent gravel; slightly acid; clear wavy boundary.

Bt1—15 to 22 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common fine roots; common faint dark brown (7.5YR 3/4) clay films on faces of peds; 4 percent gravel, 2 percent cobbles; slightly acid; clear smooth boundary.

2Bt2—22 to 30 inches; dark reddish brown (5YR 3/4) gravelly loamy sand; massive; very friable; few fine roots; few faint dark brown (7.5YR 3/4) clay bridges between sand grains; 16 percent gravel, 3 percent cobbles; moderately acid; clear smooth boundary.

2C—30 to 60 inches; reddish brown (5YR 4/4) very gravelly coarse sand; single grain; loose; 52 percent gravel, 3 percent cobbles; moderately acid.

Range in Characteristics

Depth to sand or gravel: 20 to 40 inches

Other features: An A horizon in some pedons

E horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 or 3

Texture—fine sandy loam

Content of rock fragments—0 to 15 percent gravel, 0 to 5 percent cobbles

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—7.5YR or 5YR

Value—3 to 5

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—0 to 15 percent gravel, 0 to 5 percent cobbles

2Bt horizon:

Hue—7.5YR or 5YR

Value—3 to 6

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, loamy sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent gravel, 0 to 7 percent cobbles

2C horizon:

Hue—7.5YR or 5YR

Value—3 to 6

Chroma—3 to 6

Texture—sand, coarse sand, loamy sand, loamy coarse sand, or the gravelly or very gravelly analogs of these textures
Content of rock fragments—0 to 60 percent gravel, 0 to 15 percent cobbles

302B—Rosholt fine sandy loam, 2 to 6 percent slopes

Composition

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

Setting

Landform: Outwash plains
Position on the landform: Summits and backslopes
Slope: 2 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: 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

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

Inclusions

- Leafriver and similar soils
- Oesterle and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

302C—Rosholt fine sandy loam, 6 to 12 percent slopes

Composition

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

Setting

Landform: Outwash plains
Position on the landform: Summits and backslopes
Slope: 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: 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 5.3 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

- Leafriver and similar soils
- Oesterle and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Sago Series

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow to moderately rapid; lower part—moderate
Landform: Lake plains
Parent material: Organic material over glaciolacustrine deposits
Slope range: 0 to 1 percent

Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Sago muck, 1,200 feet south and 2,300 feet west of the northeast corner of sec. 31, T. 48 N., R. 26 W.

Oa—0 to 11 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 10 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak medium and fine granular structure; very friable; many fine and very fine roots; moderately acid; abrupt wavy boundary.

A—11 to 12 inches; black (10YR 2/1) mucky loamy very fine sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; many fine roots; moderately acid; abrupt wavy boundary.

Bg1—12 to 15 inches; dark gray (5Y 4/1) loamy very fine sand; few medium prominent yellowish brown (10YR 5/4) iron concentrations; weak thick platy structure parting to weak very thin platy; very friable; common fine roots; slightly acid; clear smooth boundary.

Bg2—15 to 24 inches; olive gray (5Y 5/2) loamy very fine sand; common medium prominent brownish yellow (10YR 6/6) iron concentrations; weak medium platy structure; very friable; few coarse roots; neutral; abrupt smooth boundary.

Bg3—24 to 29 inches; light brownish gray (2.5Y 6/2), stratified loamy very fine sand to silt loam; common medium distinct yellowish brown (10YR 5/8) and few medium prominent strong brown (7.5YR 5/6) iron concentrations; weak medium platy structure; very friable; few coarse roots; neutral; abrupt smooth boundary.

Cg1—29 to 32 inches; grayish brown (2.5Y 5/2) silt loam; common fine prominent dark brown (7.5YR 4/4) iron concentrations; massive; friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg2—32 to 36 inches; light brownish gray (2.5Y 6/2) very fine sand; few medium distinct yellowish brown (10YR 5/6) iron concentrations; massive; very friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg3—36 to 44 inches; grayish brown (2.5Y 5/2), stratified silt loam to fine sand; few medium prominent yellowish brown (10YR 5/8) iron concentrations; massive; friable; light gray (10YR 7/2) carbonate coatings on faces of peds; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg4—44 to 60 inches; light brownish gray (2.5Y 6/2)

and dark grayish brown (2.5Y 4/2), stratified loamy very fine sand to silt loam; few large prominent brownish yellow (10YR 6/6) iron concentrations; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to mineral material: 8 to 16 inches

Depth to carbonates: 16 to 50 inches

Series control section: 6 to 18 percent clay and 15 to 60 percent fine sand and coarser

Oa horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 4

Chroma—1 to 3

Texture—muck

A horizon:

Hue—5Y, 2.5Y, or 10YR

Value—2 to 4

Chroma—1 or 2

Texture—silt loam, very fine sandy loam, fine sandy loam, loam, loamy fine sand, or loamy very fine sand or the mucky analogs of these textures

Bg horizon:

Hue—5GY, 5Y, or 2.5Y

Value—4 to 7

Chroma—1 or 2

Texture—fine sandy loam, loamy very fine sand, very fine sandy loam, or sandy loam; thin strata of finer or coarser textures

Content of rock fragments—0 to 3 percent gravel

Cg horizon:

Hue—5GY, 5Y, or 2.5Y

Value—4 to 8

Chroma—1 or 2

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

Content of rock fragments—0 to 3 percent gravel

532—Sago muck

Composition

Sago and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains

Slope: 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 material over 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 12.7 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

- Waukenabo and similar soils
- Cowhorn and similar soils
- Markey and similar soils
- Leafriver and similar soils
- Soils that are less decomposed than the Sago soil

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

798—Sago and Roscommon soils

Composition

Sago: Variable

Roscommon: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains

Slope: 0 to 1 percent

Component Description

Sago

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic material over 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 13.2 inches

Organic matter content: Very high

Roscommon

Surface layer texture: Mucky loamy sand

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 foot above to 1 foot below the surface

Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 4.6 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

- Menahga and similar soils
- Cowhorn and similar soils
- Meehan and similar soils
- Sandwich and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Sandwich Series

Drainage class: Poorly drained

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

Landform: Moraines and lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, frigid Arenic
Glossaqualfs

Typical Pedon

Sandwich loamy sand, 1,300 feet south and 1,050 feet east of the northwest corner of sec. 2, T. 49 N., R. 26 W.

- Oe—0 to 2 inches; moderately decomposed leaf litter.
- E—2 to 6 inches; grayish brown (2.5Y 5/2) loamy sand, light brownish gray (10YR 6/2) dry; few medium prominent strong brown (7.5YR 5/6) iron concentrations; weak medium subangular blocky structure; very friable; common roots; 2 percent gravel; moderately acid; clear wavy boundary.
- Bw—6 to 12 inches; reddish brown (5YR 5/4) sand; common large prominent light brownish gray (10YR 6/2) iron depletions; weak coarse subangular blocky structure; very friable; common roots; 2 percent gravel; moderately acid; clear wavy boundary.
- E'—12 to 34 inches; light brownish gray (10YR 6/2) sand, light gray (10YR 7/2) dry; common medium distinct yellowish brown (10YR 5/4) iron concentrations; weak coarse subangular blocky structure; very friable; few roots; 3 percent gravel; moderately acid; clear wavy boundary.
- 2E/B—34 to 41 inches; about 60 percent light brownish gray (10YR 6/2) sandy loam (E), white (10YR 8/2) dry; about 40 percent remnants of dark brown (10YR 4/3) loam (Bt); few medium distinct yellowish brown (10YR 5/6) iron concentrations; weak medium subangular blocky structure; friable; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; 4 percent gravel; moderately acid; clear wavy boundary.
- 2B/E—41 to 49 inches; about 65 percent dark brown (10YR 4/3) loam (Bt) with about 35 percent tongues of light brownish gray (2.5Y 6/2) fine sandy loam (E), white (10YR 8/2) dry; few medium distinct yellowish brown (10YR 5/6) iron concentrations; moderate coarse subangular blocky structure; firm; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; 4 percent gravel; moderately acid; clear wavy boundary.
- 2Btg—49 to 55 inches; brown (10YR 5/3) loam; common fine distinct light brownish gray (2.5Y 6/2) iron depletions and yellowish brown (10YR 4/6) iron concentrations; moderate coarse subangular blocky structure; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; 4 percent gravel; slightly acid; clear wavy boundary.

