United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with Minnesota Agricultural Experiment Station

Soil Survey of Lake of the Woods County Area, Minnesota

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How To Use This Soil Survey

General Soil Map

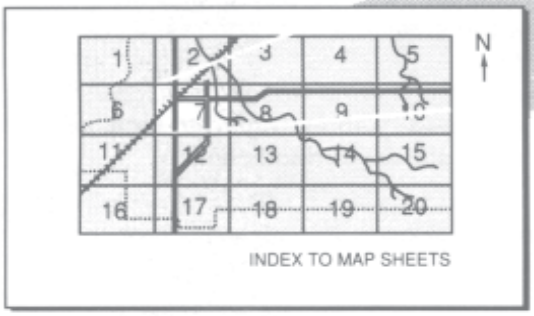
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

Detailed Soil Maps

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

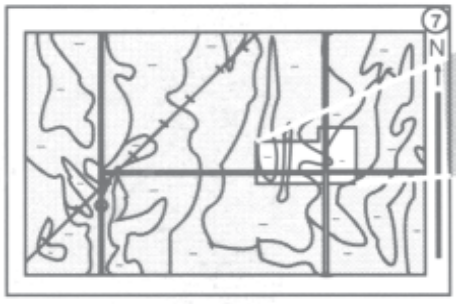
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

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



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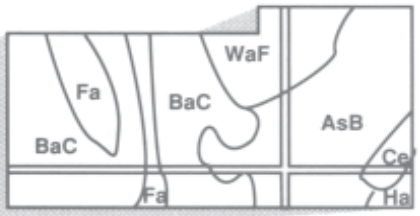

AREA OF INTEREST

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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The 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 1987. Soil names and descriptions were approved in 1989. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. Other assistance was provided by the Agricultural Extension Service, Minnesota Department of Natural Resources, and the Soil and Water Conservation Board. The survey was partially funded by the Legislative Commission of Minnesota Resources and by Lake of the Woods County. It is part of the technical assistance furnished to the Lake of the Woods Soil and Water Conservation District.

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

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

Cover: Potatoes growing in an area of Zippel very fine sandy loam.

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Issued September 1997

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Summary of Tables

Foreword

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

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

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

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

William Hunt
State Conservationist
Natural Resources Conservation Service

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Soil Survey of Lake of the Woods County Area, Minnesota

By T.A. Gustafson, Natural Resources Conservation Service

Fieldwork by T.A. Gustafson, R.B. Heschke, and C.A. Radatz-Ess, Natural Resources Conservation Service, and T.W. Neuenfeldt and P.E. Nesse, Minnesota Agricultural Experiment Station

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

The survey area is in the north-central part of Minnesota (fig. 1). It has a total land area of 839,040 acres. Baudette is the county seat. Part of the survey area is within the boundaries of the Red Lake Indian Reservation. Major industries in the county include agriculture, logging, tourism, and recreation. Hay, small grain, and potatoes are the main crops, but small acreages of corn, sunflowers, and grass for seed are also grown. Beef cattle and dairy operations are the main livestock enterprises. Both hardwood and softwood timber is harvested in the county.

The soils in the survey area formed on a glacial lake plain in mineral and organic materials. The native vegetation was mainly coniferous and hardwood forests and scattered meadows of native prairie grasses. Sedges and rushes were prominent in some peatland areas. The soils vary in color. They consist of organic material or have textures that range from sand to clay.

This survey updates the first soil survey of Lake of the Woods County, which was published in 1926 (USDA, 1926). It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the Survey Area

This section provides general information concerning the Lake of the Woods County area. It describes climate; history and development; transportation facilities and markets; farming; forestry; water supply; geology; and physiography, relief, and drainage.

Climate

Winters in the survey area are very cold, but summers are fairly warm. Crops are mainly limited to forage crops, small grain, and adapted vegetables because of the short frost-free season. Precipitation is fairly well distributed throughout the year, but it peaks slightly in summer. Snow covers the ground much of the time from late fall through early spring.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Baudette in the period 1951 to 1985. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 7 degrees F and the average daily minimum temperature is -5 degrees. The lowest temperature on record, which occurred at Baudette on January 6, 1968, is -46 degrees. In summer, the average temperature is 65 degrees and the average daily maximum temperature is 78 degrees. The highest recorded temperature, which occurred on August 7, 1983, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing

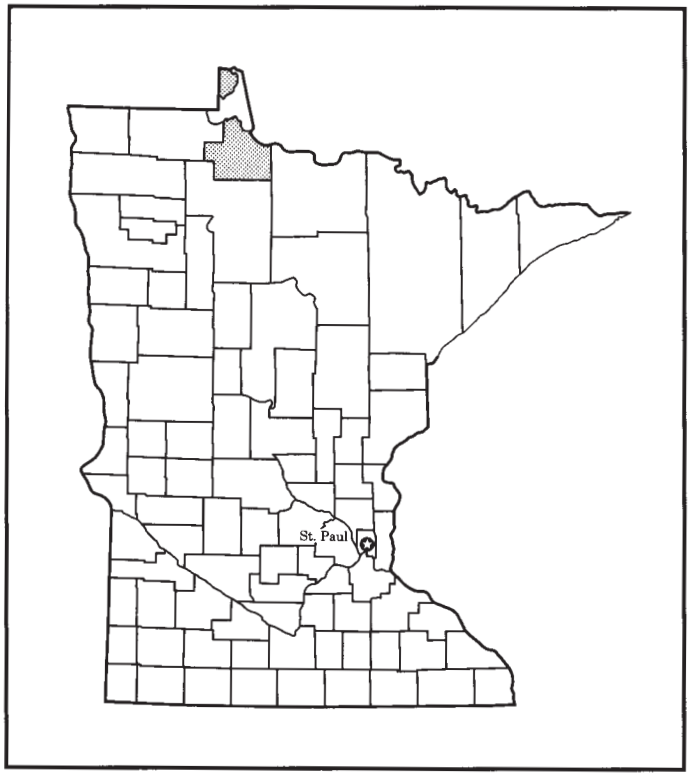

Figure 1.—Location of the survey area in Minnesota.

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

The total annual precipitation is 22.52 inches. Of this, 17 inches, or about 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15 inches. The heaviest 1-day rainfall during the period of record was 4 inches at Baudette on August 26, 1980. Thunderstorms occur on about 31 days each year.

The average seasonal snowfall is 39 inches. The greatest snow depth at any one time during the period of record was 57 inches. On the average, 140 days of the year have at least 1 inch of snow on the ground (Kuehnast, 1978). The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the west. Average windspeed is highest, 10 miles per hour, in spring.

History and Development

Lake of the Woods County was organized on November 28, 1922. It was formed from part of Beltrami County. The Northwest Angle was added to Lake of the Woods County and became part of the United States through a series of treaties, surveys, and compromises. The International Joint Boundary Commission, which was charged with the responsibility of establishing a border between the United States and Canada, tried to determine the most northwesterly point on Lake of the Woods in 1823. The two national groups could not agree on the exact location of that point, however, and international debate continued until a final settlement in 1920 (Lake of the Woods County Historical Society, 1980).

The early history of the survey area involved the activities of various tribes of Indians, groups of voyageurs, trappers, loggers, and pioneers. These early residents followed watercourses to Lake of the Woods, where they supported themselves by trapping, fishing, logging, or subsistence farming. In 1901, the construction of a railway between Warroad and Rainy River brought many new residents to the area. By 1905, the population had grown to 1,085. The villages of Baudette and Spooner were incorporated in 1906. A forest fire destroyed the towns of Graceton, Pitt, Baudette, and Spooner in 1910. Although this fire and later fires were very destructive, they made the land easier to clear for agriculture.

Much of the land that was claimed for homesteads in the southwestern part of the county had poor or very poor natural drainage. In 1912, the establishment of judicial ditches encouraged settlement in the area. These ditches crisscrossed the land, but they proved to be inadequate. Eventually, the settlers abandoned the land and forfeited ownership because they were unable to pay the taxes that were levied to pay for drainage costs. As a result, the State of Minnesota now owns more than half of the total area of the county.

The timber industry prospered in the survey area until about 1920. The tourism industry began in the mid 1920's. Agriculture in Lake of the Woods County boomed in the 1930's. Although the rest of the nation was experiencing drought, conditions in the county were nearly ideal. For a few years, bountiful crops of legumes, seeds, and cereal grains were produced.

In 1954, Spooner and Baudette were combined and became the county seat. Williams is the only other incorporated village in Lake of the Woods County. The population of the county was 4,304 in 1960, but it had

dropped to 3,987 by 1970. In 1980, the population was 3,765. A special census in 1983 showed a population of 3,925.

Transportation Facilities and Markets

A railroad runs northwest to southeast across the survey area, from Roosevelt to Baudette. Established in 1901, the railroad is now leased and operated by Canadian National Railways. The area also is serviced by two bus lines. The Grey Goose bus line runs from Winnipeg, Manitoba, to Thunder Bay, Ontario. The Red River Trails bus line runs to Thief River Falls. The Baudette Airport provides air service and has the capacity to handle medium-sized aircraft.

A network of all-weather roads services the county. Trunk Highways 72 and 172 combine to traverse the county from north to south. Trunk Highway 11 crosses the county from east to west. These highways and a number of paved or blacktopped county and State roads and highways connect a number of gravel-surfaced and State forest roads and provide access for farmers and loggers to markets and trade centers.

Grain is shipped by truck to Duluth and to elevators in Williams and Baudette. Large quantities of grain are stored on farms. Beef and feeder cattle are shipped by truck to markets in West Fargo and South St. Paul. Dairy products are marketed locally or in adjacent counties. Hardwood and softwood poletimber is transported by truck and rail to mills in International Falls, Grand Rapids, and Bemidji. Some timber is received at local mills.

Farming

The major cash crops in the survey area are wheat, oats, barley, flax, and sunflowers. Alfalfa and mixed hay are the most common crops. Small acreages of specialty crops, such as foundation seed potatoes, bluegrass seed, wild rice, and timothy for seed and forage, are also grown.

Livestock enterprises are scattered throughout the survey area. The number of dairy operations increased between 1978 and 1986, but the number of other kinds of livestock operations decreased slightly (U.S. Department of Commerce, 1984). In general, grain enterprises are more numerous than livestock enterprises.

Forestry

Forestry is an important land use in the survey area. In 1977, Lake of the Woods County had 596,100 total acres of forest land. Of this total, 360,600 acres was commercial forest. About 76 percent of the commercial forest land is publicly owned. Of the rest of the acreage, 49,200 acres is owned by farmers and 37,344 acres is owned by other groups or individuals.

Hardwood forest types make up 53 percent of the commercial forest land, and softwood forest types make up 42 percent. Most of the noncommercial forest land is made up of lowland conifers. Aspen is the dominant forest type on 115,100 acres. Other major hardwood forest types are balsam poplar (57,800 acres), paper birch (10,200 acres), and elm-ash (7,800 acres). The major softwood types are black spruce (54,900 acres), tamarack (33,600 acres), jack pine (22,600 acres), northern whitecedar (21,200 acres), balsam fir (16,500 acres), white spruce (2,700 acres), and red pine (1,400 acres) (Minnesota Department of Natural Resources, 1977).

In 1976, approximately 55,000 cords of timber was harvested in the survey area. Aspen was the most commonly harvested species (23,650 cords). About 7,850 cords of other hardwood species was also harvested. Of the 23,500 cords of softwood species harvested, 10,500 cords was black spruce and 13,500 cords was jack pine, tamarack, northern whitecedar, white spruce, and balsam fir. Most of the timber harvested in the survey area is used in pulp and paper mills. The rest is used for lumber or fuelwood.

Water Supply

Water supplies in the survey area are generally adequate for private and municipal use. Water is primarily obtained from wells that tap Pleistocene glacial deposits. Precambrian igneous and metamorphic rocks underlying the glacial deposits yield little or no water. The most accessible aquifers, which are used almost exclusively, are saturated sand and gravel within the glacial deposits. The depth and the water yield of the wells into these aquifers vary.

The aquifers in the region are confined as a result of a general slope to the northeast, a maximum change in relief of only 250 feet in 26 miles, and relatively impermeable layers within the glacial deposits. Wells tapping into these aquifers commonly produce flowing artesian wells. Flowing wells that produce good-quality water are common in the Williams and Graceton areas.

Several factors combine to create an apparent water table at or near the surface. These factors include a relatively impervious surface layer consisting of lacustrine glacial deposits, a lack of extensive relief, and the high water-holding capacity of the large peatlands. Generally, this surface water is of poor quality.

Geology

The present landscape of the survey area was largely formed during the most recent period of glaciation, which occurred from about 75,000 to 9,000 years ago. It is a young landscape in geologic terms. In comparison, the bedrock that crops out in several places in the survey area is at least 2.5 billion years old. Glaciers advanced and retreated across the area several times during the latest glacial period, which is called the Wisconsin glaciation. These glaciers left behind the parent material of the mineral soils in the survey area (Mayer-Oakes, 1967).

Glacial till is unsorted material deposited directly by glaciers. It is a mixture of sand, silt, clay, and rock fragments. The composition of the till is determined by the kind of material over which the glaciers moved during their advance. The till in the survey area has a high content of carbonates because the glaciers that covered the area came from the Winnipeg lowland in southern Manitoba, where there was an abundance of carbonate rock. The soils that formed in this till have a high pH because of the carbonates, and they contain many stones.

About 12,000 years ago, the last glacier began to retreat into Canada and glacial Lake Agassiz formed. The lake had a major influence on the soils in the survey area. As the glacier melted, meltwater was trapped between the ice margin in the north and a high topographic rim in the south, near Browns Valley, Minnesota. The outlet for the lake was the glacial River Warren, which is now the Minnesota River valley. The size and depth of Lake Agassiz varied. At one time the lake covered an area greater than the combined area of the present Great Lakes. All of the survey area was under water in the early stages of the lake's development (U.S. Geological Survey, 1970).

Wind-driven waves built up ridges of sand and gravel along the shores of Lake Agassiz. One of these ridges, which marks the lowest stable level of the lake in Minnesota, runs through Lake of the Woods County. It is called Campbell Beach. It crosses the Canadian National Railway at Pitt and runs northwest, running nearly parallel to the shores of Lake of the Woods and the Rainy River. Highway 11, between Karlstad and Roseau, is built on the ridge. The sand and gravel deposits in Beltrami Island State Forest also are shoreline features of Lake Agassiz and are valuable sources of sand and gravel. Wave action smoothed out the till landscape beneath the lake, eroding knolls, filling in depressions, and sorting sediments. Lake clay was deposited in the deeper, calmer water.

About 9,000 years ago, as the glacier continued to melt, eastern outlets to Lake Superior and Hudson Bay, which were previously blocked by ice, were exposed. During this time the lake retreated from Campbell Beach and the southern outlet. Except for the beaches, Lake Agassiz left behind a nearly level landscape with poor natural drainage. Lake of the Woods is a remnant of Lake Agassiz that did not drain.

Extensive peatlands have formed in the period since the lake receded from the survey area. Perennial cool, wet conditions inhibited the decomposition of vegetation, and peat began to accumulate. The accumulation of peat blocked drainage, and the water table began to rise. More peat accumulated, extending upslope and covering watershed divides. The large peatland area north of Red Lake, which includes part of Lake of the Woods County, is one of the largest continuous peatland areas in the world.

Physiography, Relief, and Drainage

The entire survey area has been influenced by the waters of glacial Lake Agassiz. A succession of beach ridges formed as the water of the lake receded. The most notable of these ridges are Campbell Beach, which roughly parallels Highway 11 in the northern half of the county, and the beaches that make up the Beltrami Island area, which are in the southwestern part of the county. A number of basins, in which lacustrine sand, silt, and clay were deposited, also were formed. Eddies and currents and the changing water level of the lake formed sandbars. These sandbars occur throughout the survey area and are underlain by calcareous loam and clay loam glacial till. The nearly level, undulating lake plain has little natural drainage. This lack of drainage contributed to the development of extensive peatlands in the survey area.

The highest elevation in the survey area, 1,310 feet above sea level, is in Norris Township in the southwestern part of the survey area. The water level in Lake of the Woods is maintained at about 1,060 feet above sea level. Maximum relief in the county is about 250 feet.

The survey area is drained by a system of rivers and streams that generally flow northeast into the Rainy River and Lake of the Woods. The Rapid River drains a major portion of the southern half of Lake of the Woods County. The Rapid, Baudette, and Winter Road Rivers flow into the Rainy River, which flows into Lake of the Woods. Zippel, Bostick, and Stony Creeks also flow into Lake of the Woods. The Roseau River drains a part of the southwestern portion of the county and flows into the Red River. Several small streams in the survey area merge and form broad expanses of peatland. Natural draws and creeks, judicial ditches, and agricultural drainage systems remove excess water from areas

used for farming or residential development.

How This Survey Was Made

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

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

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

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

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

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

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

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

Part of Lake of the Woods County is within the boundaries of the Red Lake Indian Reservation. This land, about 72,040 acres, was not mapped during the course of this survey.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

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

General Soil Map Units

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

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

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

Soil Descriptions

1. Spooner-Baudette Association

Nearly level and gently sloping, poorly drained and moderately well drained soils that formed in silty glacial lacustrine sediments on glacial lake plains

This association makes up about 3 percent of the survey area. It is about 40 percent Spooner and similar soils, 30 percent Baudette and similar soils, and 30 percent soils of minor extent (fig. 2). Slopes range from 0 to 4 percent but are dominantly less than 2 percent.

The poorly drained Spooner soils are in nearly level areas. Typically, the surface layer is very dark gray very fine sandy loam about 6 inches thick. The subsurface layer is light brownish gray, mottled loamy very fine sand about 9 inches thick. The subsoil is olive gray, mottled loam about 7 inches thick. The underlying material to a depth of 60 inches or more is light olive gray, mottled, calcareous silt loam and silt.

The moderately well drained Baudette soils are in nearly level or gently sloping areas. Typically, the surface layer is very dark grayish brown fine sandy loam about 6 inches thick. The subsurface layer is brown fine sandy loam about 6 inches thick. The subsoil is dark yellowish brown, mottled silty clay loam about 7 inches thick. Below this is about 7 inches of yellowish brown, mottled, calcareous silt loam. The underlying material to a depth of 60 inches or more is light olive brown, mottled, calcareous silt loam.

Of minor extent in this association are Zippel, Wabanica, Indus, and Sago soils. The poorly drained Zippel, Wabanica, and Indus soils are in nearly level areas. The very poorly drained Sago soils are in depressions and at the margins of bogs.

Most areas of this association are used for small grain or for forage plants. The major management factors are the seasonal high water table in areas of the Spooner soils and the hazard of water erosion in areas of the Baudette soils.

Some areas are used as woodland. The equipment limitation is a major management factor. Windthrow is an additional concern in areas of the Spooner soils.

2. Indus-Taylor-Clearwater Association

Nearly level and gently sloping, poorly drained and moderately well drained soils that formed in clayey glacial lacustrine sediments on glacial lake plains

This association makes up about 6 percent of the survey area. It is about 30 percent Indus and similar soils, 25 percent Taylor and similar soils, 20 percent Clearwater and similar soils, and 25 percent soils of minor extent. Slopes range from 0 to 8 percent but are dominantly less than 2 percent.

The poorly drained Indus soils are in plane or slightly convex landscape positions. Typically, the surface layer is black clay loam about 2 inches thick. The subsurface layer is grayish brown, mottled clay loam about 2 inches thick. The subsoil is olive gray, mottled clay about 14 inches thick. Below this is about 13 inches of grayish brown, mottled, calcareous clay. The underlying material to a depth of 60 inches or more is dark grayish brown, mottled, calcareous clay.

The moderately well drained Taylor soils are in nearly level and gently sloping areas. Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsurface layer is brown, mottled sandy loam about 6 inches thick. The subsoil is brown

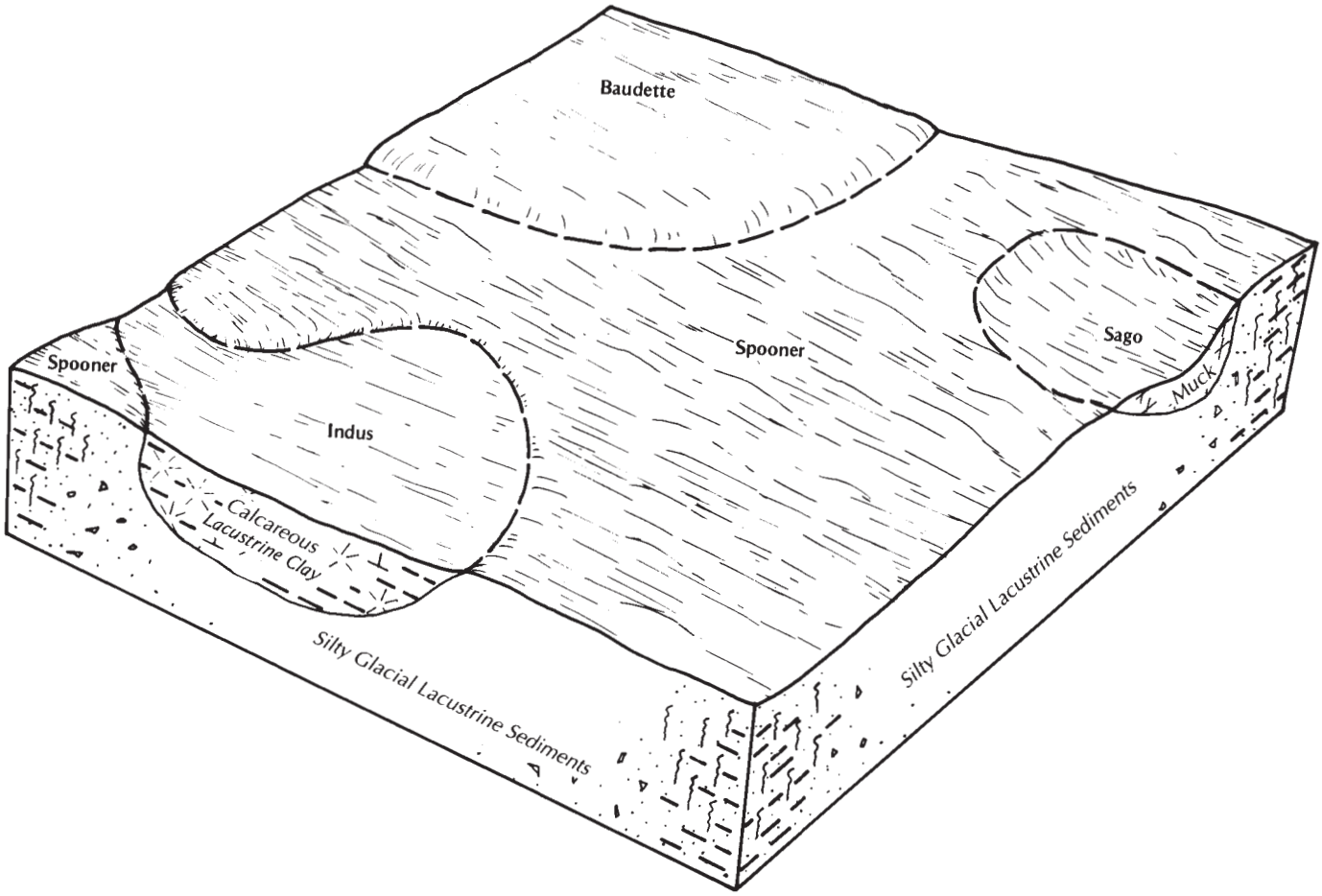

Figure 2.—Typical pattern of soils and underlying material in the Spooner-Baudette association.

and dark grayish brown clay about 17 inches thick. The underlying material to a depth of 60 inches or more is grayish brown, mottled, calcareous silty clay.

The poorly drained Clearwater soils are in nearly level areas. They are calcareous throughout. Typically, the surface layer is black clay about 9 inches thick. The subsoil is dark gray, mottled clay about 9 inches thick. The underlying material to a depth of 60 inches or more is gray, mottled clay and light brownish gray, mottled silty clay.

Of minor extent in this association are Woodslake, Wildwood, Insula, Mesaba, and Quetico soils. The poorly drained and very poorly drained Woodslake soils are in nearly level or slightly concave areas. The very poorly drained Wildwood soils are in depressions. The well drained Insula and Mesaba soils and the somewhat excessively drained Quetico soils are on complex slopes on bedrock-controlled uplands.

Most areas of this association are used for small grain or for forage plants. The major management factors are the content of organic matter and the seasonal high water table in areas of the Indus soils, the hazard of water erosion and the content of organic matter in areas of the Taylor soils, and the seasonal high water table in areas of the Clearwater soils.

Some areas are used as woodland. The equipment limitation, seedling mortality, and windthrow are major management factors in areas of the Indus soils, and the equipment limitation and windthrow are concerns in areas of the Taylor soils. Areas of the Clearwater soils are generally not used as woodland.

3. Redby-Hiwood-Cormant Association

Nearly level and gently sloping, very poorly drained to moderately well drained soils that formed in sandy sediments on glacial lake beaches, glacial lake plains, and outwash plains

This association makes up about 20 percent of the survey area. It is about 30 percent Redby and similar

soils, 25 percent Hiwood and similar soils, 20 percent Cormant and similar soils, and 25 percent soils of minor extent (fig. 3). Slopes range from 0 to 6 percent.

The somewhat poorly drained Redby soils are in nearly level or gently sloping areas. Typically, the surface layer is very dark grayish brown loamy fine sand about 3 inches thick. The subsurface layer is light brownish gray fine sand about 2 inches thick. The subsoil is yellowish brown, mottled fine sand about 14 inches thick. The underlying material to a depth of 60 inches or more is grayish brown, mottled fine sand.

The moderately well drained Hiwood soils are in nearly level or gently sloping areas. Typically, the surface layer is very dark brown fine sand about 2 inches thick. The subsurface layer is light brownish gray fine sand about 4 inches thick. The upper part of the subsoil is yellowish brown, mottled fine sand about 9 inches thick. The next part is yellowish brown fine sand about 13 inches thick. The lower part is light yellowish brown, mottled fine sand about 18 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray and pale brown, mottled fine sand.

The poorly drained and very poorly drained Cormant soils are in nearly level or slightly concave areas. Typically, the surface layer is black loamy fine sand about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray and grayish brown, mottled fine sand and sand.

Of minor extent in this association are Leafriver, Enstrom, Kratka, and Grygla soils. The very poorly drained Leafriver soils are in depressions. The moderately well drained Enstrom soils are on convex rises. The poorly drained Kratka soils and the very poorly drained and poorly drained Grygla soils are in slightly concave basins or depressions on glacial till plains.

Most areas of this association are used as woodland. The equipment limitation, seedling mortality, and windthrow are major management factors in areas of the Redby and Cormant soils, and the equipment limitation and seedling mortality are concerns in areas of the Hiwood soils.

Some areas are used for crops or for hay and pasture. The available water capacity, the hazard of soil blowing, and the content of organic matter are major management factors in areas of the Redby and Hiwood soils, and the hazard of soil blowing and the seasonal high water table are concerns in areas of the Cormant soils.

4. Marquette-Karlstad-Faunce Association

Nearly level to moderately steep, excessively drained to moderately well drained soils that formed in sandy or gravelly sediments or in a loamy or sandy mantle overlying sandy and gravelly outwash on glacial lake beaches, lake plains, or outwash plains

This association makes up about 2 percent of the survey area. It is about 25 percent Marquette and similar soils, 25 percent Karlstad and similar soils, 25 percent Faunce and similar soils, and 25 percent soils of minor extent. Slopes range from 0 to 25 percent but are dominantly 0 to 8 percent.

The excessively drained Marquette soils are in nearly level to moderately steep areas on the tops of ridges and side slopes on outwash plains. Typically, the surface layer is very dark gray loamy sand about 3 inches thick. The subsurface layer is light brownish gray sand about 13 inches thick. The subsoil is brown very gravelly loam about 5 inches thick. The underlying material to a depth of 60 inches or more is grayish brown and brown, calcareous very gravelly loamy sand and very gravelly sand.

The moderately well drained Karlstad soils are in nearly level, slightly convex to slightly concave areas on glacial lake beaches or outwash plains. Typically, the surface layer is very dark grayish brown loamy sand about 6 inches thick. The subsurface layer is brown loamy sand about 4 inches thick. The subsoil is brown, mottled sandy loam about 5 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, mottled, calcareous gravelly coarse sand.

The well drained Faunce soils are in nearly level or gently sloping areas adjacent to old glacial lake beach ridges on glacial lake plains. Typically, the surface layer is very dark grayish brown fine sand about 3 inches thick. The upper part of the subsurface layer is yellowish brown fine sand about 8 inches thick. The lower part is strong brown sand about 3 inches thick. The subsoil is yellowish brown sand and dark yellowish brown loamy coarse sand about 6 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown and very pale brown, calcareous, stratified sand and gravelly sand.

Of minor extent in this association are Menahga, Pelan, and Meehan soils. The excessively drained Menahga soils are on convex slopes. The moderately well drained Pelan soils are on convex rises adjacent to beach ridges. The somewhat poorly drained Meehan soils are in plane or slightly convex landscape positions.

Most areas of this association are used as woodland. The equipment limitation, seedling mortality, and the hazard of water erosion are major management factors in areas of the Marquette soils; the equipment limitation is a concern in areas of the Karlstad soils; and the equipment limitation and seedling mortality are

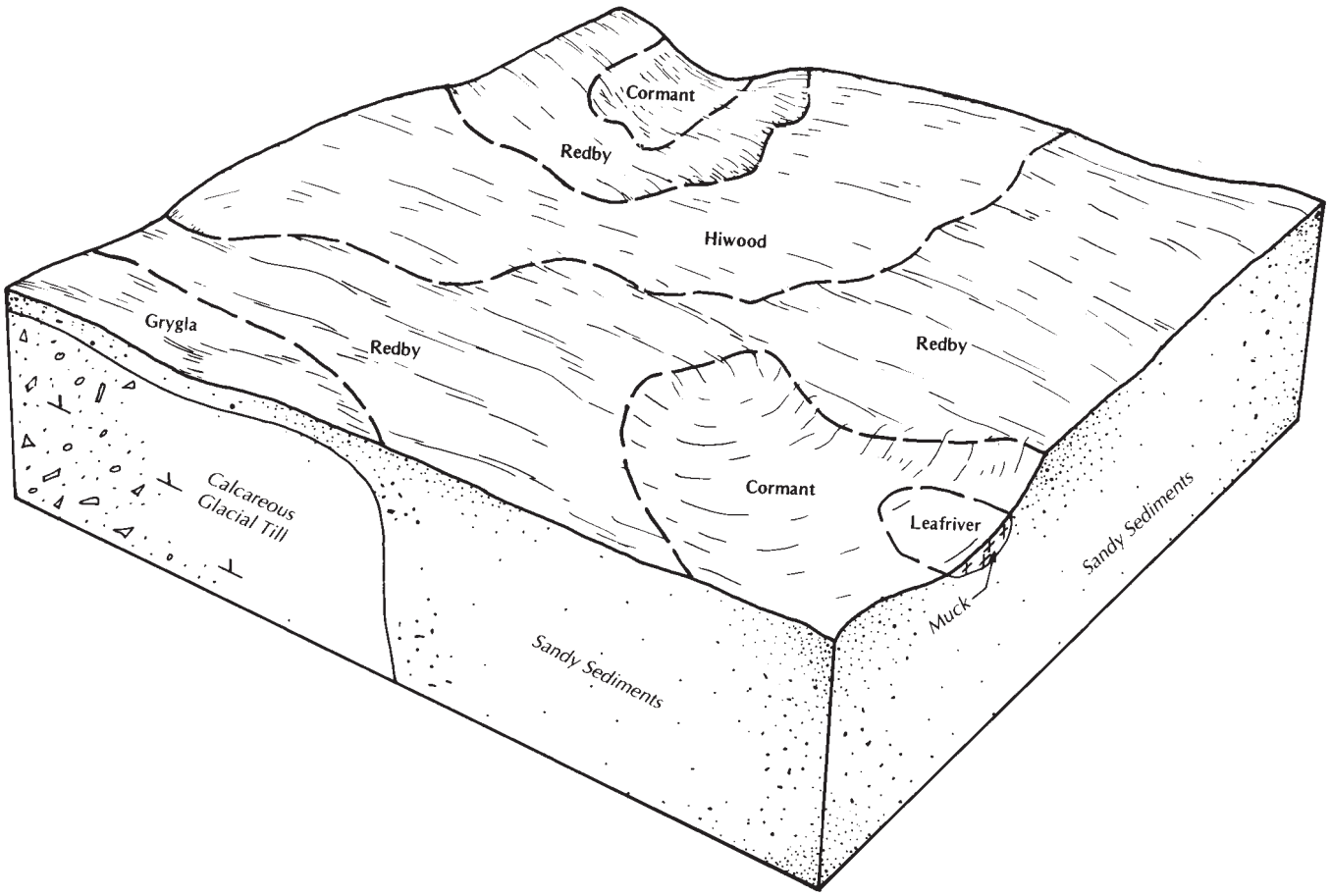

Figure 3.—Typical pattern of soils and underlying material in the Redby-Hiwood-Cormant association.

concerns in areas of the Faunce soils.

Some areas are used for crops or for hay and pasture. The available water capacity, the hazard of soil blowing, and the slope are major management factors in areas of the Marquette soils; the available water capacity and the hazard of soil blowing are concerns in areas of the Karlstad soils; and the available water capacity, the hazard of soil blowing, and the content of organic matter are concerns in areas of the Faunce soils.