2Cg—55 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct yellowish brown (10YR 5/4 and 5/6) iron concentrations; massive; friable; 4 percent gravel; neutral.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches
Depth to carbonates: 35 to more than 60 inches
Other features: An A horizon in some pedons

E horizon:

Hue—2.5Y or 10YR
Value—4 to 6
Chroma—1 to 3
Texture—loamy sand
Content of rock fragments—0 to 10 percent gravel

Bw horizon:

Hue—10YR, 7.5YR, or 5YR
Value—3 to 6
Chroma—3 or 4
Texture—loamy sand, loamy fine sand, loamy coarse sand, sand, fine sand, or coarse sand
Content of rock fragments—0 to 10 percent gravel

E' horizon:

Hue—2.5Y or 10YR
Value—5 or 6
Chroma—1 or 2
Texture—loamy sand, loamy fine sand, loamy coarse sand, sand, fine sand, or coarse sand
Content of rock fragments—0 to 10 percent gravel

E/B or B/E horizon:

Colors and textures—similar to those of the E and 2Bt horizons

2Btg horizon:

Hue—5Y, 2.5Y, or 10YR
Value—4 to 6
Chroma—2 or 3
Texture—loam, clay loam, sandy loam, or sandy clay loam
Content of rock fragments—2 to 10 percent gravel, 0 to 3 percent cobbles

2Cg horizon:

Hue—5Y or 2.5Y
Value—4 to 7
Chroma—1 or 2
Texture—loam, clay loam, sandy loam, or fine sandy loam
Content of rock fragments—2 to 10 percent gravel, 0 to 3 percent cobbles

625—Sandwich loamy sand**Composition**

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

Setting

Landform: Drainageways on moraines and lake plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 5.7 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

- Northwood and similar soils
- Dusler and similar soils
- Alstad and similar soils
- Stuntz and similar soils
- Cutaway 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

Sax Series

Drainage class: Very poorly drained
Permeability: Upper part—moderately slow to moderately rapid; lower part—moderate
Landform: Lake plains

Parent material: Organic material over glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic class: Fine-silty, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Sax muck, 200 feet north and 150 feet east of the southwest corner of sec. 6, T. 47 N., R. 25 W.

Oa—0 to 12 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 10 percent fiber, less than 5 percent rubbed; primarily herbaceous fibers; moderate fine granular structure; very friable; strongly acid; abrupt smooth boundary.

A—12 to 15 inches; black (N 2/0) silt loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

Bg—15 to 28 inches; olive gray (5Y 5/2) silt loam; few fine prominent strong brown (7.5YR 5/8) iron concentrations; weak coarse subangular blocky structure; friable; neutral; clear wavy boundary.

Cg1—28 to 39 inches; olive gray (5Y 5/2) silt loam; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; massive; friable; slight effervescence; slightly alkaline; clear wavy boundary.

Cg2—39 to 60 inches; light olive gray (5Y 6/2) silty clay loam; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to mineral material: 8 to 16 inches

Depth to carbonates: 28 to 50 inches

Oa horizon:

Hue—10YR, 7.5YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 or 1

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

Bg horizon:

Hue—5Y, 2.5Y, or neutral

Value—4 to 6

Chroma—0 to 2

Texture—silt loam or silty clay loam

Cg horizon:

Hue—5Y or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—silt loam or silty clay loam

1154—Sax muck**Composition**

Sax and similar soils: About 85 percent

Inclusions: About 15 percent

Setting*Landform:* Depressions on lake plains*Slope:* 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 material over 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 13.8 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

- Brickton and similar soils
- Spooner and similar soils
- Willosippi and similar soils
- Organic soils that are thinner than the Sax soil
- Seelyeville and similar soils
- Dalbo and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Seelyeville Series*Drainage class:* Very poorly drained*Permeability:* Moderately slow to moderately rapid*Landform:* Bogs and flood plains*Parent material:* Organic material*Slope range:* 0 to 1 percent*Taxonomic class:* Euic Typic Borosaprists**Typical Pedon**

Seelyeville muck, 100 feet south and 1,000 feet east of the northwest corner of sec. 27, T. 51 N., R. 25 W.

Oa1—0 to 9 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 15 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak fine subangular blocky structure; friable; many very fine and fine roots; strongly acid; clear smooth boundary.

Oa2—9 to 23 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 15 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak medium platy structure; friable; many fine roots; strongly acid; clear smooth boundary.

Oe—23 to 28 inches; mucky peat, very dark brown (10YR 2/2) broken face, rubbed, and pressed; 50 percent fiber, 30 percent rubbed; primarily herbaceous fibers; weak thick platy structure; friable; few fine roots; strongly acid; clear smooth boundary.

O'a1—28 to 45 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 10 percent fiber, 3 percent rubbed; primarily herbaceous fibers; weak thick platy structure; friable; few fine roots; strongly acid; clear smooth boundary.

O'a2—45 to 60 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 10 percent fiber, 3 percent rubbed; primarily herbaceous fibers; weak medium platy structure; friable; strongly acid.

Range in Characteristics*Thickness of the organic material:* Greater than 51 inches*Reaction:* Very strongly acid or strongly acid*Oa horizon:*

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 or 2

Texture—muck

Oe horizon:

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: Bogs
Slope: 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 material
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

- Loxley and similar soils
- Stuntz and similar soils
- Talmoon and similar soils
- Rifle and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

799—Seelyeville-Bowstring association

Composition

Seelyeville and similar soils: About 45 percent

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

Setting

Landform: Flats and swales on flood plains
Slope: 0 to 1 percent

Component Description

Seelyeville

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic material
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 24.0 inches
Organic matter content: Very high

Bowstring

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic material over 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 22.6 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

- Winterfield and similar soils
- Pengilly and similar soils
- Soils that are more acid than the major soils
- Soils that are less decomposed than the major 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

Shooker Series

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

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

Typical Pedon

Shooker very fine sandy loam, 1,550 feet south and 1,900 feet east of the northwest corner of sec. 19, T. 150 N., R. 29 W.; in Itasca County:

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

E—2 to 9 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; few fine faint grayish brown (2.5Y 5/2) iron depletions and few fine prominent yellowish brown (10YR 5/6) iron concentrations; moderate thin platy structure; friable; 2 percent gravel; neutral; clear wavy boundary.

B/E—9 to 11 inches; about 75 percent grayish brown (2.5Y 5/2) sandy clay loam (Bt) with about 25 percent tongues of light brownish gray (2.5Y 6/2) very fine sandy loam (E), light gray (2.5Y 7/2) dry; few fine prominent yellowish brown (10YR 5/6) iron concentrations; moderate fine subangular blocky structure; friable; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Btg1—11 to 14 inches; grayish brown (2.5Y 5/2) sandy clay loam; few fine prominent yellowish brown (10YR 5/4 and 5/6) iron concentrations; moderate very fine to medium angular blocky structure; firm; continuous distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear wavy boundary.

Btg2—14 to 23 inches; grayish brown (2.5Y 5/2) and olive gray (5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/4) iron concentrations; moderate and strong fine and medium subangular blocky structure; firm; continuous distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Btg3—23 to 27 inches; grayish brown (2.5Y 5/2) sandy clay loam; few fine prominent yellowish brown (10YR 5/4) and reddish brown (5YR 4/4) iron concentrations; weak fine and medium

blocky structure; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel and few dolomite pebbles; slightly alkaline; clear wavy boundary.