5. Chilgren-Garnes-Percy Association

Nearly level and gently sloping, poorly drained and moderately well drained soils that formed in loamy till on glacial lake plains and till plains

This association makes up about 19 percent of the survey area. It is about 30 percent Chilgren and similar soils, 25 percent Garnes and similar soils, 20 percent Percy and similar soils, and 25 percent soils of minor extent (fig. 4). Slopes range from 0 to 4 percent.

The poorly drained Chilgren soils are in nearly level areas. Typically, the surface layer is very dark gray fine sandy loam about 3 inches thick. The subsurface layer is grayish brown, mottled loamy fine sand about 5 inches thick. The subsoil is grayish brown, mottled loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, mottled, calcareous loam.

The moderately well drained Garnes soils are in nearly level or gently sloping areas. Typically, the surface layer is very dark grayish brown fine sandy loam about 3 inches thick. The subsurface layer is brown, mottled loamy fine sand about 4 inches thick. The subsoil is mottled clay loam about 8 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The underlying material to a depth of 60 inches or more is brown, mottled, calcareous fine sandy loam.

The poorly drained Percy soils are in nearly level areas. They are calcareous throughout. Typically, the surface layer is black fine sandy loam about 8 inches

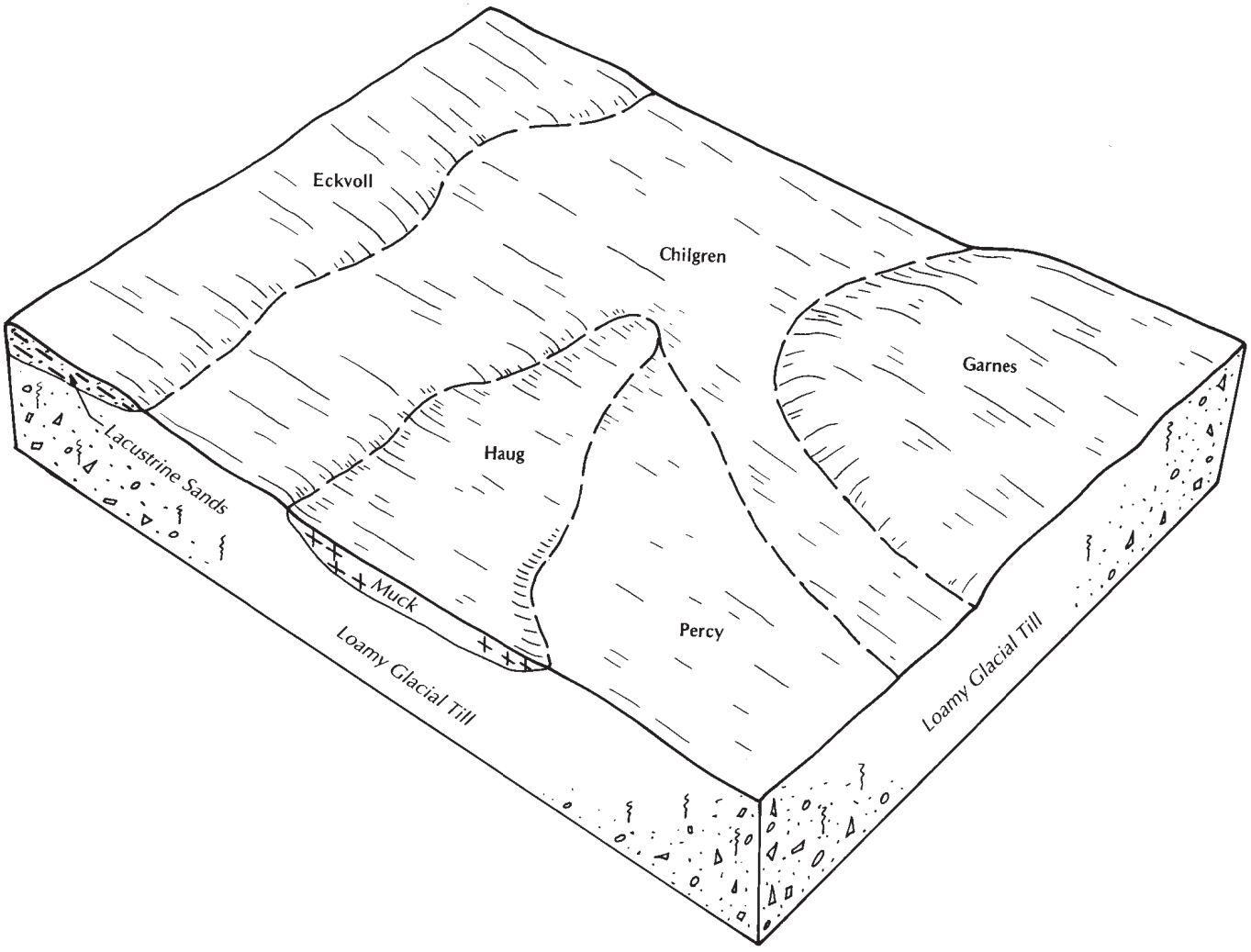

Figure 4.—Typical pattern of soils and underlying material in the Chilgren-Garnes-Percy association.

thick. The subsoil is dark grayish brown and light brownish gray, mottled fine sandy loam about 7 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, mottled loam.

Of minor extent in this association are Eckvoll, Suomi, Grygla, Roliss, and Haug soils. The moderately well drained Eckvoll and Suomi soils are on convex rises. The poorly drained and very poorly drained Grygla and Roliss soils are in nearly level areas. The very poorly drained Haug soils are in depressions. Eckvoll and Grygla soils have a sandy layer that is underlain by glacial till. Suomi soils have more clay in the subsoil than the major soils.

Most areas of this association are used for small grain or for forage plants. The major management factors are the seasonal high water table in areas of the Chilgren and Percy soils and the hazard of water erosion and the content of organic matter in areas of the Garnes soils.

Some areas are used as woodland. The major management factors are the equipment limitation and windthrow in areas of the Chilgren soils and the equipment limitation in areas of the Garnes soils. The Percy soils are generally not used as woodland.

6. Seelyeville-Cathro-Haug Association

Nearly level, very poorly drained soils that formed in highly decomposed organic material and in highly decomposed organic material overlying mineral material on glacial lake plains

This association makes up about 34 percent of the survey area. It is about 25 percent Seelyeville and similar soils, 25 percent Cathro and similar soils, 15

percent Haug and similar soils, and 35 percent soils of minor extent. Slopes range from 0 to 2 percent.

The very poorly drained Seelyeville soils are in large, plane or slightly concave bogs. Typically, the surface layer is very dark grayish brown mucky peat about 3 inches thick. The next layer is very dark grayish brown muck about 17 inches thick. Below this to a depth of 60 inches or more is very dark brown muck.

The very poorly drained Cathro soils are in drainageways and small depressions and on the outer margins of large bogs. Typically, the organic part of the surface layer is muck about 25 inches thick. The upper part is dark reddish brown, and the lower part is black. Below this is a mineral surface layer of silty clay loam about 3 inches thick. The upper part of the underlying material is dark gray, mottled silty clay loam about 12 inches thick. The lower part to a depth of 60 inches or more is light brownish gray, mottled, calcareous silty clay loam.

The very poorly drained Haug soils are in small depressions and concave basins. Typically, the surface layer is black muck about 15 inches thick. Below this is about 3 inches of very dark gray, mottled, calcareous fine sandy loam. The underlying material to a depth of 60 inches or more is grayish brown and light brownish gray, mottled, calcareous fine sandy loam and sandy loam.

Of minor extent in this association are the very poorly drained Rifle, Lupton, and Markey soils. Rifle soils formed dominantly in herbaceous mucky peat. Lupton soils formed in woody materials. Markey soils formed in herbaceous muck overlying sandy sediments.

Stunted trees and herbaceous plants are in most areas of this association. The stunted trees include willow, speckled alder, bog birch, and redosier dogwood. The herbaceous plants consist mostly of sedges and wetland grasses. Most areas are poorly suited to woodland because of wetness. Black spruce, tamarack, and northern whitecedar are the most common commercial species.

Even if properly drained, the soils in this association are poorly suited to most agricultural uses. They are well suited to the production of wild rice if adequate water-control measures are used.

7. Rifle Association

Nearly level, very poorly drained soils that formed in moderately decomposed organic material on glacial lake plains

This association makes up about 9 percent of the survey area. It is about 65 percent Rifle and similar soils and 35 percent soils of minor extent. Slopes range from 0 to 2 percent.

The very poorly drained Rifle soils are in flowages or in large, plane areas on peatlands. Typically, the surface layer is dark brown mucky peat about 3 inches thick. The next layer is very dark grayish brown mucky peat about 10 inches thick. Below this is dark brown mucky peat about 39 inches thick. The next layer to a depth of 60 inches or more is very dark grayish brown mucky peat.

Of minor extent in this association are the very poorly drained Greenwood, Lupton, Tacoosh, Cathro, and Bullwinkle soils. Greenwood soils are more acid than the Rifle soils. Lupton soils formed in woody materials. Tacoosh, Cathro, and Bullwinkle soils formed in 16 to 51 inches of organic material overlying mineral soil.

This association is poorly suited to crops, to hay and pasture, and to woodland because of wetness. Most areas support reeds, sedges, shrubs, scattered tamarack, black spruce, and various other water-tolerant plant species.

Areas of this association are well suited to use as habitat for wetland wildlife. Desirable water levels and sources of food and cover can be easily maintained.

8. Greenwood-Lobo Association

Nearly level, very poorly drained soils that formed in organic material in bogs on glacial lake plains

This association makes up about 7 percent of the survey area. It is about 45 percent Greenwood and similar soils, 20 percent Lobo and similar soils, and 35 percent soils of minor extent. Slopes are 0 to 1 percent.

The very poorly drained Greenwood soils are in large, plane or slightly convex bogs. Typically, the surface layer is grayish brown peat about 18 inches thick. Below this to a depth of 60 inches or more is mucky peat. The upper 38 inches is dark brown, and the lower part is dark reddish brown.

The very poorly drained Lobo soils are in raised areas in bogs. Typically, the surface layer is dark brown peat about 38 inches thick. Below this to a depth of 60 inches or more is dark brown mucky peat.

Of minor extent in this association are the very poorly drained Rifle and Tacoosh soils and very poorly drained soils that have more than 61 inches of peat material. Rifle soils formed dominantly in herbaceous mucky peat. Tacoosh soils formed in 16 to 51 inches of organic material overlying mineral soil.

The soils in this association are unsuited to crops and to hay and pasture because of wetness. They are poorly suited to use as woodland because of a high

water table. Most areas support stunted trees, including black spruce and tamarack, and bog rosemary, leatherleaf, sphagnum moss, and various other water-tolerant plant species.

Areas of this association are well suited to use as habitat for wetland wildlife. Desirable water levels and sources of food and cover can be easily maintained.

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Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other 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, Garnes loam, very stony, is a phase of the Garnes series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Insula-Mesaba gravelly loams, 2 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits component of the Udorthents-Pits, gravel, complex is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

This technical publication includes suggested management practices that can increase crop production, minimize soil blowing and water erosion, and help to overcome wetness limitations. Over a period of time, some or all of these practices may not be in accordance with Federal, State, and local laws or with agency rules and guidelines.

Soil Descriptions

48B—Hiwood fine sand, 0 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Slight rises on glacial lake plains or outwash plains
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 2 inches—very dark brown fine sand
2 to 6 inches—light brownish gray fine sand

6 to 15 inches—yellowish brown, mottled fine sand
15 to 28 inches—yellowish brown fine sand
28 to 46 inches—light yellowish brown, mottled fine sand
46 to 56 inches—light brownish gray, mottled fine sand
56 to 60 inches—pale brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Moderately low or low
Surface runoff: Medium or slow
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Cormant soils, which are in depressions
• The excessively drained Menahga soils, which are on the higher parts of the landscape
• The somewhat poorly drained Redby soils, which are in slight depressions

Similar soils:
• Soils that have a surface layer of loamy fine sand or loamy sand
• Soils that have a substratum of loam at a depth of about 40 inches
• Soils that have slopes of more than 6 percent

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality
• The principal tree species is jack pine. Red pine, quaking aspen, eastern white pine, paper birch, and balsam poplar are species of limited extent (fig. 5).
• The sandy texture of the soil limits trafficability on log landings and haul roads, and traction is poor for wheeled logging equipment in logging areas and on skid trails if the soil is dry.
• The use of equipment is limited during the spring thaw and for short periods following heavy rains.
• Moderate plant competition may hinder the development of fully stocked stands.
• Adequate site preparation and measures that control competing vegetation are necessary for the satisfactory establishment and early growth of conifers.
• Because of the thin surface layer, site preparation methods that leave the surface relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
• Selecting adapted plants for planting helps to ensure the establishment and survival of seedlings.
• Windthrow is a hazard if the soil is saturated and winds are strong. Carefully selecting cutting areas can reduce the hazard of windthrow.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing, organic matter content
• Crops and forage plants that can tolerate drought are the best suited. The available moisture supply is inadequate for the good growth of other crops.
• Leaving crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Planting drought-tolerant grasses and legumes can maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 8S

52—Augsburg loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave areas on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Elongated or irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 8 inches—black loam
8 to 15 inches—light brownish gray, mottled, calcareous very fine sandy loam
15 to 22 inches—light brownish gray, mottled, calcareous loamy very fine sand
22 to 30 inches—dark gray, mottled, calcareous clay
30 to 60 inches—olive gray, mottled, calcareous clay

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; slow or very slow in the lower part
Available water capacity: High

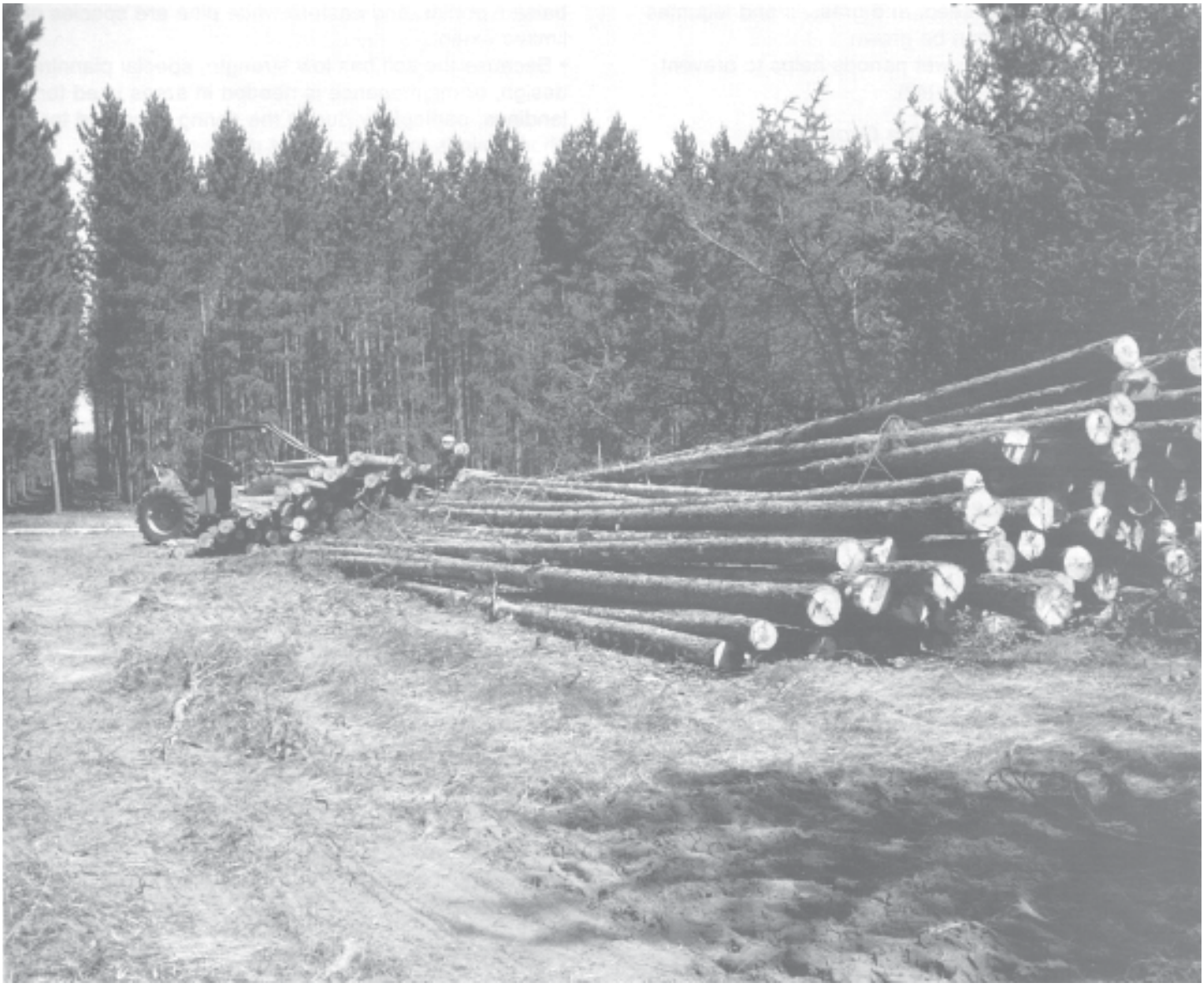

Figure 5.—A wooded area of Hiwood fine sand, 0 to 6 percent slopes. Red pine, shown in the background, is commonly planted in logged areas of this soil.

Content of organic matter: High
Surface runoff: Very slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Donaldson soils, which are on convex rises
• The poorly drained Wabanica soils, which are in landscape positions similar to those of the Augsburg soil and contain more silt

Similar soils:
• Soils that have a surface layer of silt loam or very fine sandy loam
• Soils that have a sandy mantle more than 40 inches thick or less than 20 inches thick
• Soils that are not calcareous in the upper part

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• If adequate drainage is provided, small grain,

potatoes, grasses for seed, and grasses and legumes for hay and pasture can be grown.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

77B—Garnes fine sandy loam, 1 to 4 percent slopes

Composition

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

Setting

Landform and position on the landform: Convex rises on glacial lake plains
Shape of areas: Irregular
Size of areas: 8 to 80 acres

Typical Profile

0 to 3 inches—very dark grayish brown fine sandy loam
3 to 7 inches—brown, mottled loamy fine sand
7 to 13 inches—dark brown, mottled clay loam
13 to 15 inches—dark yellowish brown, mottled clay loam
15 to 60 inches—brown, mottled, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: Moderately low or low
Surface runoff: Medium or slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren soils, which are in concave landscape positions

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

Use and Management

Woodland

Major management factors: Equipment limitations
• The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, bur oak, jack pine, balsam poplar, and eastern white pine are species of limited extent.
• Because the soil has low strength, special planning, design, or maintenance is needed in areas used for log landings, particularly during the spring thaw and for short periods following heavy rains.
• Adequate site preparation and measures that control competing vegetation are needed.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.

Cropland, pasture, and forage

Major management factors: Water erosion, organic matter content
• Using minimum tillage or planting a close-growing cover crop can reduce the hazard of water erosion.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L

116—Redby loamy fine sand

Composition

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

Setting

Landform and position on the landform: Slightly convex areas on glacial lake beaches
Slope range: 0 to 3 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy fine sand
3 to 5 inches—light brownish gray fine sand
5 to 19 inches—yellowish brown, mottled fine sand
19 to 60 inches—grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Moderately low or low
Surface runoff: Slow
Depth to the water table: 1.5 to 3.0 feet

Inclusions

Contrasting inclusions:
- The very poorly drained and poorly drained Cormant soils, which are in the lower areas
- The moderately well drained Hiwood soils, which are in the higher areas
- The very poorly drained Leafriver soils, which are in depressions

Similar soils:
- Soils that have a surface layer of fine sand
- Soils that are stratified with medium and coarse sand

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
- The principal tree species are quaking aspen and jack pine. Red pine, balsam fir, white spruce, paper birch, balsam poplar, and eastern white pine are species of limited extent.
- The sandy texture of the soil limits trafficability on log landings and haul roads.
- If the soil is dry, poor traction interferes with site preparation, the use of wheeled logging equipment in logging areas and on skid trails, and the use of planting equipment.
- The use of equipment is limited during the spring thaw and for short periods following heavy rains.
- Moderate plant competition may hinder the development of fully stocked stands.
- Adequate site preparation and measures that control competing vegetation are necessary for the satisfactory establishment and early growth of conifers.
- Because of the thin surface layer, site preparation methods that leave the surface relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
- Selecting adapted species for planting helps to ensure the establishment and survival of seedlings.
- Windthrow is a hazard if the soil is saturated and winds are strong.
- Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing, organic matter content
- This soil is susceptible to soil blowing and may be droughty during dry periods.
- Leaving crop residue on the surface helps to control soil blowing and conserves soil moisture.
- Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 7S

117—Cormant loamy fine sand

Composition

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

Setting

Landform and position on the landform: Slightly concave positions on glacial lake plains and outwash plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 6 inches—black loamy fine sand
6 to 10 inches—light brownish gray fine sand
10 to 33 inches—light brownish gray, mottled fine sand
33 to 40 inches—grayish brown, mottled fine sand
40 to 60 inches—light brownish gray sand

Soil Properties and Qualities

Drainage class: Very poorly drained and poorly drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Moderate to very high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The poorly drained Grygla soils, which have loamy underlying material
- The somewhat poorly drained Redby soils, which are on convex rises
- Very poorly drained organic soils in depressions

Similar soils:
- Soils that have a surface layer of fine sand, loamy sand, sand, sandy loam, or fine sandy loam
- Soils that have a thicker surface layer or that have silty sediments in the underlying material
- Soils that have a calcic horizon, coarser sand, or gravelly layers in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

• Most areas are wooded. The principal tree species are quaking aspen and balsam poplar. Balsam fir, white spruce, and black ash are species of limited extent.
• Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Site preparation or special planting stock may be needed to reduce the seedling mortality rate because of the depth to the water table.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Soil blowing, seasonal high water table
• In areas used for crops, leaving the surface rough and covered with plant residue and establishing windbreaks can minimize soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVw
Woodland ordination symbol: 6W

122B—Taylor loam, 1 to 8 percent slopes

Composition

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

Setting

Landform and position on the landform: Slightly convex rises on glacial lake plains
Shape of areas: Elongated or irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 6 inches—very dark grayish brown loam
6 to 12 inches—brown, mottled sandy loam
12 to 17 inches—brown, mottled clay
17 to 29 inches—dark grayish brown, mottled clay
29 to 60 inches—grayish brown, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: Moderate
Content of organic matter: Moderately low
Surface runoff: Medium
Depth to the water table: 3 to 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Indus soils, which are in concave landscape positions

Similar soils:
• Soils that have a surface layer of loamy fine sand, silt loam, silty clay loam, very fine sandy loam, or fine sandy loam
• Soils that have a sandy mantle 8 inches thick
• Soils that have clay loam in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
• Special planning, design, or maintenance is needed to overcome the equipment limitations.
• Because of the clayey texture of the soil, traction is poor for wheeled logging equipment during wet periods and low strength reduces the traffic-supporting capacity.
• The use of equipment is limited during the spring thaw and for short periods following heavy rains.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.

Cropland, pasture, and forage

Major management factors: Water erosion, organic matter content
• Using minimum tillage or planting a close-growing cover crop can reduce the hazard of water erosion.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6D

145—Enstrom loamy sand

Composition

Enstrom and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Convex rises on glacial lake plains (fig. 6)
Slope range: 0 to 3 percent
Shape of areas: Elongated or irregular
Size of areas: 8 to 60 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand
4 to 20 inches—dark yellowish brown, mottled sand
20 to 25 inches—brown, mottled sand
25 to 60 inches—grayish brown, mottled loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Moderate
Content of organic matter: Very low to moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Grygla soils, which are in drainageways and closed depressions
• The poorly drained Kratka soils, which are in the slightly lower landscape positions

Similar soils:
• Soils that have a surface layer of sand, fine sand, loamy fine sand, or fine sandy loam
• Soils that have sandy sediments more than 40 inches thick or less than 20 inches thick
• Soils that have coarse sand in the upper part

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality
• The principal tree species are jack pine and quaking aspen. Red pine, eastern white pine, paper birch, and balsam fir are species of limited extent.
• Special planning, design, or maintenance is needed to overcome the equipment limitations.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• If the soil is dry, poor traction interferes with site preparation, the use of wheeled logging equipment in logging areas and on skid trails, and the use of planting equipment.
• Because of the thin surface layer, site preparation methods that leave the surface relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
• The seedling mortality rate is moderate because of the droughty soil conditions during periods of low rainfall. Using containerized stock or special planting stock that is larger than usual reduces the seedling mortality rate.

Cropland, pasture, and forage

Major management factors: Organic matter content, soil blowing, available water capacity
• This soil is susceptible to soil blowing and may be droughty during dry periods.
• Maintaining crop residue on the surface helps to control soil blowing and conserves moisture.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 7S

147—Spooner very fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave positions on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Elongated or irregular
Size of areas: 8 to 150 acres

Typical Profile

0 to 6 inches—very dark gray very fine sandy loam
6 to 15 inches—light brownish gray, mottled loamy very fine sand
15 to 22 inches—olive gray, mottled loam
22 to 30 inches—light olive gray, mottled, calcareous silt loam
30 to 60 inches—light olive gray, mottled, calcareous silt

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: High

Figure 6.—An area of Enstrom loamy sand. The light-colored Enstrom soil is on the convex rises. The darker areas are Kratka fine sand.

Content of organic matter: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The moderately well drained Baudette soils, which are on convex rises
- The very poorly drained Sago soils, which are in depressions

Similar soils:
- Soils that have a surface layer of loamy very fine sand or silt loam
- Soils that have a thin sandy layer in the underlying material
- Soils that are underlain by clay at a depth of 20 to 40 inches

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen and balsam poplar. Balsam fir, paper birch, black ash, and white spruce are species of limited extent.
- Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
- Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
- Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
- The seedling mortality rate is moderate because of wetness, and special planting stock or site preparation may be needed.
- The effective rooting depth is restricted during prolonged periods of wetness.
- Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Seasonal high water table

- Small grain, potatoes, grasses for seed, and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
- Restricting use during wet periods helps to maintain tilth.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 8W

167B—Baudette fine sandy loam, 1 to 4 percent slopes

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex rises on glacial lake plains
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 6 inches—very dark grayish brown fine sandy loam
6 to 12 inches—brown fine sandy loam
12 to 19 inches—dark yellowish brown, mottled silty clay loam
19 to 26 inches—yellowish brown, mottled, calcareous silt loam
26 to 60 inches—light olive brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: Moderate or moderately low
Surface runoff: Medium or slow
Depth to the water table: 3 to 6 feet

Inclusions

Contrasting inclusions:

- The poorly drained Spooner soils, which are in concave areas

Similar soils:

- Soils that have a surface layer of silt loam, loam, or very fine sandy loam
- Soils that contain more clay
- Soils that contain fine sand

Use and Management

Woodland

Major management factors: Equipment limitations

- The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, bur oak, jack pine, balsam poplar, and eastern white pine are species of limited extent.
- Because this soil has low strength, particularly during the spring thaw and for short periods following heavy rains, log landings require special planning, design, or maintenance.
- Adequate site preparation and control of competing vegetation are necessary.
- Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.

Cropland, pasture, and forage

Major management factors: Water erosion

- Using minimum tillage or planting a close-growing cover crop can reduce the hazard of water erosion.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L

172—Indus clay loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex positions on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 2 inches—black clay loam
2 to 4 inches—grayish brown, mottled clay loam
4 to 18 inches—olive gray, mottled clay
18 to 31 inches—grayish brown, mottled, calcareous clay
31 to 60 inches—dark grayish brown, mottled, calcareous clay

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: Moderate
Content of organic matter: Moderately low
Surface runoff: Slow
Depth to the water table: 0.5 foot to 3.0 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Taylor soils, which are in the higher landscape positions
• Very poorly drained soils in depressions

Similar soils:
• Soils that have a surface layer of clay, silty clay loam, or silty clay
• Soils that have a thin sandy or silty mantle
• Soils that have a thicker dark surface layer

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are quaking aspen and balsam poplar. Balsam fir, paper birch, black ash, and white spruce are species of limited extent.
• Wetness and the content of clay restrict site preparation and limit the use of planting equipment and wheeled logging equipment.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Using special planting stock or site preparation can reduce the seedling mortality rate.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Organic matter content, seasonal high water table
• If adequate drainage is provided, small grain, grasses for seed, and grasses and legumes for hay and pasture can be grown.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Restricting use during wet periods helps to prevent soil compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 7W

187—Haug muck

Composition

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

Setting

Landform and position on the landform: Depressions and concave basins on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Round or irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 15 inches—black muck
15 to 18 inches—very dark gray, mottled, calcareous fine sandy loam
18 to 30 inches—grayish brown, mottled, calcareous fine sandy loam
30 to 60 inches—light brownish gray, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 3 feet below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are in landscape positions similar to those of the Haug soil and have a thicker organic surface layer
• The poorly drained Percy soils, which are in landscape positions slightly higher than those of the Haug soil

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

Use and Management

Cropland, pasture, and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas support native vegetation, which consists of water-tolerant species.
• In drained areas, maintaining plant residue on the surface helps to control soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

191—Epoufette loamy fine sand

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave positions adjacent to outwash plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 8 to 200 acres

Typical Profile

0 to 6 inches—black loamy fine sand
6 to 10 inches—dark gray, mottled loamy fine sand
10 to 20 inches—dark grayish brown, mottled sandy loam
20 to 28 inches—grayish brown, mottled sand
28 to 37 inches—grayish brown, mottled coarse sand
37 to 60 inches—grayish brown, mottled, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Available water capacity: Very low
Content of organic matter: High
Surface runoff: Very slow
Depth to the water table: 0.5 foot to 2.0 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Leafriver soils, which are in depressions and drainageways or at the margins of bogs
• The somewhat poorly drained Redby soils, which are on slightly convex rises
• The moderately well drained Karlstad soils, which are in the higher landscape positions

Similar soils:
• Soils that have a surface layer of loamy sand, sandy loam, or fine sandy loam

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are quaking aspen and balsam poplar. Balsam fir, white spruce, and black ash are species of limited extent.
• Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Because of the high water table, special planting stock or site preparation may be needed to minimize seedling mortality.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas are wooded.
• In drained areas, leaving the surface rough and

covered with plant residue reduces the hazard of soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 5W

195B—Taylor loamy fine sand, 1 to 4 percent slopes

Composition

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

Setting

Landform and position on the landform: Slightly convex rises on glacial lake plains
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 7 inches—very dark grayish brown loamy fine sand
7 to 12 inches—yellowish brown, mottled fine sand
12 to 18 inches—brown, mottled silty clay
18 to 60 inches—grayish brown, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; slow in the lower part
Available water capacity: Moderate
Content of organic matter: Moderately low
Surface runoff: Slow
Depth to the water table: 3 to 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Baudette soils, which are in landscape positions similar to those of the Taylor soil and have less clay in the subsoil
• The poorly drained Bearville and Indus soils, which are in the lower landscape positions

Similar soils:
• Soils that have a surface layer of silt loam, silty clay loam, very fine sandy loam, fine sandy loam, or loam
• Soils that have loamy sediments in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• Special planning, design, or maintenance is needed to overcome the equipment limitations.
• Traction is poor during wet periods for wheeled logging equipment because of the clayey texture of the soil, and low strength reduces the traffic-supporting capacity.
• The use of equipment is limited during the spring thaw and for short periods following heavy rains.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.

Cropland, pasture, and forage

Major management factors: Organic matter content, soil blowing
• Maintaining crop residue on the surface and establishing field windbreaks reduce the hazard of soil blowing.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6D

202—Meehan loamy sand

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex rises on outwash plains
Slope range: 0 to 3 percent
Shape of areas: Long and narrow
Size of areas: 8 to 80 acres

Typical Profile

1 inch to 0—partially decomposed forest litter
0 to 4 inches—very dark grayish brown loamy sand
4 to 15 inches—light brownish gray loamy sand
15 to 27 inches—yellowish brown, mottled sand
27 to 40 inches—brownish yellow, mottled sand
40 to 47 inches—light yellowish brown, mottled sand
47 to 60 inches—pale brown, mottled sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Low to moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The very poorly drained and poorly drained Cormant soils, which are in depressions
- The excessively drained Menahga soils, which are in the higher landscape positions

Similar soils:
- Soils that have a surface layer of sand
- Soils that have thin bands of gravel in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
- Most areas are wooded. The principal tree species are quaking aspen and jack pine. Red pine, balsam fir, paper birch, balsam poplar, eastern white pine, and white spruce are species of limited extent.
- Special planning, design, or maintenance is needed to overcome the equipment limitations.
- The sandy texture of the soil limits trafficability on log landings and haul roads.
- If the soil is dry, poor traction interferes with site preparation, the use of wheeled logging equipment in logging areas and on skid trails, and the use of planting equipment.
- The use of equipment is limited during the spring thaw and for short periods following heavy rains.
- Because of the thin surface layer, site preparation methods that leave the surface relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
- Site preparation or the use of special planting stock reduces the seedling mortality rate.