Cg1—27 to 48 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine prominent yellowish brown (10YR 5/4) and few fine faint light olive brown (2.5Y 5/4) iron concentrations; massive; friable; 8 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Cg2—48 to 60 inches; light olive gray (5Y 6/2) loam; many fine and medium prominent yellowish brown (10YR 5/4) iron concentrations; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 48 inches

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

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—very fine sandy loam

E horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—1 or 2

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

Btg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 or 5

Chroma—1 or 2

Texture—loam, clay loam, or sandy clay loam

Cg horizon:

Hue—5Y or 2.5Y

Value—5 or 6

Chroma—2 to 4

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

72—Shooker very fine sandy loam

Composition

Shooker and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and rises on moraines

Slope: 0 to 2 percent

Component Description

Surface layer texture: Very 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: 0.5 foot to 1.5 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

- Itasca and similar soils
- Cathro and similar soils
- Talmoon 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

Spoooner Series

Drainage class: Poorly drained

Permeability: Moderate or moderately rapid

Landform: Lake plains and flood plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Spoooner silt loam, 150 feet south and 150 feet east of the northwest corner of sec. 15, T. 49 N., R. 25 W.

A—0 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; friable; many fine roots; moderately acid; abrupt wavy boundary.

E—4 to 10 inches; grayish brown (2.5Y 5/2) silt loam,

light brownish gray (10YR 6/2) dry; few fine prominent yellowish brown (10YR 5/4) iron concentrations; moderate thin platy structure; very friable; many fine roots; moderately acid; abrupt wavy boundary.

Btg1—10 to 15 inches; dark grayish brown (2.5Y 4/2) silt loam; few fine prominent yellowish brown (10YR 5/6) iron concentrations; weak fine subangular blocky structure; friable; many roots; common distinct dark gray (N 4/0) clay films on faces of peds; slightly acid; clear wavy boundary.

Btg2—15 to 29 inches; grayish brown (2.5Y 5/2) silt loam; common large prominent yellowish brown (10YR 5/6) and few medium prominent olive yellow (2.5Y 6/6) iron concentrations; weak medium angular blocky structure; friable; many roots; few distinct dark gray (N 4/0) clay films on faces of peds; slight effervescence; slightly alkaline; clear wavy boundary.

C1—29 to 46 inches; gray (5Y 6/1) silt loam; many large prominent olive yellow (2.5Y 6/6) and common medium prominent strong brown (7.5YR 5/6) iron concentrations; massive; friable; few roots; strong effervescence; moderately alkaline; clear wavy boundary.

C2—46 to 60 inches; gray (5Y 6/1) silty clay loam; many large prominent olive yellow (2.5Y 6/6) and few medium prominent strong brown (7.5YR 5/6) iron concentrations; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches

Other features: A BC horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

E horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—1 or 2

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

Btg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

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

C horizon:

Hue—5Y or 2.5Y

Value—5 or 6

Chroma—1 to 3

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

147—Spoooner silt loam

Composition

Spoooner and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats on lake plains

Slope: 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: 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 11.7 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

- Sax and similar soils
- Seelyeville and similar soils
- Baudette and similar soils
- Soils that have coarse fragments in the subsoil

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

Stuntz Series

Drainage class: Somewhat poorly drained

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

Landform: Moraines

Parent material: Till

Slope range: 0 to 3 percent

Taxonomic class: Fine-loamy, mixed, frigid Aeric Glossaqualfs

Typical Pedon

Stuntz very fine sandy loam, 200 feet north and 300 feet east of the southwest corner of sec. 18, T. 47 N., R. 25 W.

A—0 to 3 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; moderate fine granular structure; very friable; many fine roots; 2 percent gravel; moderately acid; abrupt smooth boundary.

E—3 to 7 inches; grayish brown (2.5Y 5/2) very fine sandy loam, light gray (2.5Y 7/2) dry; weak thin platy structure; very friable; common fine roots; 2 percent gravel; moderately acid; clear wavy boundary.

B/E—7 to 17 inches; about 60 percent light olive brown (2.5Y 5/4) clay loam (Bt) with about 40 percent tongues of grayish brown (2.5Y 5/2) very fine sandy loam (E), light gray (2.5Y 7/2) dry; strong medium subangular blocky structure; firm; few fine roots; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds and in pores; 2 percent gravel, 2 percent cobbles; strongly acid; clear wavy boundary.

Btg1—17 to 26 inches; light olive brown (2.5Y 5/4) clay loam; few medium distinct grayish brown (2.5Y 5/2) iron depletions; moderate medium subangular blocky structure; firm; few coarse roots; many distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds and in pores; 5 percent gravel, including soft gray shale; slightly acid; clear smooth boundary.

Btg2—26 to 37 inches; light olive brown (2.5Y 5/4) clay loam; common medium distinct grayish brown (2.5Y 5/2) iron depletions; weak medium subangular blocky structure; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds and in pores; 5 percent gravel, including soft gray shale; slightly acid; gradual smooth boundary.

C—37 to 60 inches; grayish brown (2.5Y 5/2) loam; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; massive; friable; 5 percent

gravel, including soft gray shale; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches

Content of clay in the Bt horizon: 20 to 35 percent

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—very fine sandy loam

Content of rock fragments—0 to 3 percent gravel, 0 to 2 percent cobbles

E horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—1 to 3

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

Content of rock fragments—0 to 3 percent gravel, 0 to 2 percent cobbles

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Btg horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 or 4

Texture—clay loam, sandy clay loam, or loam

Content of rock fragments—2 to 10 percent gravel, 0 to 2 percent cobbles

C horizon:

Hue—2.5Y or 10YR

Value—5 to 7

Chroma—2 to 4

Texture—loam, sandy clay loam, or clay loam

Content of rock fragments—2 to 10 percent gravel, 0 to 3 percent cobbles

243—Stuntz very fine sandy loam

Composition

Stuntz and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope: 0 to 3 percent

Component Description

Surface layer texture: Very fine sandy 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 3.0 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

- Talmoon and similar soils
- Seelyeville and similar soils
- Sandwick and similar soils
- Warba and similar soils
- Soils that have stones on the surface

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

Talmoon Series

Drainage class: Very poorly drained and poorly drained

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

Landform: Lake plains and moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

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

Typical Pedon

Talmoon muck, depressional, 200 feet south and 75 feet west of the northeast corner of sec. 24, T. 48 N., R. 25 W.

Oa—0 to 4 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 15 percent fiber, 5 percent rubbed; primarily herbaceous fibers; weak very fine granular structure; very friable;

many fine and very fine roots; moderately acid; abrupt smooth boundary.

A—4 to 8 inches; black (10YR 2/1) fine sandy loam, gray (10YR 5/1) dry; weak fine and very fine subangular blocky structure; friable; many fine and very fine roots; 5 percent gravel; moderately acid; clear smooth boundary.

Eg—8 to 20 inches; grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) fine sandy loam, light gray (10YR 7/2) dry; common large prominent yellowish brown (10YR 5/6) and common fine prominent light olive brown (2.5Y 5/6) iron concentrations; weak medium subangular blocky structure; friable; few very fine roots; 5 percent gravel; moderately acid; clear wavy boundary.

BE—20 to 24 inches; grayish brown (10YR 5/2) loam; common fine prominent yellowish brown (10YR 5/8) and few fine prominent strong brown (7.5YR 5/6) iron concentrations; weak medium subangular blocky structure; friable; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; 5 percent gravel; slightly acid; clear wavy boundary.

Btg1—24 to 33 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) clay loam; common medium and large prominent strong brown (7.5YR 5/8) iron concentrations; weak medium and fine subangular blocky structure; firm; few faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; 5 percent gravel; slightly acid; gradual wavy boundary.

Btg2—33 to 42 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) loam; common medium prominent strong brown (7.5YR 5/6) iron concentrations; weak fine subangular blocky structure; friable; few faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; 5 percent gravel; neutral; gradual wavy boundary.

Cg1—42 to 53 inches; light brownish gray (2.5Y 6/2) loam; common medium prominent yellowish brown (10YR 5/6) iron concentrations; massive; friable; 5 percent gravel; neutral; gradual wavy boundary.

Cg2—53 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium prominent yellowish brown (10YR 5/6) iron concentrations; massive; friable; 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 44 inches

Content of rock fragments: 1 to 10 percent gravel throughout the profile

Other features: A BCg horizon in some pedons

O horizon:

Hue—2.5Y, 10YR, or neutral

Value—2

Chroma—0 or 1

Texture—muck

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

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

Eg horizon:

Hue—5Y, 2.5Y, or 10YR

Value—4 to 6

Chroma—1 or 2

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

E/B or B/E horizon:

Colors and textures—similar to those of the E and Btg horizons

Btg horizon:

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—clay loam, sandy clay loam, or loam

Cg horizon:

Hue—5Y or 2.5Y

Value—5 to 7

Chroma—1 or 2

Texture—loam, sandy clay loam, or clay loam; subhorizons of sandy loam, silt loam, or silty clay loam

346—Talmoon fine sandy loam

Composition

Talmoon and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drainageways on moraines and lake plains

Slope: 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 over 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 10.4 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

- Rifle and similar soils
- Sandwich and similar soils
- Stuntz 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

628—Talmoon muck, depressional

Composition

Talmoon and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Depressions on lake plains and moraines

Slope: 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: Glaciolacustrine deposits over 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 11.0 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

- Cathro and similar soils
- Lupton and similar soils
- Alstad and similar soils
- Stuntz and similar soils

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Tawas Series

Drainage class: Very poorly drained

Permeability: Moderately slow

Landform: Bogs

Parent material: Organic material over alluvium

Slope range: 0 to 1 percent

Taxonomic class: Sandy or sandy-skeletal, mixed, euc Terric Borosaprists

Typical Pedon

Tawas muck, 1,650 feet north and 1,000 feet west of the southeast corner of sec. 19, T. 145 N., R. 25 W.; in Itasca County:

Oa1—0 to 13 inches; muck, black (5YR 2.5/1) broken face, rubbed, and pressed; 30 percent fiber, 10 percent rubbed; primarily woody fibers; weak medium granular structure; very friable; slightly acid; abrupt smooth boundary.

Oa2—13 to 26 inches; muck, dark reddish brown (5YR 3/2) broken face, rubbed, and pressed; 20 percent fiber, 5 percent rubbed; primarily woody fibers; weak coarse subangular blocky structure parting to weak coarse granular; very friable; 3 percent wood fragments; charcoal line 0.5 inch thick at a depth of 23 inches; slightly acid; clear smooth boundary.

Oa3—26 to 30 inches; muck, dark reddish brown (5YR 3/2) broken face, rubbed, and pressed; 15 percent fiber, 5 percent rubbed; primarily woody fibers; massive; very friable; slightly acid; abrupt smooth boundary.

Oa4—30 to 31 inches; muck, black (5YR 2.5/1)

broken face, rubbed, and pressed; 25 percent fiber, 10 percent rubbed; primarily woody fibers; massive; friable; about 50 percent mineral material; slightly acid; abrupt smooth boundary.

2Cg1—31 to 37 inches; olive gray (5Y 5/2) loamy sand; massive; friable; slight effervescence; slightly alkaline; clear smooth boundary.

2Cg2—37 to 60 inches; light olive gray (5Y 6/2) coarse sand; common medium prominent yellowish brown (10YR 5/6 and 5/8) iron concentrations; single grain; loose; slightly acid.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches

Reaction: Very strongly acid to slightly alkaline

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

C horizon:

Hue—5Y, 2.5Y, 10YR, 7.5YR, or neutral

Value—3 to 6

Chroma—0 to 3

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

627—Tawas muck

Composition

Tawas and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Bogs

Slope: 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 material over alluvium

Flooding: None

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

Ponding duration: Very long

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

- Meehan and similar soils
- Roscommon and similar soils
- Rifle and similar soils
- Northwood and similar soils
- Lupton and similar soils
- Soils that are less acid than the Tawas soil

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

Twig Series

Drainage class: Very poorly drained

Permeability: Upper part—moderate or moderately rapid; next part—slow or moderately slow; dense till—very slow

Landform: Moraines

Parent material: Organic material over till

Slope range: 0 to 1 percent

Taxonomic class: Coarse-loamy, mixed, acid, frigid Histic Humaquepts

Typical Pedon

Twig muck, in an area of Twig and Giese soils, 780 feet south and 1,750 feet west of the northeast corner of sec. 1, T. 43 N., R. 22 W.

Oa—0 to 10 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; 25 percent fiber, 15 percent rubbed; primarily herbaceous fibers; massive; very friable; many medium roots; strongly acid; abrupt smooth boundary.

A—10 to 16 inches; black (10YR 2/1) loam, gray (10YR 5/1) dry; massive; friable; common medium roots; strongly acid; clear smooth boundary.

Eg—16 to 21 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; few fine distinct yellowish brown (10YR 5/6) iron

concentrations; weak medium subangular blocky structure; friable; few fine roots; strongly acid; clear smooth boundary.

2Bg—21 to 29 inches; grayish brown (10YR 5/2) sandy loam; many large distinct yellowish brown (10YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; few fine roots; 2 percent gravel; strongly acid; clear wavy boundary.

2Bw—29 to 44 inches; reddish brown (5YR 4/4) sandy loam; common medium distinct brown (7.5YR 5/2) iron depletions and common fine distinct strong brown (7.5YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; 3 percent gravel; strongly acid; clear wavy boundary.

2BC—44 to 52 inches; reddish brown (5YR 4/4) sandy loam; common medium distinct brown (7.5YR 5/2) and reddish brown (5YR 5/3) iron depletions; moderate medium platy structure; friable; 5 percent gravel; strongly acid; clear wavy boundary.

2Cd—52 to 60 inches; reddish brown (5YR 4/4) sandy loam; common fine distinct yellowish red (5YR 5/6) iron concentrations; massive; moderate medium plate-like soil fragments; very firm; 5 percent gravel; moderately acid.

Range in Characteristics

Depth to mineral material: 8 to 16 inches

Depth to dense till: 40 to 60 inches

Other features: Some pedons do not have a 2Bw horizon.

Oa horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 4

Chroma—1 to 4

Texture—muck

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

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

Content of rock fragments—0 to 10 percent gravel, 0 to 1 percent cobbles

Eg horizon:

Hue—10YR, 7.5YR, or 5YR

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam, loam, or silt loam

Content of rock fragments—0 to 10 percent gravel, 0 to 1 percent cobbles

2Bg horizon:

Hue—5Y, 2.5Y, 10YR, 7.5YR, or 5YR

Value—4 or 5

Chroma—1 to 3

Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—0 to 10 percent gravel, 0 to 2 percent cobbles

2BC and 2Cd horizons:

Hue—5YR or 2.5YR

Value—3 to 5

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—5 to 15 percent gravel, 0 to 2 percent cobbles

990—Twig and Giese soils

Composition

Twig: Variable

Giese: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope: 0 to 1 percent

Component Description

Twig

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic material over 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 9.4 inches

Organic matter content: Very high

Giese

Surface layer texture: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

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

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

- Ronneby and similar soils
- Seelyeville and similar soils
- Soils that have stones on the surface

Major Uses of the Unit

- Pasture
- Forest land

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

- Agronomy section
- Forest Land section

1072—Udorthents, shallow (sanitary landfill)

Composition

Udorthents: 100 percent

Description of the Unit

- Shallow areas used as sanitary landfill

W—Water

Composition

Water: 100 percent

Description of the Unit

- Naturally occurring basins of surface water

1356—Water, miscellaneous

Composition

Miscellaneous water: 100 percent

Description of the Unit

- Small manmade areas that are used for industrial, sanitary, or mining applications and that contain water most of the year

Wabedo Series

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; next part—slow; dense till—very slow

Landform: Moraines

Parent material: Till

Slope range: 1 to 6 percent

Taxonomic class: Coarse-loamy, mixed, frigid Aquic Dystric Eutrochrepts

Typical Pedon

Wabedo sandy loam, 1 to 6 percent slopes, 500 feet south and 1,000 feet west of the northeast corner of sec. 13, T. 139 N., R. 28 W.; in Cass County:

A—0 to 5 inches; very dark brown (10YR 2/2) sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; 2 percent gravel; very strongly acid; abrupt wavy boundary.