Cropland, pasture, and forage

Major management factors: Organic matter content, seasonal high water table, soil blowing
- In areas used for crops, leaving the surface rough and covered with plant residue or establishing windbreaks reduces the hazard of soil blowing.
- Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
- Water-tolerant forage species should be selected for planting.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVw
Woodland ordination symbol: 6W

205—Karlstad loamy sand

Composition

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

Setting

Landform and position on the landform: Slightly convex to slightly concave areas on glacial lake beaches or outwash plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 8 to 200 acres

Typical Profile

0 to 6 inches—very dark grayish brown loamy sand
6 to 10 inches—brown loamy sand
10 to 15 inches—brown, mottled sandy loam
15 to 60 inches—light brownish gray, mottled, calcareous gravelly coarse sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; rapid or very rapid in the lower part
Available water capacity: Low
Content of organic matter: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
- The very poorly drained and poorly drained Cormant soils, which are in depressions
- The poorly drained Epoufette soils, which are in the lower landscape positions
- The excessively drained Marquette soils, which are in the higher landscape positions

Similar soils:
- Soils that have a surface layer of sandy loam or fine sandy loam
- Soils that do not have clay accumulations at a depth of 10 to 15 inches

Use and Management

Woodland

Major management factors: Equipment limitations

• The principal tree species is jack pine. Red pine, quaking aspen, eastern white pine, paper birch, and balsam fir are species of limited extent.
• This soil may have low strength after the spring thaw or for short periods after heavy rains.
• The sandy texture of the soil limits trafficability on log landings and haul roads, and traction is poor for wheeled logging equipment in logging areas and on skid trails if the soil is dry.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing
• Crops and forage plants that can tolerate drought are the best suited.
• Maintaining crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 6L

242B—Marquette loamy sand, 1 to 8 percent slopes

Composition

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

Setting

Landform and position on the landform: Ridgetops on outwash plains (fig. 7)
Shape of areas: Long and narrow
Size of areas: 15 to 100 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand
3 to 16 inches—light brownish gray sand
16 to 21 inches—brown very gravelly loam
21 to 32 inches—grayish brown, calcareous very gravelly loam
32 to 60 inches—brown, calcareous very gravelly sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Available water capacity: Low
Content of organic matter: Moderately low or moderate
Surface runoff: Medium or slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Karlstad soils, which are in the lower landscape positions
• The excessively drained Menahga soils, which are in border areas and contain little or no gravel

Similar soils:
• Soils that have a surface layer of loamy coarse sand, fine sand, sand, coarse sand, or loamy fine sand

Use and Management

Woodland

Major management factors: Seedling mortality
• The principal tree species are jack pine and red pine. Quaking aspen, eastern white pine, paper birch, and balsam fir are species of limited extent.
• The seedling mortality rate is moderate because the soil is droughty. Using special planting stock or containerized seedlings can increase the seedling survival rate.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing
• Crops and forage plants that can tolerate drought are the best suited.
• Maintaining crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 6F

242D—Marquette loamy fine sand, 8 to 25 percent slopes

Composition

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

Setting

Landform and position on the landform: Convex ridgetops and side slopes on outwash plains
Shape of areas: Long and narrow
Size of areas: 10 to 100 acres

Figure 7.—An area of Marquette loamy sand, 1 to 8 percent slopes, that has been excavated for sand and gravel.

Typical Profile

0 to 2 inches—very dark grayish brown loamy fine sand
2 to 4 inches—dark yellowish brown loamy fine sand
4 to 8 inches—dark brown coarse gravelly sandy loam
8 to 19 inches—yellowish brown coarse gravelly loamy sand
19 to 60 inches—brown, mottled coarse gravelly loamy sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Available water capacity: Very low
Content of organic matter: Moderately low or low
Surface runoff: Rapid or medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Karlstad soils, which are in the lower landscape positions

• The excessively drained Menahga soils, which are in broad areas and contain little or no gravel

Similar soils:
• Soils that have a surface layer of loamy sand, loamy coarse sand, fine sand, sand, or coarse sand

Use and Management

Woodland

Major management factors: Erosion, equipment limitations, seedling mortality
• The principal tree species are jack pine and red pine. Quaking aspen, eastern white pine, paper birch, and balsam fir are species of limited extent.
• Establishing logging roads and skid roads in the less sloping areas or across side slopes can minimize water erosion.
• The slope hinders the use of wheeled or tracked equipment.
• The seedling mortality rate is moderate because the soil is droughty. Using special planting stock or containerized seedlings can increase the seedling survival rate.

Pasture and forage

Major management factors: Available water capacity, slope
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 6R

280—Pelan sandy loam

Composition

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

Setting

Landform and position on the landform: Convex rises adjacent to old glacial lake beaches on glacial lake plains
Slope range: 0 to 3 percent
Shape of areas: Elongated or irregular
Size of areas: 8 to 40 acres

Typical Profile

0 to 4 inches—black sandy loam
4 to 6 inches—brown loamy sand
6 to 9 inches—dark yellowish brown, mottled sandy loam
9 to 15 inches—dark yellowish brown, mottled very gravelly sandy loam
15 to 20 inches—pale brown, mottled, calcareous coarse sand
20 to 38 inches—brown, mottled, calcareous gravelly coarse sand
38 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderate in the lower part
Available water capacity: Moderate
Content of organic matter: Low to moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Grygla soils, which are in drainageways and closed depressions
• The somewhat excessively drained Marquette soils, which are in the higher, more convex landscape positions
• The poorly drained Strandquist and Percy soils, which are in the lower landscape positions

Similar soils:
• Soils that have a surface layer of loamy sand, loamy fine sand, or fine sandy loam

Use and Management

Woodland

Major management factors: Equipment limitations
• The principal tree species are quaking aspen and jack pine. Red pine, eastern white pine, paper birch, and balsam fir are species of limited extent.
• This soil may have low strength after the spring thaw or for short periods after heavy rains.

Cropland, pasture, and forage

Major management factors: Organic matter content, available water capacity
• This soil may be droughty during dry periods. Maintaining crop residue on the surface conserves soil moisture.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.

• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 6L

379—Percy loam, very stony

Composition

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

Setting

Landform and position on the landform: Slight depressions on glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 6 inches—black loam
6 to 10 inches—gray, mottled sandy loam
10 to 30 inches—light brownish gray, mottled, calcareous sandy loam
30 to 60 inches—pale brown, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: High or very high
Surface runoff: Very slow
Depth to the water table: 0.5 foot to 3.0 feet
Special characteristics: 1 to 3 percent of the surface covered by stones

Inclusions

Contrasting inclusions:
• The moderately well drained Garnes soils, which are on convex rises and are stony
• The poorly drained Kratka soils, which are in landscape positions similar to those of the Percy soil and contain more sand

Similar soils:
• Soils that have a surface layer of sandy loam or that are not stony

Use and Management

Pasture

Major management factors: Stones, seasonal high water table
• Most areas are wooded, but some areas are used as unimproved pasture (fig. 8).
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

387—Roliss loam, depressional

Composition

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

Setting

Landform and position on the landform: Depressions and drainageways on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Elongated or irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 7 inches—black loam
7 to 10 inches—dark grayish brown, mottled loam
10 to 60 inches—light brownish gray, mottled loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow or moderate
Available water capacity: High
Content of organic matter: Moderate or high
Surface runoff: Very slow or ponded
Seasonal high water table: 0.5 foot above to 3.0 feet below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Clearwater soils, which are in the slightly higher plane areas
• The very poorly drained Haug soils, which are in landscape positions similar to those of the Roliss soil and have a thinner organic layer

Similar soils:
• Soils that have a surface layer of clay loam
• Soils that have silty sediments in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Some areas have been drained and are used for farming.
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.

Figure 8.—An area of Percy loam, very stony, used as pasture.

• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

404—Chilgren fine sandy loam

Composition

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

Setting

Landform and position on the landform: Slight depressions on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 3 inches—very dark gray fine sandy loam
3 to 8 inches—grayish brown, mottled loamy fine sand
8 to 14 inches—grayish brown, mottled loam
14 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate

Available water capacity: High
Content of organic matter: Moderate or moderately low
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained Clearwater soils, which are on broad flats and contain more clay than the Chilgren soil
• The moderately well drained Garnes soils, which are in the higher landscape positions
• The very poorly drained Haug soils, which are in small depressions

Similar soils:
• Soils that have a surface layer of sandy loam or loam
• Soils that have a thicker and darker surface layer
• Soils that have a thick sandy mantle overlying loamy material

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
• The principal tree species are quaking aspen and balsam poplar. Balsam fir, black ash, and white spruce are species of limited extent.
• Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• The seedling mortality rate is moderate because of wetness, and special planting stock or site preparation may be needed.
• The effective rooting depth is restricted during periods of prolonged wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to maintain tilth.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 6W

425—Donaldson loamy very fine sand

Composition

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

Setting

Landform and position on the landform: Convex rises on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Elongated or irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 10 inches—very dark gray loamy very fine sand
10 to 20 inches—dark grayish brown, mottled very fine sand
20 to 38 inches—light brownish gray, mottled, calcareous very fine sand
38 to 54 inches—light brownish gray, mottled, calcareous silty clay loam
54 to 60 inches—olive gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; slow in the lower part
Available water capacity: High
Content of organic matter: Moderate or high
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Augsburg soils, which are in the lower landscape positions
• The poorly drained Clearwater soils, which are in the lower landscape positions and do not have a sandy mantle
• The poorly drained Wabanica soils, which are in the lower landscape positions and contain more silt than the Donaldson soil

Similar soils:
• Soils that have a surface layer of very fine sandy loam
• Soils that have a sandy mantle more than 40 inches thick or less than 20 inches thick

Use and Management

Cropland, pasture, and forage

Major management factors: Soil blowing
• Maintaining crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Applying fertilizer, using proper stocking rates, and

rotating pastures help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: Not assigned

432—Strandquist sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave areas on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 8 to 150 acres

Typical Profile

0 to 8 inches—very dark brown, calcareous sandy loam
8 to 14 inches—grayish brown, calcareous very gravelly sand
14 to 36 inches—grayish brown, calcareous very gravelly coarse sand
36 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Rapid in the upper part; moderate in the lower part
Available water capacity: Moderate
Content of organic matter: High or moderate
Surface runoff: Slow
Depth to the water table: 0.5 foot to 3.0 feet

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Cormant soils, which are in depressions
• The poorly drained Kratka soils, which are in landscape positions similar to those of the Strandquist soil but do not have gravel in the upper part
• The moderately well drained Pelan soils, which are on slightly convex rises

Similar soils:
• Soils that have a surface layer of fine sandy loam or loam
• Soils that have a gravelly mantle more than 40 inches thick

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to maintain tilth.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: Not assigned

458B—Menahga loamy sand, 0 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Old glacial beaches on outwash plains
Shape of areas: Long and narrow
Size of areas: 20 to 200 acres

Typical Profile

2 inches to 0—partially decomposed forest litter
0 to 3 inches—very dark grayish brown loamy sand
3 to 16 inches—brown sand
16 to 32 inches—yellowish brown sand
32 to 50 inches—light yellowish brown sand
50 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Moderately low or low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Marquette soils, which are in landscape positions similar to those of the Menahga soil and contain more gravel
• The somewhat poorly drained Meehan soils, which are in the lower landscape positions

Similar soils:
• Soils that have a surface layer of sand

• Soils that have lenses of gravel or fine sand in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality

• The principal tree species is jack pine. Red pine, quaking aspen, paper birch, and balsam fir are species of limited extent.
• Special planning, design, or maintenance is needed to overcome the equipment limitations.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• If the soil is dry, poor traction interferes with site preparation, the use of wheeled logging equipment in logging areas and on skid trails, and the use of planting equipment.
• Site preparation methods that leave the surface layer relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
• The seedling mortality rate is moderate because of the droughty soil conditions during periods of low rainfall. Using containerized stock or special planting stock that is larger than usual reduces the seedling mortality rate.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing, organic matter content

• Crops and forage plants that can tolerate drought are the best suited.
• Maintaining crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 8S

481—Kratka fine sandy loam

Composition

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

Setting

Landform and position on the landform: Depressions on glacial lake plains or moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 9 inches—black fine sandy loam
9 to 12 inches—dark grayish brown, mottled loamy fine sand
12 to 25 inches—pale brown, mottled fine sand
25 to 60 inches—light brownish gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Rapid in the upper part; moderately slow or moderate in the lower part
Available water capacity: Moderate
Content of organic matter: High or moderate
Surface runoff: Slow
Depth to the water table: 0.5 foot to 3.0 feet

Inclusions

Contrasting inclusions:

• The moderately well drained Enstrom soils, which are on convex rises
• The very poorly drained Northwood soils, which are in small depressions or along margins of bogs

Similar soils:

• Soils that have a surface layer of loamy sand, loamy fine sand, or sandy loam
• Soils that have a sandy mantle more than 40 inches thick or less than 20 inches thick

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table

• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to maintain tilth.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: Not assigned

482—Grygla loamy fine sand

Composition

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

Setting

Landform and position on the landform: Slightly concave areas and drainageways on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 6 inches—black loamy fine sand
6 to 12 inches—grayish brown, mottled fine sand
12 to 21 inches—light brownish gray, mottled fine sand
21 to 60 inches—light brownish gray, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained and poorly drained
Permeability: Rapid in the upper part; moderately slow or moderate in the lower part
Available water capacity: High
Content of organic matter: Moderate or moderately low
Surface runoff: Slow
Depth to the water table: 0.5 foot to 2.0 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Enstrom soils, which are on convex rises

Similar soils:
• Soils that have a surface layer of sand, fine sand, or loamy sand
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that have more clayey sediments in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are quaking aspen and balsam poplar. Balsam fir, white spruce, and black ash are species of limited extent.
• Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Because of the high water table, special planting stock or site preparation may be needed to minimize seedling mortality.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas helps to minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Soil blowing, seasonal high water table
• In areas that have been drained, leaving the surface rough and covered with plant residue can minimize soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVw
Woodland ordination symbol: 6W

514—Tacoosh muck

Composition

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

Setting

Landform and position on the landform: Small depressions and margins of bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 250 acres

Typical Profile

0 to 6 inches—black muck
6 to 19 inches—very dark brown mucky peat
19 to 36 inches—very dark grayish brown mucky peat
36 to 38 inches—black, calcareous loam
38 to 42 inches—dark grayish brown, mottled, calcareous loam
42 to 60 inches—light brownish gray, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid or moderate in the upper part; moderate or moderately slow in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Haug soils, which are on slight island rises and contain more mineral soil material than the Tacoosh soil
• Very poorly drained soils that are in the center of depressions and have more than 51 inches of organic material

Similar soils:
• Soils that contain more sand

Use and Management

Pasture and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas of this soil support native vegetation, which consists of water-tolerant species.
• Outlets and surface drains are needed in areas used for crops.
• In drained areas, maintaining plant residue on the surface helps to control soil blowing.
• Wild rice can be grown if sufficient water is available for flooding paddies.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

532—Sago muck

Composition

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

Setting

Landform and position on the landform: Depressions on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Round or irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 13 inches—very dark brown muck
13 to 19 inches—dark grayish brown very fine sandy loam
19 to 28 inches—light brownish gray, mottled loamy very fine sand
28 to 60 inches—light brownish gray, mottled silt loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Zippel soils, which are in the slightly higher positions and formed entirely in silty material

Similar soils:
• Soils that have an organic surface layer more than 16 inches thick or less than 8 inches thick

Use and Management

Pasture and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas of this soil support native vegetation, which consists of water-tolerant species.
• In drained areas, maintaining plant residue on the surface helps to control soil blowing.
• Wild rice can be grown if sufficient water is available for flooding paddies.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

540—Seelyeville mucky peat

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave bogs on glacial lake plains

Slope range: 0 to 2 percent
Shape of areas: Oblong or round
Size of areas: 40 to 200 acres

Typical Profile

0 to 3 inches—very dark grayish brown mucky peat
3 to 20 inches—very dark grayish brown muck
20 to 60 inches—very dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are at the margins of peatlands adjacent to mineral soils and are underlain by glacial till at a depth of 16 to 51 inches
• The very poorly drained Lupton soils, which are in wooded peatland areas and formed in woody peat

Similar soils:
• Soils that contain more peat

Use and Management

Pasture and forage

Major management factors: Seasonal high water table
• Most areas of this soil support native vegetation, which consists of water-tolerant species.
• Outlets and surface drains are needed in areas used for crops.
• Wild rice can be grown if sufficient water is available for flooding paddies.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

541—Rifle mucky peat

Composition

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

Setting

Landform and position on the landform: Plane bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow or irregular
Size of areas: 50 to more than 200 acres

Typical Profile

0 to 3 inches—dark brown mucky peat
3 to 13 inches—very dark grayish brown mucky peat
13 to 52 inches—dark brown mucky peat
52 to 60 inches—very dark grayish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Greenwood soils, which are in slightly convex positions and have pH of less than 4.5
• The very poorly drained Tacoosh soils, which are at the margins of bogs and are underlain by mineral material between depths of 16 and 51 inches

Similar soils:
• Soils that have more than 10 inches of sapric material in the surface layer and subsurface layer
• Soils that have coprogenous earth at a depth of 10 to 60 inches