Bw1—5 to 8 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; 3 percent gravel; strongly acid; clear wavy boundary.

Bw2—8 to 15 inches; dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) sandy loam; few fine distinct yellowish brown (10YR 5/6) iron concentrations; weak fine subangular blocky structure; friable; 2 percent gravel; very strongly acid; clear wavy boundary.

Bw3—15 to 27 inches; dark yellowish brown (10YR 4/4) and dark brown (10YR 4/3) sandy loam; few fine distinct grayish brown (10YR 5/2), few fine distinct yellowish brown (10YR 5/6), and few fine prominent strong brown (7.5YR 5/6) iron concentrations; moderate medium subangular blocky structure; friable; 3 percent gravel; strongly acid; abrupt wavy boundary.

BC—27 to 47 inches; dark brown (7.5YR 4/4) sandy loam; common fine prominent grayish brown (10YR 5/2) iron depletions and common fine distinct strong brown (7.5YR 5/6) iron concentrations; strong thick platy structure parting to moderate fine subangular blocky; very firm; 8 percent gravel; strongly acid; clear smooth boundary.

Cd—47 to 60 inches; strong brown (7.5YR 4/6) sandy loam; common medium prominent grayish brown (10YR 5/2) iron depletions and common medium distinct strong brown (7.5YR 5/6) iron concentrations; massive; moderate thick plate-like soil fragments; very firm; 10 percent gravel; moderately acid.

Range in Characteristics

Depth to dense till: 40 to 60 inches

Content of rock fragments: 2 to 25 percent gravel throughout the profile

Other features: An E, EB, or BE horizon in some pedons

A or Ap horizon:

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

Bw horizon:

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—sandy loam, fine sandy loam, or
 gravelly sandy loam

BC horizon:

Hue—7.5YR or 5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—sandy loam, loamy sand, or gravelly
 sandy loam

Cd horizon:

Hue—7.5YR or 5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—sandy loam, loamy sand, or gravelly
 sandy loam

146B—Wabedo sandy loam, 1 to 6 percent slopes

Composition

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

Setting

Landform: Rises on moraines
Slope: 1 to 6 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 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

- Cathro and similar soils
- Nokay and similar soils
- Flak and similar soils
- Soils that have stones or cobbles on the surface

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

Warba Series

Drainage class: Well drained and moderately well drained

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

Landform: Moraines

Parent material: Till

Slope range: 1 to 12 percent

Taxonomic class: Fine-loamy, mixed Glossic
 Eutroboralfs

Typical Pedon

Warba very fine sandy loam, 1 to 6 percent slopes, 1,320 feet south and 2,640 feet east of the northwest corner of sec. 10, T. 50 N., R. 23 W.

Oe—0 to 3 inches; moderately decomposed leaf litter.

A—3 to 4 inches; very dark gray (10YR 3/1) very fine sandy loam, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; very friable; many roots; moderately acid; abrupt smooth boundary.

E—4 to 14 inches; grayish brown (10YR 5/2) very fine sandy loam, light gray (10YR 7/2) dry; weak thin and medium platy structure; very friable; many roots; strongly acid; abrupt wavy boundary.

E/B—14 to 19 inches; about 75 percent light brownish gray (10YR 6/2) loam (E), light gray (10YR 7/2) dry; about 25 percent remnants of dark yellowish brown (10YR 4/4) loam (Bt); moderate medium and coarse subangular blocky structure; friable; many roots; few faint dark brown (10YR 4/3) clay films in pores of peds; moderately acid; clear wavy boundary.

B/E—19 to 25 inches; about 70 percent dark yellowish brown (10YR 4/4) clay loam (Bt) with about 30 percent tongues of light brownish gray (10YR 6/2) loam (E), light gray (10YR 7/2) dry; moderate coarse and medium subangular blocky structure; firm; many roots; few faint dark brown (10YR 4/3) clay films on faces of peds; 5 percent gravel; moderately acid; clear wavy boundary.

Bt1—25 to 34 inches; dark yellowish brown (10YR 4/4) clay loam; strong medium and coarse subangular blocky structure; firm; common roots; many distinct dark brown (10YR 4/3) clay films on faces of peds; 5 percent gravel, including soft gray shale; moderately acid; clear wavy boundary.

Bt2—34 to 46 inches; dark yellowish brown (10YR 4/4) clay loam; strong medium and coarse subangular blocky structure; firm; common roots; common distinct dark brown (10YR 4/3) clay films on faces of peds; 5 percent gravel, including soft gray shale; slightly acid; clear wavy boundary.

C—46 to 60 inches; brown (10YR 5/3) loam; massive; friable; few roots; 8 percent gravel, including soft gray shale; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 34 to 70 inches

A horizon:

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

E horizon:

Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—very fine sandy loam, silt loam, fine sandy loam, or loam
Content of rock fragments—0 to 3 percent gravel, 0 to 1 percent cobbles

E/B or B/E horizon:

Colors and textures—similar to those of the E and Bt horizons

Bt horizon:

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

Content of rock fragments—2 to 10 percent gravel, 0 to 2 percent cobbles

C horizon:

Hue—2.5Y or 10YR
Value—4 to 6
Chroma—3 or 4
Texture—loam, sandy clay loam, or clay loam
Content of rock fragments—2 to 10 percent gravel, 0 to 2 percent cobbles

240B—Warba very fine sandy loam, 1 to 6 percent slopes

Composition

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

Setting

Landform: Rises on moraines
Slope: 1 to 6 percent

Component Description

Surface layer texture: Very 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: 3.5 to 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.9 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

- Hamre and similar soils
- Talmoon and similar soils
- Stuntz and similar soils
- Cutaway and similar soils
- Steeper areas

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

240C—Warba very fine sandy loam, 6 to 12 percent slopes

Composition

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

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope: 6 to 12 percent

Component Description

Surface layer texture: Very 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 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

- Hamre and similar soils
- Talmoon and similar soils
- Stuntz and similar soils
- Cutaway 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

Waskish Series

Drainage class: Very poorly drained

Permeability: Rapid

Landform: Bogs

Parent material: Organic material

Slope range: 0 to 1 percent

Taxonomic class: Dysic, frigid Typic Sphagnofibrists

Typical Pedon

Waskish peat, in an area of Lobo and Waskish peats, 2,500 feet north and 1,000 feet east of the southwest corner of sec. 24, T. 146 N., R. 25 W.; in Itasca County:

Oi1—0 to 7 inches; peat, light yellowish brown (10YR 6/4) broken face, very pale brown (10YR 7/3 and 8/3) rubbed and pressed; 95 percent fiber, 85 percent rubbed; primarily sphagnum fibers; massive; loose; extremely acid; clear wavy boundary.

Oi2—7 to 12 inches; peat, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; 80 percent fiber, 70 percent rubbed; primarily sphagnum fibers; weak thin platy structure; nonplastic and nonsticky; extremely acid; clear smooth boundary.

Oi3—12 to 26 inches; peat, brown (7.5YR 5/4 and 4/4) broken face and rubbed, light brown (7.5YR 6/4) pressed; 85 percent fiber, 70 percent rubbed; primarily sphagnum fibers; weak thin platy structure; nonplastic and nonsticky; extremely acid; clear smooth boundary.