Use and Management

Pasture and forage

Major management factors: Seasonal high water table
• Most areas of this soil support native vegetation, which consists of water-tolerant species.
• Outlets and surface drains are needed in areas used for crops.
• Wild rice can be grown if sufficient water is available for flooding paddies.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

543—Markey muck

Composition

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

Setting

Landform and position on the landform: Closed depressions, drainageways, and areas along the margins of large bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to more than 200 acres

Typical Profile

0 to 18 inches—black muck
18 to 26 inches—very dark brown muck
26 to 28 inches—very dark gray muck
28 to 32 inches—gray sand
32 to 60 inches—grayish brown sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; rapid in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Cormant soils, which are on small islands
• The very poorly drained Leafriver soils, which are at the edges of bogs and formed in thinner organic material than the Markey soil

Similar soils:
• Soils that have gravel in the underlying material
• Soils that have more than 51 inches of organic material

Use and Management

Pasture and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas of this soil support native vegetation, which consists of water-tolerant species.
• In areas that have been drained, maintaining plant residue on the surface helps to control soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

544—Cathro muck

Composition

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

Setting

Landform and position on the landform: Drainageways, small depressions, and the outer margins of large bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 250 acres

Typical Profile

0 to 12 inches—dark reddish brown muck
12 to 25 inches—black muck
25 to 28 inches—black silty clay loam
28 to 40 inches—dark gray, mottled silty clay loam
40 to 60 inches—light brownish gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; moderately slow or moderate in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren soils, which are on level uplands and are loamy throughout
• The very poorly drained and poorly drained Grygla soils, which are in landscape positions similar to those

of the Cathro soil and have sandy sediments overlying loamy material

Similar soils:
- Soils that have a surface layer of mucky peat
- Soils that have organic material less than 16 inches thick or more than 51 inches thick
- Soils that have more clay in the underlying material

Use and Management

Pasture and forage

Major management factors: Soil blowing, seasonal high water table
- Most areas of this soil support native vegetation, which consists of water-tolerant species.
- In drained areas, maintaining crop residue on the surface helps to control soil blowing.
- Water-tolerant forage species should be selected for planting.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

- Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

546—Lupton mucky peat

Composition

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

Setting

Landform and position on the landform: Deep, woody swamps on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 50 to more than 200 acres

Typical Profile

0 to 8 inches—black mucky peat
8 to 18 inches—black muck
18 to 48 inches—dark reddish brown muck
48 to 60 inches—very dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow
Seasonal high water table: At the surface to 1 foot below the surface

Inclusions

Contrasting inclusions:
- The very poorly drained Bullwinkle soils, which are at the edges of swamps and are underlain by glacial till at a depth of less than 51 inches
- The very poorly drained Seelyeville soils, which are in depressions and flowage channels and formed in herbaceous peat

Similar soils:
- Soils that have a thick surface layer of sphagnum

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
- The principal tree species are black spruce and tamarack. Northern whitecedar is a species of limited extent.
- Regardless of moisture content, the soil has low strength and can support equipment only when sufficiently frozen.
- In some years an insulating snow cover prevents adequate freezing.
- Logging activities should be conducted during the winter.
- Maintaining living moss on the seedbed can reduce the seedling mortality rate.
- The effective rooting depth is limited during prolonged periods of wetness.
- Carefully planning cutting areas can minimize the damage caused by windthrow.

Pasture and forage

Major management factors: Seasonal high water table
- Most areas of this soil support native vegetation, which consists of water-tolerant species.
- Outlets and surface drains are needed in areas used for crops.
- Wild rice can be grown if sufficient water is available for flooding paddies.
- Water-tolerant forage species should be selected for planting.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: 3W

549—Greenwood peat

Composition

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

Setting

Landform and position on the landform: Large, plane or slightly convex bogs on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Oblong
Size of areas: 80 to 200 acres

Typical Profile

0 to 18 inches—grayish brown peat
18 to 56 inches—dark brown mucky peat
56 to 60 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Rapid in the upper part; moderate or moderately rapid in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow
Seasonal high water table: At the surface to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Lobo soils, which are in the slightly higher, more convex areas of bogs and formed in a thicker layer of sphagnum moss fibers than the Greenwood soil

Similar soils:
• Soils that have 10 to 20 inches of muck within a depth of 51 inches

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are black spruce and tamarack. Northern whitecedar is a species of limited extent.
• Regardless of moisture content, the soil has low strength and can support equipment only when sufficiently frozen.
• In some years an insulating snow cover prevents adequate freezing.
• Logging activities should be conducted during the winter.
• The seedling mortality rate is lowest when the seedbed is covered with living moss.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: 4W

560—Greenwood-Lobo peats

Composition

Greenwood and similar soils: 40 to 60 percent
Lobo and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Greenwood—plane or slightly convex rises in bogs on glacial lake plains; Lobo—slightly raised areas in large bogs on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Oblong or teardrop
Size of areas: 80 to more than 200 acres

Typical Profile

Greenwood

0 to 15 inches—brown peat
15 to 60 inches—dark brown mucky peat

Lobo

0 to 38 inches—dark brown peat
38 to 60 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Rapid in the upper part; moderate or moderately rapid in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow
Seasonal high water table: Greenwood—at the surface to 1 foot below the surface; Lobo—at the surface to 2 feet below the surface

Inclusions

Contrasting inclusions:
• Organic soils that are ponded

Similar soils:
• Soils that have more peat

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are black spruce and tamarack. Northern whitecedar is a species of limited extent.
- Regardless of moisture content, the soils have low strength and can support equipment only when sufficiently frozen.
- In some years an insulating snow cover prevents adequate freezing.
- Logging activities should be conducted during the winter.
- The seedling mortality rate is lowest when the seedbed is covered with living moss.
- The effective rooting depth is restricted during prolonged periods of wetness.
- Carefully planning cutting areas can minimize the damage caused by windthrow.

Habitat for wetland wildlife

- Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: Greenwood—4W; Lobo—2W

563—Northwood muck

Composition

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

Setting

Landform and position on the landform: Shallow bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 9 inches—black muck
9 to 12 inches—black loamy sand
12 to 27 inches—grayish brown, mottled fine sand
27 to 60 inches—light brownish gray, calcareous, mottled clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid or rapid in the upper part; moderate in the lower part
Available water capacity: High
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils, which have a thicker organic surface layer than the Northwood soil
- The very poorly drained and poorly drained Grygla soils, which formed in a sandy mantle underlain by loamy material

Similar soils:

- Soils that have less than 8 inches or more than 16 inches of organic material

Use and Management

Pasture and forage

Major management factors: Soil blowing, seasonal high water table

- Most areas support native vegetation, which consists of water-tolerant species.
- In drained areas, leaving plant residue on the surface helps to control soil blowing.
- Water-tolerant forage species should be selected for planting.
- Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

- Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

565—Eckvoll loamy fine sand

Composition

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

Setting

Landform and position on the landform: Convex rises on till-floored glacial lake plains
Slope range: 0 to 3 percent
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 4 inches—very dark gray loamy fine sand
4 to 7 inches—grayish brown fine sand
7 to 24 inches—brown, mottled fine sand

24 to 28 inches—brown, mottled clay loam
28 to 35 inches—light brownish gray, mottled, calcareous clay loam
35 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; moderate in the lower part
Available water capacity: Moderate
Content of organic matter: Moderate or moderately low
Surface runoff: Slow
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren and Kratka soils, which are in the lower landscape positions
• The very poorly drained and poorly drained Grygla soils, which are in the lower landscape positions

Similar soils:
• Soils that have a surface layer of loamy sand or fine sand
• Soils that have a layer of sand more than 40 inches thick or less than 20 inches thick
• Soils that have more clay in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
• The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, bur oak, jack pine, balsam poplar, and eastern white pine are species of limited extent.
• The soil has low strength, particularly during the spring thaw and for short periods following heavy rains.
• Special planning, design, or maintenance is needed to minimize the effects of low strength in areas used as log landings.
• Adequate site preparation and measures that control competing vegetation are needed.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.

Cropland, pasture, and forage

Major management factors: Soil blowing, available water capacity
• This soil is susceptible to soil blowing and may be droughty during dry periods.
• Maintaining crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 6L

568—Zippel very fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave areas on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 7 inches—black, calcareous very fine sandy loam
7 to 12 inches—dark brownish gray, mottled, calcareous very fine sandy loam
12 to 25 inches—light brownish gray, mottled, calcareous very fine sandy loam
25 to 27 inches—light brownish gray, mottled, calcareous silt loam
27 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid
Available water capacity: High
Content of organic matter: Moderate or high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Cormant soils, which are in landscape positions similar to those of the Zippel soil and have more sand
• The somewhat poorly drained Redby soils on convex rises
• The very poorly drained Sago soils, which are in depressions

Similar soils:
• Soils that have a surface layer of silt loam or loamy very fine sand
• Soils that have more clay in the underlying material

• Soils that are not calcareous at a depth of 10 to 20 inches

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain, potatoes, grasses for seed, and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

569—Wabanica silt loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave areas on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 8 inches—black, calcareous silt loam
8 to 11 inches—dark gray, mottled, calcareous silt loam
11 to 39 inches—grayish brown, mottled, calcareous silt loam
39 to 60 inches—light brownish gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained Clearwater soils, which are in landscape positions similar to those of the Wabanica soil and contain more clay
• The very poorly drained Roliss and Sago soils, which are in depressions

Similar soils:
• Soils that have a surface layer of silty clay loam, loam, or clay loam
• Soils that have more sand throughout
• Soils having layers that are not calcareous at a depth of 10 to 20 inches

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain, grasses for seed, and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

570—Faunce fine sand

Composition

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

Setting

Landform and position on the landform: Adjacent to glacial lake beach ridges on glacial lake plains
Slope range: 0 to 4 percent
Shape of areas: Elongated
Size of areas: 10 to 40 acres

Typical Profile

0 to 3 inches—very dark grayish brown fine sand
3 to 11 inches—yellowish brown fine sand
11 to 14 inches—strong brown sand
14 to 20 inches—yellowish brown sand and dark yellowish brown gravelly loamy coarse sand
20 to 28 inches—light yellowish brown, calcareous gravelly sand
28 to 35 inches—very pale brown, calcareous sand
35 to 60 inches—pale brown, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Hiwood and Karlstad soils, which are in the slightly lower areas
• The somewhat excessively drained Marquette soils, which are in the slightly higher, more convex areas

Similar soils:
• Soils that have a surface layer of loamy fine sand, loamy sand, or sand

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality
• The principal tree species is jack pine. Red pine, quaking aspen, paper birch, and balsam fir are species of limited extent.
• Special planning, design, or maintenance is needed to overcome the equipment limitations.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• If the soil is dry, poor traction interferes with site preparation, the use of wheeled logging equipment in logging areas and on skid trails, and the use of planting equipment.
• Site preparation methods that leave the surface layer relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
• The seedling mortality rate is moderate because of the droughty soil conditions during periods of low rainfall. Using containerized stock or special planting stock that is larger than usual reduces the seedling mortality rate.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing, organic matter content
• Crops and forage plants that can tolerate drought are the best suited.
• Maintaining crop residue on the surface helps to control soil blowing and conserves soil moisture.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 7S

581—Percy fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave basins on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

0 to 8 inches—black, calcareous fine sandy loam
8 to 11 inches—dark grayish brown, mottled, calcareous fine sandy loam
11 to 15 inches—light brownish gray, mottled, calcareous fine sandy loam
15 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: High or very high
Surface runoff: Very slow
Depth to the water table: 0.5 foot to 3.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Clearwater soils, which are in landscape positions similar to those of the Percy soil and have more clay
• The moderately well drained Garnes soils, which are on slight rises
• The very poorly drained Haug soils, which are in small depressions

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

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided (fig. 9).
• Restricting use during wet periods helps to maintain tilth.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

Figure 9.—Bluegrass in an area of Percy fine sandy loam. Bluegrass seed is an important crop in the survey area.

582—Roliss clay loam

Composition

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

Setting

Landform and position on the landform: Slight depressions on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 9 inches—black, calcareous clay loam
9 to 15 inches—grayish brown, mottled, calcareous clay loam
15 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately slow or moderate
Available water capacity: High
Content of organic matter: Moderate or high
Surface runoff: Very slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- The poorly drained Boash soils, which are in landscape positions similar to those of the Roliss soil and have a clay mantle 12 inches or more thick overlying loamy glacial till
- The poorly drained Clearwater soils, which are in landscape positions similar to those of the Roliss soil and have more clay throughout
- Areas of very poorly drained Roliss soils in small swales and drainageways

Similar soils:
- Soils that have a surface layer of loam or silty clay loam

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain, grasses for seed, and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

616—Effie loam

Composition

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

Setting

Landform and position on the landform: Convex areas on glacial till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 800 acres

Typical Profile

0 to 6 inches—very dark gray loam
6 to 14 inches—olive gray, mottled clay
14 to 20 inches—light brownish gray, mottled, calcareous silty clay loam
20 to 40 inches—light brownish gray, mottled, calcareous clay loam
40 to 50 inches—olive gray, mottled, calcareous clay loam
50 to 60 inches—grayish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: High
Content of organic matter: Moderately low or moderate
Surface runoff: Slow or very slow
Depth to the water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:
• The poorly drained Boash soils, which are in landscape positions similar to those of the Effie soil and have a clayey mantle overlying loamy material
• The moderately well drained Suomi soils, which are on convex rises

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

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are quaking aspen and balsam poplar. Balsam fir, paper birch, black ash, and white spruce are species of limited extent.
• Wetness and the content of clay in the soil restrict the use of wheeled logging equipment.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Site preparation and the use of planting equipment are limited by wetness and the content of clay in the soil.
• Site preparation or the use of special planting stock can minimize seedling mortality.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 7W

626—Suomi loam, 1 to 4 percent slopes

Composition

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

Setting

Landform and position on the landform: Convex rises on glacial moraines
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 4 inches—very dark brown loam
4 to 8 inches—brown, mottled sandy loam
8 to 15 inches—dark yellowish brown, mottled clay loam

15 to 20 inches—yellowish brown, mottled clay loam
20 to 26 inches—pale brown, mottled, calcareous clay loam
26 to 40 inches—dark grayish brown, mottled, calcareous clay loam
40 to 60 inches—pale brown, mottled clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: High
Content of organic matter: Moderate or moderately low
Surface runoff: Medium or slow
Depth to the water table: 1 to 2 feet

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren and Effie soils, which are in the lower landscape positions

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

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
• The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, red pine, and eastern white pine are species of limited extent.
• Traction is poor for wheeled logging equipment because of the content of clay in the soil, and low strength limits the traffic-supporting capacity.
• The use of equipment is restricted during the spring thaw and for short periods following heavy rains.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Trees commonly are susceptible to damage caused by windthrow if the soil is excessively wet and winds are strong.

Cropland, pasture, and forage

Major management factors: Water erosion
• Using minimum tillage or planting a close-growing cover crop can reduce the hazard of water erosion.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7W

627—Tawas muck

Composition

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

Setting

Landform and position on the landform: Concave basins and the margins of large bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 50 to more than 200 acres

Typical Profile

0 to 33 inches—very dark brown muck
33 to 36 inches—black muck
36 to 60 inches—light brownish gray fine sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; rapid in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow
Seasonal high water table: At the surface to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Bullwinkle soils, which are in landscape positions similar to those of the Tawas soil and have loamy underlying material
• The very poorly drained Cathro soils, which are in landscape positions similar to those of the Tawas soil and have loamy underlying material
• The very poorly drained and poorly drained Cormant soils, which are in the slightly higher landscape positions

Similar soils:
• Soils that contain fibers derived primarily from herbaceous plants
• Soils that have organic layers less than 16 inches thick or more than 51 inches thick

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are black spruce and tamarack. Northern whitecedar is a species of limited extent.
• Regardless of moisture content, the soil has low strength and can support equipment only when sufficiently frozen.