Oe—26 to 32 inches; mucky peat, dark brown (7.5YR 3/2) broken face and rubbed, brown (7.5YR 4/2) pressed; 65 percent fiber, 30 percent rubbed; primarily sphagnum and herbaceous fibers; weak coarse subangular blocky structure; nonplastic and nonsticky; extremely acid; clear smooth boundary.

O'i—32 to 63 inches; peat, reddish brown (5YR 4/4) broken face and rubbed, light brown (7.5YR 6/4) pressed; 95 percent fiber, 75 percent rubbed; primarily sphagnum fibers; weak thick platy structure; nonplastic and nonsticky; extremely acid.

Range in Characteristics

Thickness of the organic material: Greater than 63 inches

Reaction: Extremely acid

Fiber content: 75 to 90 percent before rubbing and 60 to 90 percent after rubbing

Content of wood fragments: 1 to 10 percent

Oi horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 7

Chroma—2 to 4

Texture—peat

Oe horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 or 3

Chroma—1 or 2

Texture—mucky peat

Watab Series

Drainage class: Poorly drained

Permeability: Upper part—rapid; next part—slow to moderately rapid; dense till—very slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, frigid Arenic
Epiaqualfs

Typical Pedon

Watab fine sand, 2,350 feet north and 1,800 feet east of the southwest corner of sec. 15, T. 45 N., R. 24 W.

Oe—0 to 3 inches; moderately decomposed leaf litter.

E—3 to 7 inches; dark grayish brown (10YR 4/2) fine sand, pinkish gray (7.5YR 6/2) dry; single grain; loose; common fine roots; 2 percent gravel; strongly acid; clear smooth boundary.

Bw1—7 to 14 inches; dark brown (7.5YR 3/4) loamy fine sand; common medium distinct brown (7.5YR 5/4) iron concentrations; weak coarse subangular blocky structure; very friable; few fine roots; 2 percent gravel; strongly acid; clear smooth boundary.

Bw2—14 to 28 inches; dark brown (7.5YR 4/4) loamy fine sand; common medium faint brown (7.5YR 5/4) iron concentrations; weak coarse subangular blocky structure; very friable; 2 percent gravel; strongly acid; clear smooth boundary.

Bw3—28 to 36 inches; brown (7.5YR 5/4) fine sand; many large prominent yellowish red (5YR 4/6) iron concentrations; single grain; loose; 2 percent gravel; strongly acid; abrupt smooth boundary.

2Bt—36 to 42 inches; reddish brown (5YR 4/4) fine sandy loam (Bt); interfingerings of reddish gray (5YR 5/2) fine sandy loam (E); moderate medium subangular blocky structure; firm; few faint reddish brown (5YR 4/3) clay films on faces of peds; 5 percent gravel; moderately acid; clear smooth boundary.

2BC—42 to 54 inches; reddish brown (5YR 4/4) sandy loam; few fine distinct reddish gray (5YR 5/2) iron depletions; moderate thick platy structure parting to weak medium subangular

blocky; firm; few faint reddish brown (5YR 4/3) clay films on faces of peds; 6 percent gravel; moderately acid; clear smooth boundary.

2Cd—54 to 60 inches; reddish brown (5YR 4/3) sandy loam; common medium distinct reddish gray (5YR 5/2) iron depletions; massive; moderate very coarse plate-like soil fragments; very firm; 6 percent gravel; moderately acid.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches

Depth to dense till: 40 to 60 inches

Other features: An A or 2B/E horizon in some pedons

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 or 3

Texture—fine sand

Content of rock fragments—0 to 3 percent gravel

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 6

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

Content of rock fragments—0 to 3 percent gravel

E' horizon (if it occurs):

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 or 3

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

Content of rock fragments—0 to 3 percent gravel

E/B or B/E horizon (if it occurs):

Colors and textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or the gravelly analogs of these textures

Content of rock fragments—8 to 20 percent gravel, 0 to 7 percent cobbles

2BC and 2Cd horizons:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—8 to 20 percent gravel, 0 to 3 percent cobbles

218—Watab fine sand**Composition**

Watab and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines

Slope: 0 to 2 percent

Component Description

Surface layer texture: Fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

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 4.1 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

- Pomroy and similar soils
- Bushville and similar soils
- Leafriver 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

Waukenabo Series

Drainage class: Poorly drained

Permeability: Moderate

Landform: Lake plains

Parent material: Alluvium and glaciolacustrine deposits

Slope range: 0 to 2 percent

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

Typical Pedon

Waukenabo fine sandy loam, in an area of native grasses, 2,300 feet north and 300 feet west of the southeast corner of sec. 29, T. 48 N., R. 26 W.

A—0 to 6 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine and very fine roots; moderately acid; clear wavy boundary.

Eg1—6 to 9 inches; grayish brown (10YR 5/2) loamy sand, light brownish gray (10YR 6/2) dry; few fine faint yellowish brown (10YR 5/4) iron concentrations; weak coarse subangular blocky structure; very friable; common fine and very fine roots; slightly acid; clear wavy boundary.

Eg2—9 to 15 inches; light brownish gray (10YR 6/2) sand, pale brown (10YR 6/3) dry; common medium prominent strong brown (7.5YR 5/6) iron concentrations; single grain; loose; common fine and very fine roots; neutral; clear wavy boundary.

Btg1—15 to 17 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; few fine prominent reddish brown (5YR 5/4) iron concentrations; moderate medium subangular blocky structure; friable; few fine roots; common distinct dark gray (10YR 4/1) clay films on faces of peds; neutral; abrupt wavy boundary.

Btg2—17 to 28 inches; grayish brown (2.5Y 5/2) sandy loam; few fine prominent yellowish brown (10YR 5/4) iron concentrations; moderate fine subangular blocky structure; friable; few fine roots; many distinct gray (10YR 5/1) clay bridges connecting sand grains; neutral; abrupt wavy boundary.

Bkg—28 to 30 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; few fine prominent light yellowish brown (10YR 6/4) iron concentrations; weak medium platy structure; friable; few fine roots; disseminated carbonates; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Cg1—30 to 52 inches; light brownish gray (10YR 6/2), stratified loamy sand, sandy loam, and silt loam; common medium faint pale brown (10YR 6/3) and common coarse prominent yellowish brown (10YR 5/8) iron concentrations; massive; very friable; slightly effervescent; slightly alkaline; abrupt wavy boundary.

Cg2—52 to 80 inches; pinkish gray (7.5YR 6/2), stratified very fine sandy loam, silt loam, loamy sand, sand, and sandy loam; few fine distinct

strong brown (7/5YR 4/6) iron concentrations; massive; friable; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 25 to 50 inches

Content of rock fragments: Less than 2 percent gravel in some pedons

Clay content: 6 to 18 percent in the argillic horizon; up to 35 percent in some thin individual layers

Other features: Some pedons have stratified subhorizons that contain more sand or clay. Other pedons have a Bg horizon.

A or Ap horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam or sandy loam

Eg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

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

Btg horizon:

Hue—5Y, 2.5Y, 10YR, or 7.5YR

Value—4 to 6

Chroma—1 or 2

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

Bkg horizon:

Hue—5Y, 2.5Y, 10YR, or 7.5YR

Value—4 to 6

Chroma—1 or 2

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

Cg horizon:

Hue—5Y, 2.5Y, 10YR, or 7.5YR

Value—4 to 6

Chroma—1 to 3

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

759—Waukenabo fine sandy loam

Composition

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

Setting

Landform: Flats and slight rises on lake plains

Slope: 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: Alluvium and 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 8.2 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

- Sago and similar soils
- Cowhorn 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

Wawina Series

Drainage class: Well drained

Permeability: Moderately rapid

Landform: Lake plains

Parent material: Alluvium and glaciolacustrine deposits

Slope range: 1 to 10 percent

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

Typical Pedon

Wawina loamy very fine sand, 1 to 10 percent slopes, 100 feet south and 1,250 feet west of the northeast corner of sec. 13, T. 52 N., R. 25 W.