• In some years an insulating snow cover prevents adequate freezing.
• Logging activities should be conducted in winter.
• The seedling mortality rate is lowest when the seedbed is covered with living moss.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Pasture and forage

Major management factors: Seasonal high water table
• Most areas support native vegetation, which consists of water-tolerant species.
• Outlets and surface drains are needed in areas used for crops.
• Wild rice can be grown if sufficient water is available for flooding paddies.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 3W

630—Wildwood mucky peat

Composition

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

Setting

Landform and position on the landform: Small depressions and concave basins on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Round or irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 6 inches—very dark grayish brown mucky peat
6 to 10 inches—black muck
10 to 12 inches—black silty clay loam
12 to 18 inches—very dark gray clay
18 to 34 inches—dark gray, mottled clay
34 to 60 inches—olive gray, mottled, calcareous clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part; slow in the lower part
Available water capacity: High
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Woodslake soils, which are in landscape positions similar to those of the Wildwood soil, do not have an organic surface layer, and formed entirely in clay

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

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are quaking aspen and balsam poplar. Balsam fir, white spruce, and black ash are species of limited extent.
• Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Because of the high water table, special planting stock or site preparation may be needed to minimize seedling mortality.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Pasture and forage

Major management factors: Seasonal high water table
• Most areas support native vegetation, which consists of water-tolerant species. Some areas have been drained and are used for farming.
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 3W

641—Clearwater clay

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave basins on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 9 inches—black, calcareous clay
9 to 18 inches—dark gray, mottled, calcareous clay
18 to 40 inches—gray, mottled, calcareous clay
40 to 60 inches—light brownish gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: High
Content of organic matter: High or moderate
Surface runoff: Slow or very slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained Percy soils, which are in landscape positions similar to those of the Clearwater soil and contain less clay
• The very poorly drained and poorly drained Roliss soils, which are in landscape positions similar to those of the Clearwater soil and contain less clay
• The moderately well drained Taylor soils, which are on convex rises
• The very poorly drained and poorly drained Woodslake soils, which are in small depressions

Similar soils:
• Soils that have a surface layer of silty clay, silty clay loam, or clay loam
• Soils that have a thin sandy or silty mantle

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

644—Boash clay loam

Composition

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

Setting

Landform and position on the landform: Plane areas on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 7 inches—black, calcareous clay loam
7 to 11 inches—dark gray, mottled, calcareous clay
11 to 15 inches—dark grayish brown, mottled, calcareous clay
15 to 35 inches—gray, mottled, calcareous clay
35 to 60 inches—dark grayish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow in the upper part; moderate in the lower part
Available water capacity: High
Content of organic matter: High or moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained Effie soils, which are in landscape positions similar to those of the Boash soil and do not have a clayey mantle
• The very poorly drained and poorly drained Roliss soils, which are in landscape positions similar to those of the Boash soil and do not have a clayey mantle
• The very poorly drained and poorly drained Woodslake soils, which are in depressions and drainageways

Similar soils:
• Soils that have a surface layer of silty clay loam or clay
• Soils that have a clayey mantle more than 40 inches

thick and are not calcareous within a depth of 20 inches

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: Not assigned

655—Bearville loamy fine sand

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave positions on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 4 inches—black loamy fine sand
4 to 13 inches—light brownish gray, mottled fine sand
13 to 16 inches—dark grayish brown, mottled sandy clay loam
16 to 24 inches—olive gray, mottled clay
24 to 60 inches—olive gray, mottled, calcareous clay

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Rapid in the upper part; moderately slow or slow in the lower part
Available water capacity: Moderate
Content of organic matter: Moderate or moderately low
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Taylor soils, which are on small convex rises bordering major drainageways

Similar soils:
• Soils that have a surface layer of loamy sand, loamy very fine sand, or fine sandy loam
• Soils that have a sandy mantle less than 10 inches thick or more than 20 inches thick

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• Most areas are wooded. The principal tree species are quaking aspen and balsam poplar. Balsam fir, white spruce, and black ash are species of limited extent.
• Wetness limits the use of wheeled logging equipment, especially in the spring and fall.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Because of the high water table, special planting stock or site preparation may be needed to reduce the seedling mortality rate.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Soil blowing, seasonal high water table
• In areas used for crops, leaving the surface rough and covered with plant residue or establishing windbreaks can minimize soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 7W

702—Bullwinkle-Cathro mucks

Composition

Bullwinkle and similar soils: 40 to 60 percent
Cathro and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Depressions and the margins of large bogs on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 50 to more than 200 acres

Typical Profile

Bullwinkle

0 to 42 inches—black muck
42 to 44 inches—black sandy loam
44 to 60 inches—gray, calcareous loam

Cathro

0 to 25 inches—black muck
25 to 60 inches—dark gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; moderate or moderately slow in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Very slow
Seasonal high water table: Bullwinkle—at the surface to 1 foot below the surface; Cathro—1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren soils, which are in the slightly higher landscape positions and are loamy throughout
• The very poorly drained and poorly drained Cormant soils, which are in landscape positions similar to those of the Bullwinkle and Cathro soils and are sandy throughout
• The very poorly drained and poorly drained Grygla soils, which are in landscape positions similar to those of the Bullwinkle and Cathro soils and have a sandy mantle underlain by loamy material

Similar soils:
• Soils that have organic material less than 16 inches thick or more than 51 inches thick
• Soils that have a surface layer of mucky peat or contain thick layers of mucky peat

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species are black spruce and tamarack. Northern whitecedar is a species of limited extent.
• Regardless of moisture content, the soil has low strength and can support equipment only when sufficiently frozen.
• In some years an insulating snow cover prevents adequate freezing.
• Logging activities should be conducted in winter.
• The seedling mortality rate is lowest when the seedbed is covered with living moss.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Pasture and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas support native vegetation, which consists of water-tolerant species.
• Outlets and surface drains are needed in areas used for crops.
• In areas that have been drained, leaving plant residue on the surface helps to control soil blowing.
• Wild rice can be grown if sufficient water is available for flooding paddies.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Bullwinkle—3W; Cathro—not assigned

755—Woodslake clay

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave areas on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 7 inches—black clay
7 to 10 inches—dark gray, mottled clay
10 to 19 inches—dark grayish brown, mottled clay
19 to 45 inches—grayish brown, mottled, calcareous clay
45 to 60 inches—gray, mottled, calcareous clay

Soil Properties and Qualities

Drainage class: Very poorly drained and poorly drained
Permeability: Very slow

Available water capacity: Moderate
Content of organic matter: High or moderate
Surface runoff: Very slow or ponded
Seasonal high water table: 0.5 foot above to 1.0 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Clearwater soils, which are in the slightly higher landscape positions and have a thicker dark surface layer than the Woodslake soil
• The poorly drained Indus soils, which are in landscape positions similar to those of the Woodslake soil and have more clay
• The moderately well drained Taylor soils, which are on convex rises

Similar soils:
• Soils that have a surface layer of clay loam or silty clay loam
• Soils that have a thin organic surface layer

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table
• Small grain and grasses and legumes for hay and pasture can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: Not assigned

792—Fordum fine sandy loam

Composition

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

Setting

Landform and position on the landform: Low flood plains
Slope range: 0 to 2 percent
Shape of areas: Elongated
Size of areas: 10 to 200 acres

Typical Profile

0 to 8 inches—very dark brown fine sandy loam
8 to 17 inches—light brownish gray, mottled fine sand
17 to 24 inches—dark gray, mottled silt loam
24 to 39 inches—dark gray, mottled fine sandy loam
39 to 60 inches—dark gray and gray, mottled fine sandy loam, loamy fine sand, and sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate or moderately rapid in the upper part; moderately rapid in the lower part
Available water capacity: Moderate
Content of organic matter: Moderately low to very high
Surface runoff: Slow
Seasonal high water table: At the surface to 1 foot below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• Very poorly drained organic and mineral soils in depressions

Similar soils:
• Soils that have a surface layer of very fine sandy loam, silt loam, or sandy loam

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• Most areas support native vegetation, which consists of sedges, willow, alder, and cattails. Some areas support black ash and elm.
• Seedling mortality is severe because of flooding and seasonal wetness. Planting suitable species reduces the seedling mortality rate.
• Harvesting activities should be conducted during periods when the soil is frozen.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Pasture

Major management factors: Flooding
• The seasonal flooding limits the use of this soil for pasture.

Habitat for wetland wildlife

• Because of the flooding and the seasonal wetness, this soil is best suited to use as habitat for wetland wildlife.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 6W

794—Faunce Variant loamy fine sand

Composition

Faunce Variant and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Slightly convex areas on glacial lake plains
Slope range: 0 to 3 percent
Shape of areas: Elongated
Size of areas: 10 to 200 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy fine sand
3 to 15 inches—brown loamy sand and dark brown coarse sandy loam
15 to 29 inches—light yellowish brown, mottled fine sand
29 to 39 inches—grayish brown, mottled gravelly coarse sand
39 to 46 inches—light brownish gray, calcareous gravelly coarse sand
46 to 60 inches—light brownish gray, calcareous fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Moderately low
Surface runoff: Slow
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:
• The very poorly drained and poorly drained Cormant soils, which are in depressions
• The well drained Faunce soils, which are in the slightly higher convex areas
• The moderately well drained Karlstad soils, which are in landscape positions similar to those of the Faunce Variant soil and have more clay in the subsoil

Similar soils:
• Soils that have a surface layer of loamy sand, fine sand, or sand
• Soils that do not have gravelly sediments in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality
• The principal tree species is jack pine. Red pine, quaking aspen, paper birch, and balsam fir are species of limited extent.
• Special planning, design, or maintenance is needed to overcome the equipment limitations.
• The sandy texture of the soil limits trafficability on log landings and haul roads.
• If the soil is dry, poor traction interferes with site preparation, the use of wheeled logging equipment in logging areas and on skid trails, and the use of planting equipment.
• Site preparation methods that leave the surface layer relatively intact, such as furrowing, scarification, roller chopping, or winter sheering, should be used.
• The seedling mortality rate is moderate because of the droughty soil conditions during periods of low rainfall. Using containerized stock or special planting stock that is larger than usual reduces the seedling mortality rate.

Cropland, pasture, and forage

Major management factors: Available water capacity, soil blowing, organic matter content
• Crops and forage plants that can tolerate drought are the best suited.
• Maintaining crop residue on the surface helps to control soil blowing and conserves moisture.
• Incorporating crop residue into the surface layer helps to maintain tilth and increases the content of organic matter.
• Planting grasses and legumes that can tolerate drought helps to maximize yields of forage and hay crops.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during dry periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 5S

828D—Insula-Mesaba gravelly loams, 2 to 30 percent slopes

Composition

Insula and similar soils: 45 to 65 percent
Mesaba and similar soils: 25 to 40 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes of hills on uplands (fig. 10)
Shape of areas: Irregular
Size of areas: 40 to 500 acres

Typical Profile

Insula

2 inches to 0—partially decomposed leaf litter
0 to 3 inches—dark grayish brown gravelly loam
3 to 11 inches—dark brown very gravelly loam
11 inches—granite bedrock

Mesaba

3 inches to 0—partially decomposed forest litter

Figure 10.—An area of Insula-Mesaba gravelly loams, 2 to 30 percent slopes, on Oak Island.

0 to 14 inches—dark brown gravelly loam
14 to 22 inches—very cobbly coarse sandy loam
22 inches—granite bedrock

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid
Available water capacity: Insula—very low; Mesaba—low
Content of organic matter: Insula—moderately low or moderate; Mesaba—very low
Surface runoff: Rapid or medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Quetico soils, which are in landscape positions similar to those of the Insula and Mesaba soils and are very shallow over bedrock

Similar soils:
• Soils that have a surface layer of cobbly loam or loam

Use and Management

Woodland

Major management factors: Erosion, equipment limitations, seedling mortality, windthrow
• The principal tree species are balsam fir, northern whitecedar, paper birch, and red pine.
• Establishing logging roads and skid roads in the less sloping areas or diagonally across side slopes can minimize water erosion.
• The slope hinders the use of wheeled and tracked equipment.
• The seedling mortality rate is moderate in areas of the Insula soil because of the shallow depth to bedrock, but the mortality rate can be reduced by using special planting stock or containerized seedlings.
• Trees growing in areas of these soils are shallow rooted because of the depth to bedrock, and many trees are blown down during periods of high winds and excessive wetness.

Cropland, hay, and pasture

• These soils are generally not used for crops, hay, or pasture because of the depth to bedrock and the slope.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 6R

952E—Quetico-Rock outcrop complex, 6 to 35 percent slopes

Composition

Quetico and similar soils: 40 to 60 percent
Rock outcrop: 35 to 55 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Ridges and side slopes of hills on uplands
Slope range: 6 to 35 percent
Shape of areas: Narrow or irregular
Size of areas: 20 to 100 acres

Typical Profile

Quetico

2 inches to 0—partially decomposed forest litter
0 to 3 inches—dark brown loam
3 to 8 inches—very dark brown loam
8 inches—granite bedrock

Soil Properties and Qualities

Quetico

Drainage class: Somewhat excessively drained
Permeability: Moderate
Available water capacity: Very low
Content of organic matter: Moderate
Surface runoff: Rapid or medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Insula and Mesaba soils, which have bedrock at a depth of 20 to 40 inches

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

Use and Management

Woodland

Major management factors: Erosion, equipment limitations, seedling mortality, windthrow
• The principal tree species are eastern white pine, jack pine, white spruce, balsam fir, northern whitecedar, quaking aspen, and paper birch.
• Establishing logging roads and skid roads in the less sloping areas or diagonally across side slopes can minimize water erosion.
• The slope hinders the use of wheeled and tracked equipment.
• The seedling mortality rate is moderate in areas of the Quetico soil because of the shallow depth to bedrock. Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
• Trees growing in areas of the Quetico soil are shallow rooted because of the depth to bedrock, and many trees are blown down during periods of high winds and excessive wetness.

Cropland, hay, and pasture

• Areas of this map unit are generally not used for crops, hay, or pasture because of the depth to bedrock and the slope.

Interpretive Groups

Land capability classification: Quetico—VIIs; Rock outcrop—not assigned
Woodland ordination symbol: Quetico—2R; Rock outcrop—not assigned

1030—Udorthents-Pits, gravel, complex

Setting

Landform and position on the landform: Beach ridges

Inclusions

Contrasting inclusions:
• Epoufette, Faunce, Karlstad, Pelan, and Marquette soils on scattered beach ridges

Description

• This map unit consists of areas that have been excavated for gravel. The coarser, gravelly materials have been removed from these areas, leaving open pits. The surface layer has been stripped from the surrounding soils and has been deposited around the edges of the gravel pits.
• The size and shape of the pits are determined by the quality and quantity of gravel materials at each site.
• Many gravel pits are ponded, especially the deeper, abandoned ones.
• No interpretive groups are assigned.

1033—Beaches-Menahga complex

Composition

Beaches: 50 to 70 percent
Menahga and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Outwash plains adjacent to Lake of the Woods
Slope range: Menahga—1 to 18 percent
Shape of areas: Irregular
Size of areas: More than 200 acres

Typical Profile

Menahga

0 to 8 inches—dark grayish brown loamy sand
8 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Menahga

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Content of organic matter: Low or moderately low
Surface runoff: Medium or rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in depressions
Similar soils:
• Soils that have a surface layer of sandy loam

Use and Management

• Because this map unit is adjacent to Lake of the Woods, most areas are used primarily as habitat for wildlife.
• The Beaches consist of sand that is frequently washed by wave action. They do not support vegetation.

Interpretive Groups

Land capability classification: Beaches—not assigned; Menahga—IVs
Woodland ordination symbol: Not assigned

1059—Wega silt loam

Composition

Wega and similar soils: 80 to 85 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: The higher flood plains
Slope range: 0 to 3 percent
Shape of areas: Elongated
Size of areas: 40 to 300 acres

Typical Profile

0 to 8 inches—very dark grayish brown silt loam
8 to 14 inches—dark grayish brown silt loam
14 to 19 inches—brown silt loam
19 to 24 inches—brown very fine sandy loam
24 to 54 inches—brown and grayish brown, mottled, calcareous, stratified very fine sandy loam, loamy very fine sand, silt, and silt loam
54 to 60 inches—yellowish brown, mottled, calcareous, stratified silt and silt loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate
Available water capacity: Moderate
Content of organic matter: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet
Frequency of flooding: Rare

Inclusions

Contrasting inclusions:
• The poorly drained Waupaca soils, which are in the lower areas
Similar soils:
• Soils that have a surface layer of loam or very fine sandy loam
• Soils that are marshy, are in oxbows, or are subject to occasional flooding

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
• The principal tree species are black ash and quaking aspen. Balsam poplar, bur oak, silver maple, and basswood are species of limited extent.
• Wetness restricts the use of wheeled logging equipment, especially in the spring and fall.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• The seedling mortality rate is moderate because of wetness, and special planting stock or site preparation may be needed.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.

Cropland, pasture, and forage

Major management factors: Wetness, flooding
• This soil is subject to rare flooding (fig. 11).
• Most crops and forage plants can be grown if adequate drainage is provided.
• Restricting use during wet periods helps to prevent compaction and maintain tilth.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 5W

Figure 11.—A flooded area of Wega silt loam on the flood plain along the Rapid River.