E1—0 to 4 inches; dark grayish brown (10YR 4/2) loamy very fine sand, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; many very fine roots; moderately acid; clear wavy boundary.

E2—4 to 5 inches; grayish brown (10YR 5/2) loamy very fine sand, light gray (10YR 7/2) dry; weak medium granular structure; very friable; many fine roots; moderately acid; clear broken boundary.

Bw1—5 to 11 inches; dark yellowish brown (10YR 4/4) loamy very fine sand; weak coarse subangular blocky structure; very friable; many fine roots; moderately acid; clear smooth boundary.

Bw2—11 to 23 inches; yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4) loamy very fine sand; weak medium subangular blocky structure; very friable; many fine roots; moderately acid; gradual smooth boundary.

C—23 to 60 inches; pale brown (10YR 6/3) very fine sand; single grain; loose; common fine and very fine roots; slightly acid.

Range in Characteristics

Depth to carbonates: Greater than 60 inches

Other features: An A horizon in some pedons

E horizon:

Hue—10YR

Value—4 to 7

Chroma—1 or 2

Texture—loamy very fine sand

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 or 4

Texture—loamy very fine sand or very fine sand

C horizon:

Hue—2.5Y or 10YR

Value—5 to 7

Chroma—2 to 4

Texture—very fine sand or loamy very fine sand

629B—Wawina loamy very fine sand, 1 to 10 percent slopes

Composition

Wawina and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Lake plains

Position on the landform: Summits and backslopes

Slope: 1 to 10 percent

Component Description

Surface layer texture: Loamy very fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Alluvium and 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 9.5 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

- Sago and similar soils
- Cowhorn and similar soils
- Wabedo and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Forest land

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

- Agronomy section
- Forest Land section

Wealthwood Series

Drainage class: Poorly drained

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

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, frigid Arenic Epiaqualfs

Typical Pedon

Wealthwood loamy fine sand, 400 feet north and 120 feet west of the southeast corner of sec. 29, T. 46 N., R. 26 W.

A—0 to 4 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; moderate fine

- granular structure; very friable; many fine roots; strongly acid; clear smooth boundary.
- E—4 to 8 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; common fine prominent strong brown (7.5YR 5/6) iron concentrations; weak fine subangular blocky structure; very friable; common fine roots; few distinct very dark gray (10YR 3/1) wormcasts; strongly acid; clear smooth boundary.
- Bw1—8 to 15 inches; yellowish brown (10YR 5/6) loamy fine sand; common medium distinct strong brown (7.5YR 4/6) iron concentrations and few medium distinct grayish brown (10YR 5/2) iron depletions; weak medium subangular blocky structure; very friable; strongly acid; clear wavy boundary.
- Bw2—15 to 23 inches; yellowish brown (10YR 5/4) fine sand; many medium distinct strong brown (7.5YR 4/6) iron concentrations and few fine distinct grayish brown (10YR 5/2) iron depletions; single grain; loose; strongly acid; clear smooth boundary.
- E'—23 to 28 inches; brown (10YR 5/3) fine sand, very pale brown (10YR 7/3) dry; common medium distinct yellowish brown (10YR 5/6) iron concentrations; single grain; loose; strongly acid; abrupt smooth boundary.
- 2Btg1—28 to 32 inches; brown (7.5YR 5/2) fine sandy loam; many medium distinct strong brown (7.5YR 5/6) and few fine prominent reddish brown (5YR 4/4) iron concentrations; moderate medium subangular blocky structure; friable; few faint brown (7.5YR 5/2) clay bridges between sand grains; moderately acid; abrupt smooth boundary.
- 2Btg2—32 to 35 inches; dark brown (7.5YR 4/4) loamy fine sand; common coarse prominent light brownish gray (10YR 6/2) iron depletions; weak medium subangular blocky structure; friable; few faint brown (7.5YR 5/2) clay bridges between sand grains; moderately acid; abrupt smooth boundary.
- 2Btg3—35 to 42 inches; light brownish gray (10YR 6/2) fine sandy loam stratified with brown (7.5YR 5/4) loamy fine sand; few fine prominent yellowish red (5YR 4/6) iron concentrations; weak medium subangular blocky structure; friable; few faint brown (10YR 5/2) clay bridges between sand grains; moderately acid; abrupt smooth boundary.
- 2Cg1—42 to 54 inches; strong brown (7.5YR 4/6) very fine sand stratified with pinkish gray (7.5YR 6/2) fine sandy loam; common medium distinct pinkish gray (7.5YR 6/2) iron depletions in the

very fine sand and common medium distinct strong brown (7.5YR 4/6) iron concentrations in the fine sandy loam; massive; friable; moderately acid; clear smooth boundary.

- 2Cg2—54 to 60 inches; dark yellowish brown (10YR 4/4), stratified loamy fine sand and loamy very fine sand; common medium distinct light brownish gray (10YR 6/2) iron depletions; massive; friable; moderately acid.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches

Ap or A horizon:

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

E horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2

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

Bw horizon:

Hue—10YR, 7.5YR, or 5YR

Value—3 to 6

Chroma—2 to 6

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

E' horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—2 or 3

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

2Btg horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—1 to 4

Texture—stratified sand to silty clay loam

2C horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—1 to 6

Texture—stratified sand to silt loam

1372—Wealthwood loamy fine sand

Composition

Wealthwood and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on lake plains

Slope: 0 to 2 percent

Component Description

Surface layer texture: Loamy fine sand

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 7.3 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

- Nemadji and similar soils
- Alban and similar soils
- Omega and similar soils
- Roscommon 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

Willissippi Series

Drainage class: Poorly drained

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

Landform: Lake plains

Parent material: Alluvium and glaciolacustrine deposits

Slope range: 0 to 2 percent

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

Typical Pedon

Willissippi loam, 200 feet north and 1,900 feet west of

the southeast corner of sec. 21, T. 49 N., R. 25 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many fine and very fine roots; moderately acid; abrupt smooth boundary.

Eg—7 to 12 inches; light brownish gray (2.5Y 6/2) fine sandy loam, light gray (10YR 7/2) dry; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; weak medium platy structure; friable; few very fine and fine roots; moderately acid; abrupt wavy boundary.

Btg1—12 to 22 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent dark yellowish brown (10YR 4/4) iron concentrations; moderate medium angular blocky structure; firm; few very fine roots; many distinct dark grayish brown (2.5Y 4/2 and 10YR 4/2) clay films on faces of peds; moderately acid; clear wavy boundary.

Btg2—22 to 24 inches; grayish brown (2.5Y 5/2) loamy sand; common fine prominent dark yellowish brown (10YR 4/4) iron concentrations; weak fine subangular blocky structure; very friable; common distinct dark grayish brown (10YR 4/2) clay bridges between sand grains; moderately acid; clear wavy boundary.

Btg3—24 to 26 inches; olive gray (5Y 5/2) loam; few fine prominent strong brown (7.5YR 5/8) iron concentrations; moderate fine subangular blocky structure; friable; many distinct olive gray (5Y 4/2) clay films on faces of peds; slightly acid; clear wavy boundary.

Btg4—26 to 32 inches; dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) sandy loam; common medium distinct yellowish brown (10YR 5/6) iron concentrations; weak fine subangular blocky structure; very friable; many distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; neutral; clear wavy boundary.

Cg1—32 to 42 inches; olive gray (5Y 5/2) silt loam; few fine prominent yellowish brown (10YR 5/6) iron concentrations; massive; friable; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg2—42 to 49 inches; grayish brown (2.5Y 5/2) silt loam; few fine prominent yellowish brown (10YR 5/6) iron concentrations; massive; friable; strong effervescence; moderately alkaline; clear wavy boundary.

Cg3—49 to 53 inches; grayish brown (2.5Y 5/2), stratified loamy sand to silt loam; common medium distinct light olive brown (2.5Y 5/6) iron concentrations; massive; friable; strong effervescence; moderately alkaline; clear wavy boundary.

Cg4—53 to 60 inches; light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2), stratified silt loam to sandy loam; many common distinct light olive brown (2.5Y 5/6) and olive yellow (2.5Y 6/6) iron concentrations; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches
Series control section: No rock fragments

Ap or A horizon (if it occurs):

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

E or Eg horizon:

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

Btg horizon:

Hue—5Y, 2.5Y, or 10YR
Value—4 to 6
Chroma—2
Texture—stratified clay loam, loam, silty clay loam, and silt loam; thin strata of loamy sand, sandy loam, fine sandy loam, loamy fine sand, loamy very fine sand, or very fine sandy loam

Cg horizon:

Hue—5Y, 2.5Y, or 10YR
Value—5 to 7
Chroma—2
Texture—stratified clay loam, loam, silty clay loam, and silt loam; thin strata of loamy sand, sandy loam, fine sandy loam, loamy fine sand, loamy very fine sand, or very fine sandy loam

672—Willosippi loam

Composition

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

Setting

Landform: Flats and slight rises on lake plains
Slope: 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: Alluvium and 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 10.4 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

- Hamre and similar soils
- Sandwich and similar soils
- Gravelly soils
- Aftad 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

Winterfield Series

Drainage class: Somewhat poorly drained

Permeability: Rapid

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 4 percent

Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Winterfield loamy fine sand, in an area of Pengilly-Winterfield association, 1,800 feet north and 3,500 feet east of the southwest corner of sec. 17, T. 54 N., R. 24 W.; in Itasca County:

Oi—0 to 3 inches; slightly decomposed leaf litter.

A—3 to 6 inches; very dark brown (10YR 2/2) loamy fine sand; weak fine and medium granular structure; very friable; many fine and medium roots; neutral; clear smooth boundary.

C1—6 to 17 inches; dark brown (10YR 4/3) and dark

grayish brown (10YR 4/2) loamy fine sand; weak medium and coarse subangular blocky structure; very friable; many fine and medium roots; moderately acid; gradual wavy boundary.

C2—17 to 41 inches; pale brown (10YR 6/3) and brown (10YR 5/3) fine sand; common fine distinct light brownish gray (2.5Y 6/2) iron depletions and few fine prominent strong brown (7.5YR 5/6) iron concentrations; weak coarse subangular blocky structure; very friable; few fine roots; moderately acid; clear smooth boundary.

C3—41 to 55 inches; pale brown (10YR 6/3) sand; few fine distinct yellowish brown (10YR 5/6) iron concentrations; single grain; loose; moderately acid; gradual smooth boundary.

C4—55 to 60 inches; pale brown (10YR 6/3) sand; few fine distinct yellowish brown (10YR 5/6) iron concentrations and many large distinct light brownish gray (10YR 6/2) iron depletions; single grain; loose; moderately acid.

Range in Characteristics

Reaction: Moderately acid to slightly alkaline

Content of organic carbon: Decreases irregularly with increasing depth

Other features: Mottles with chroma of 2 or less within a depth of 40 inches

A horizon:

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy fine sand

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 or 4

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

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Glossary

- Ablation till.** Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.
- Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.
- Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.
- Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.
- Aquic conditions.** Current soil wetness characterized by saturation, reduction, and redoximorphic features.
- Aspect.** The direction in which a slope faces.
- Association, soil.** A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.
- Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:
- | | |
|-----------------|--------------|
| Very low | 0 to 3 |
| Low | 3 to 6 |
| Moderate | 6 to 9 |
| High | 9 to 12 |
| Very high | more than 12 |
- Backslope.** The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Backslopes in profile are commonly steep and linear and descend to a footslope. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water.
- Basal till.** Compact glacial till deposited beneath the ice.
- Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.
- Bedding planes.** Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.
- Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
- Bedrock-controlled topography.** A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.
- Bench terrace.** A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.
- Bisequum.** Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.
- Blowout.** A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.
- Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.
- Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.
- California bearing ratio (CBR).** The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various

sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where wind erosion is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming).

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. The thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

Drainage, surface. Runoff, or surface flow of water, from an area.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as

- flood plains and coastal plains. Synonym: natural erosion.
- Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.
- Erosion pavement.** A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.
- Escarpment.** A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.
- Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.
- Excess lime** (in tables). Excess carbonates in the soil that restrict the growth of some plants.
- Fast intake** (in tables). The rapid movement of water into the soil.
- Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.
- Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.
- Fine textured soil.** Sandy clay, silty clay, or clay.
- First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.
- Flood plain.** A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.
- Footslope.** The geomorphic component that forms the inner, gently inclined surface at the base of a hillslope. The surface is dominantly concave. In terms of gradational processes, a footslope is a transition zone between an upslope site of erosion (backslope) and a downslope site of deposition (toeslope).
- Forb.** Any herbaceous plant not a grass or a sedge.
- Fragile** (in tables). A soil that is easily damaged by use or disturbance.
- Frost action (in tables).** Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.
- Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.
- Geomorphology.** The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.
- Glacial drift.** Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.
- Glacial outwash.** Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.
- Glaciofluvial deposits.** Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.
- Glaciolacustrine deposits.** Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.
- Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.
- Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.
- Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.
- Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.
- Green manure crop** (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.
- Ground water.** Water filling all the unblocked pores of underlying material below the water table.
- Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily

runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

High-chroma zones. Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer,

excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Ice-walled lake plain. A relict surface marking the floor of an extinct lake basin that was formed on solid ground and surrounded by stagnant ice in a stable or unstable superglacial environment on stagnation moraines. As the ice melted, the lake plain became perched above the adjacent landscape. The lake plain is well sorted, generally fine textured, stratified deposits.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake bed. The bottom of a lake; a lake basin.

Lake plain. A nearly level surface marking the floor of an extinct lake filled by well-sorted, generally fine-textured, stratified deposits, commonly containing varves.

Lakeshore. A narrow strip of land in contact with or bordering a lake; especially the beach of a lake.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lake shore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low-chroma zones. Zones having chroma of 2 or less. Typical color in areas of iron depletions.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and

low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly

nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. An extensive area of glaciofluvial material that was deposited by meltwater streams.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Parts per million (ppm). The concentration of a substance in the soil, such as phosphorus or potassium, in one million parts of air-dried soil on a weight per weight basis.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

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:

Extremely slow	less than 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on

features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth).

Depth to which roots could penetrate if the content of moisture in the soil were adequate.

The soil has no properties restricting the penetration of roots to this depth.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline.

The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	less than 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having

- a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.
- Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.
- Root zone.** The part of the soil that can be penetrated by plant roots.
- Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.
- Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.
- Sandstone.** Sedimentary rock containing dominantly sand-sized particles.
- Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.
- Saturation.** Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.
- Scarification.** The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.
- Second bottom.** The first terrace above the normal flood plain (or first bottom) of a river.
- Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.
- Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.
- Sequum.** A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)
- Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.
- Shale.** Sedimentary rock formed by the hardening of a clay deposit.
- Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.
- Shoulder.** The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in origin.
- Shrink-swell** (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.
- Silica.** A combination of silicon and oxygen. The mineral form is called quartz.
- Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.
- Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.
- Slippage** (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.
- Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.
- Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.
- Sloughed till.** Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.
- Slow intake** (in tables). The slow movement of water into the soil.
- Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.
- Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are

either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope profile and exhibiting a nearly level surface. A general term for the top, or highest level of a landform such as a hill, mountain, or tableland. It usually refers to a high interfluvial area of gentler slope that is flanked by steeper hillslopes, e.g. mountain fronts or tableland escarpments.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Swale. A slight depression in the midst of generally level land. A shallow depression in an undulating ground moraine due to uneven glacial deposition.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Till plain. An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The outermost inclined surface at the base of a hill. Toeslopes are commonly gentle and linear in profile.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as salts, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in

soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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