1066—Rock outcrop-Garnes complex, very stony

Composition

Rock outcrop: 50 to 60 percent
Garnes and similar soils: 35 to 40 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Garnes—low ridges and convex rises on glacial lake plains
Slope range: Garnes—0 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Garnes

0 to 3 inches—very dark brown loam
3 to 5 inches—grayish brown sandy loam
5 to 9 inches—brown clay loam
9 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Garnes

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: Moderately low or low
Surface runoff: Medium
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Percy soils, which are in the lower areas and are stony

• The moderately well drained Pelan soils, which are in landscape positions similar to those of the Garnes soil and have a sandy mantle
• The somewhat excessively drained Quetico soils, which are in landscape positions similar to those of the Garnes soil, are loamy, and are shallow over bedrock

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

Use and Management

Woodland

Major management factors: Equipment limitations
• The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, bur oak, jack pine, balsam poplar, and eastern white pine are species of limited extent.
• Because the Garnes soil has low strength, particularly during the spring thaw and for short periods following heavy rains, log landings require special planning, design, or maintenance.
• Adequate site preparation and measures that control competing vegetation are needed.
• Using equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• Rock outcrops and surface stones hinder harvesting operations.

Pasture

Major management factors: Rock outcrops
• The Garnes soil is generally not used for crops or hay because of the rock outcrops. Some areas are used as unimproved pasture.
• Proper stocking rates and pasture rotation help to keep pastures in good condition.

Interpretive Groups

Land capability classification: Rock outcrop—not assigned; Garnes—VIs
Woodland ordination symbol: Rock outcrop—not assigned; Garnes—7L

1067—Waupaca-Eutroboralfs complex, 0 to 60 percent slopes

Composition

Waupaca and similar soils: 50 to 60 percent
Eutroboralfs: 35 to 45 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Low flood plains and adjacent river escarpments
Slope range: Waupaca—0 to 2 percent; Eutroboralfs—12 to 60 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Waupaca

0 to 8 inches—black very fine sandy loam
8 to 16 inches—dark grayish brown very fine sand
16 to 21 inches—dark grayish brown, mottled silt loam
21 to 60 inches—light brownish gray and grayish brown, mottled, calcareous, stratified silt, silt loam, and very fine sand

Eutroboralfs

• Eutroboralfs commonly are sandy loam, clay loam, silt loam, or loam. They have short, steep slopes that range from 50 to 200 feet in length.

Soil Properties and Qualities

Waupaca

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: Moderate
Content of organic matter: Moderate
Surface runoff: Very slow
Seasonal high water table: At the surface to 1 foot below the surface
Frequency of flooding: Occasional

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in depressions

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

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• Most areas are wooded. Areas of these soils are generally not used for crops or pasture because of the slope and the hazard of flooding.
• Wetness is the major limitation affecting logging in areas of the Waupaca soil, especially in the spring.
• The principal tree species are black ash, elm, and quaking aspen. Balsam poplar, bur oak, silver maple, and basswood are species of limited extent.
• Logging activities should be conducted in winter when the ground is frozen or during dry periods in summer.
• Special planting stock or site preparation may be needed to reduce the seedling mortality rate.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the

damage caused by windthrow.

Interpretive Groups

Land capability classification: Waupaca—VIw; Eutroboralfs—not assigned
Woodland ordination symbol: Waupaca—3W; Eutroboralfs—not assigned

1807—Cathro muck, ponded

Composition

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

Setting

Landform and position on the landform: Drainageways, closed depressions, and margins of lakes on glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Oblong or irregular
Size of areas: 40 to more than 200 acres

Typical Profile

0 to 21 inches—black muck
21 to 27 inches—dark gray, mottled silt loam
27 to 60 inches—gray, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• Very poorly drained, very deep organic soils that are near the center of depressions

Similar soils:
• Soils that contain more peat

Use and Management

Habitat for wetland wildlife

• This soil is used only as habitat for wetland wildlife because of the ponding and a general lack of suitable drainage outlets.
• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIIIw
Woodland ordination symbol: Not assigned

1808—Markey muck, ponded

Composition

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

Setting

Landform and position on the landform: Drainageways and small depressions on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 200 acres

Typical Profile

0 to 28 inches—black muck
28 to 60 inches—light brownish gray, mottled fine sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; rapid in the lower part
Available water capacity: Very high
Content of organic matter: Very high
Surface runoff: Ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• Very poorly drained, very deep organic soils that are near the center of depressions

Similar soils:
• Soils that contain more peat

Use and Management

Habitat for wetland wildlife

• This soil is used only as habitat for wetland wildlife because of the ponding and a general lack of suitable drainage outlets.
• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIIIw
Woodland ordination symbol: Not assigned

1923—Garnes loam, very stony

Composition

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

Setting

Landform and position on the landform: Slightly convex rises on glacial lake plains
Slope range: 0 to 4 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—very dark brown loam
3 to 5 inches—grayish brown sandy loam
5 to 9 inches—brown clay loam
9 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Content of organic matter: Moderately low or low
Surface runoff: Medium
Depth to the water table: 2.5 to 6.0 feet
Special characteristics: 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:
• The moderately well drained Percy soils, which are in landscape positions similar to those of the Garnes soil and have a sandy and gravelly surface mantle
• The poorly drained, stony Percy soils, which are in the lower concave or plane landscape positions

Similar soils:
• Soils that have a surface layer of sandy loam or loam
• Soils that are not stony

Use and Management

Woodland

Major management factors: Equipment limitations
• The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, bur oak, jack pine, balsam poplar, and eastern white pine are species of limited extent.
• Stones on the surface hinder logging activities.
• Because the soil has low strength, particularly during the spring thaw and for short periods following heavy rains, log landings require special planning, design, or maintenance.
• Using heavy, wheeled equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 7L

1924—Grygla fine sandy loam, very stony

Composition

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

Setting

Landform and position on the landform: Slightly concave areas on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 6 inches—black fine sandy loam
6 to 20 inches—dark grayish brown, mottled sandy loam
20 to 31 inches—grayish brown, mottled, calcareous sand
31 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Moderate
Content of organic matter: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet
Special characteristics: 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll and Enstrom soils, which are on convex rises
• The very poorly drained Northwood soils, which are in depressions and at the margins of the larger peatlands

Similar soils:
• Soils having a surface layer that is not stony
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow
• The principal tree species is quaking aspen. Paper birch, balsam fir, white spruce, bur oak, jack pine, balsam poplar, and eastern white pine are species of limited extent.
• Stones on the surface hinder logging activities.
• Because the soil has low strength, particularly during the spring thaw and for short periods following heavy

rains, log landings require special planning, design, or maintenance.
• Using heavy wheeled equipment when the soil is wet hinders the reestablishment of trees and can result in mired equipment and excessive compaction.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.
• Using special planting stock or containerized seedlings can increase the seedling survival rate.

Pasture

• Most areas are wooded, but some areas are used as unimproved pasture.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 6X

1925—Eckvoll loamy fine sand, very stony

Composition

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

Setting

Landform and position on the landform: Convex rises on glacial lake plains
Slope range: 0 to 3 percent
Shape of areas: Oblong or irregular
Size of areas: 8 to 100 acres

Typical Profile

0 to 5 inches—very dark brown loamy fine sand
5 to 26 inches—yellowish brown fine sand
26 to 34 inches—dark brown, mottled, calcareous sandy clay loam
34 to 60 inches—grayish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; moderate in the lower part
Available water capacity: Moderate
Content of organic matter: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 2 to 5 feet
Special characteristics: 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren soils, which are in the lower landscape positions

Similar soils:
• Soils having a surface layer that is not stony
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow
• The principal tree species is quaking aspen. Jack pine, bur oak, white spruce, and balsam fir are species of limited extent.
• Because stoniness and low strength hinder logging activities, particularly during the spring thaw and for short periods following heavy rains, log landings require special planning, design, or maintenance.
• The effective rooting depth is restricted during prolonged periods of wetness.
• Carefully planning cutting areas can minimize the damage caused by windthrow.
• Using special planting stock or containerized seedlings can increase the seedling survival rate.

Pasture

Major management factors: Stones, seasonal high water table
• Most areas are wooded, but some areas are used as unimproved pasture.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 6L

1984—Leafriver muck

Composition

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

Setting

Landform and position on the landform: Depressions, narrow drainageways, or margins of bogs on glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 8 to 200 acres

Typical Profile

0 to 6 inches—black muck
6 to 11 inches—very dark brown muck
11 to 16 inches—very dark gray loamy sand
16 to 25 inches—grayish brown fine sand
25 to 60 inches—olive gray, mottled fine sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part; rapid in the lower part
Available water capacity: Moderate
Content of organic matter: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The poorly drained Cormant soils, which are on slight island rises and have more fine sand than the Leafriver soil
• The poorly drained and very poorly drained Grygla soils, which are on slight island rises and formed in sand and glacial till

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

Use and Management

Cropland, pasture, and forage

Major management factors: Soil blowing, seasonal high water table
• Most areas of this soil support native vegetation, which consists of water-tolerant species.
• In areas that have been drained, leaving plant residue on the surface helps to control soil blowing.
• Water-tolerant forage species should be selected for planting.
• Applying fertilizer, using proper stocking rates, rotating pastures, and deferring grazing during wet periods help to keep pastures in good condition.

Habitat for wetland wildlife

• Desired water levels and areas that can provide food and cover for wetland wildlife can be easily maintained.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

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

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

About 178,000 acres in the survey area, or about 21 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern part, mainly in associations 1, 2, and 5, which are described under the heading "General Soil Map Units." Most of the prime farmland is used for crops. The crops grown on this land account for most of the county's total agricultural income each year.

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

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

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

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

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

Grain farming is the main agricultural enterprise in the survey area. Livestock operations are scattered throughout the county, but they are fewer in number than the grain operations. Some farmers raise beef cattle or hogs, and others manage dairy operations. During the period 1978 to 1986, the number of dairy operations in the county increased but the number of other livestock operations decreased slightly (U.S. Department of Commerce, 1984).

The productivity of the soils in the survey area ranges from marginal to high. Wheat, oats, barley, and alfalfa are the main crops, but flax and sunflowers are also grown. Corn is grown for local use as feed grain and silage, but the acreage is small. Specialty crops, such as foundation seed potatoes, timothy for seed and forage, and bluegrass seed, are an important part of the agricultural industry in the survey area. About 91,300 acres, or 11 percent of the total land area, is cropland, and 10,300 acres, or 1 percent, is pasture. During the period 1978 to 1982, the number of farms in the survey area decreased but the average size of the farms increased slightly (U.S. Department of Commerce, 1984).

Soil blowing is a hazard in the survey area because of the nearly level topography. Most soil blowing occurs in areas where the soils are left bare during the winter and spring. Using conservation tillage practices, using a conservation cropping system, rotating crops, using field shelterbelts, and leaving crop residue on the surface help to control soil blowing. Conservation practices in minimum tillage systems include using chisel plows,

disks, and field cultivators. No-till systems can be used for planting small grain.

Wetness is a problem on many of the soils in the survey area. Open ditches are commonly used to remove surface water. Field ditches are used to remove excess water from fields in the spring, which allows for better seedbed preparation and more timely planting. Plants develop better root systems in adequately drained areas than in undrained areas because the movement of air and water in the soil is not restricted. Also, adequately drained soils generally warm up earlier in the spring.

Tilling too frequently or when the soil is too wet or dry damages the soil structure. Frequent tillage results in a powdery surface layer, which does not readily absorb water. Tilling during periods when the soil does not have the proper moisture content results in a cloddy surface layer, which is unsuitable as a seedbed. The soils should be tilled only enough to prepare a good seedbed and to control the growth of weeds.

Applying fertilizer increases crop yields on most of the soils in the survey area. Soil tests are needed to determine the proper amounts of fertilizer. Applications vary, depending upon the type of soil, past management, and nutrient demands of the crops to be grown.

Good pasture management is needed to establish highly productive forage grasses and legumes. Poorly drained soils can support grasses and legumes that are tolerant of wet conditions, such as reed canarygrass, timothy, creeping foxtail, birdsfoot trefoil, red clover, ladino clover, and alsike clover. The better drained soils can support a wider range of forage species, including alfalfa, crownvetch, orchardgrass, and Kentucky bluegrass. Good pasture management includes proper fertilization programs, pasture rotation, proper stocking rates, deferred grazing during wet periods, brush and weed control, and a full-season grazing system.

A full-season grazing system generally includes a combination of cool-season grasses for early and late season grazing and warm-season grasses for grazing during the warmer, drier summer months. Planting cool- and warm-season grasses in different pastures and using a pasture rotation system maximize forage production. Suitable warm-season grasses include big bluestem, indiangrass, switchgrass, little bluestem, and sideoats grama.

Applications of fertilizer should be based on the results of soil tests. Applying fertilizer to cool-season grasses in the spring and late summer promotes vigorous growth during the period when the grasses are most used for grazing. Pasture use can be maximized by rotating pastures, using proper stocking rates, and harvesting excess forage. Deferring grazing helps to maintain stands of legumes and warm-season grasses, minimizes soil compaction, and minimizes damage to growing plants when the soils are wet.

Yields per Acre

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

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

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

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

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

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do

they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes (USDA, 1961).

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate*

indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks are an effective method of controlling soil blowing in the survey area. Soils that have a surface layer of loamy fine sand, fine sand, loamy very fine sand, or fine sandy loam erode easily. Soils that have a surface layer of clay, loam, or silt loam are less affected by wind action, but they are subject to erosion if not protected from the wind.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Much of the survey area is used for recreation. Forest roads and trails provide access to remote locations. Easy access to Lake of the Woods and other water resources is very important to the tourism industry in the area (fig. 12). The survey area has great potential for recreational uses, but the capability of soil resources should be evaluated prior to recreational development.

The soils of the survey area are rated in table 9

Figure 12.—A tourist resort in an area of Baudette fine sandy loam, 1 to 4 percent slopes, along the Rainy River. Tourism is a major industry in the survey area.

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

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning,

design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

There are many types of wildlife habitat in the survey area. In any specific area, the type of habitat and its condition are related to land use, the climate, and the soil. Agriculture and forestry are the two main land uses that affect wildlife habitat in the survey area. The soils can be associated with the vegetation they support and thus with different types of habitat. Habitat types in the survey area include areas that support lowland conifer, lowland brush, open bog-fir, bottom-land hardwood, aspen, mixed coniferous-deciduous, upland conifer, openland, and marsh vegetation.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and

features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are quaking aspen, balsam poplar, paper birch, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, Siberian peashrub, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, and cedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wild rice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include sharp-tailed grouse, meadowlark, field sparrow, cottontail, and red fox.

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

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, sandhill cranes, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution,

liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations

are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit

revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

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

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes

of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material, a high content of stones or boulders, and a high content of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

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

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

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Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

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

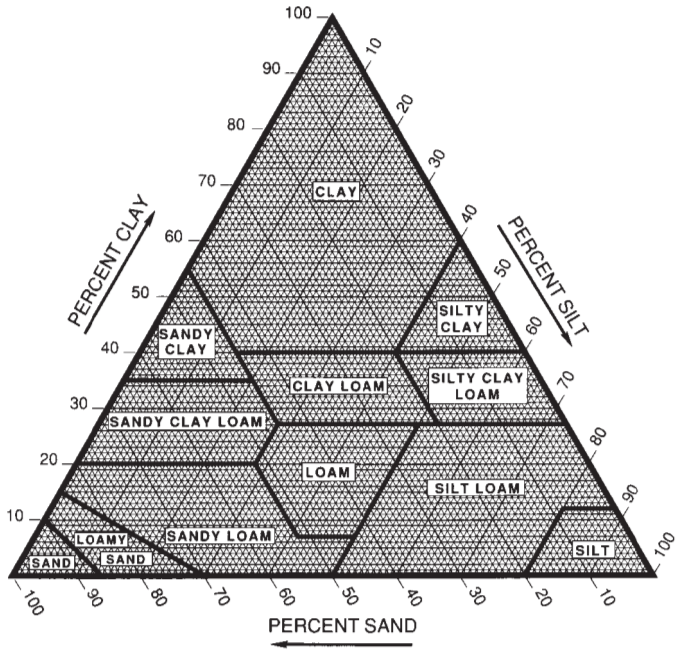

Figure 13.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

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

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

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

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

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for

fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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

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

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

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

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

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

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

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

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

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

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are

the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

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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. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

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

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

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

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

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

The map units of each soil series are described in the section "Detailed Soil Map Units."

Augsburg Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; slow or

very slow in the lower part
Landform: Glacial lake plains
Parent material: Calcareous glaciolacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Coarse-silty over clayey, frigid Typic Calciaquolls

Typical Pedon

Augsburg loam, 1,700 feet west and 200 feet south of the northeast corner of sec. 27, T. 162 N., R. 33 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; firm; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bkg1—8 to 15 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; many medium distinct light yellowish brown (2.5Y 6/4) and few medium prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; lime disseminated throughout; strong effervescence; moderately alkaline; clear smooth boundary.

Bkg2—15 to 22 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; lime disseminated throughout; strong effervescence; moderately alkaline; abrupt wavy boundary.

2Cg1—22 to 30 inches; dark gray (5Y 4/1) clay; few fine distinct gray (2.5Y 6/1) and few fine prominent dark yellowish brown (10YR 4/4) mottles; massive; varved; firm; strong effervescence; moderately alkaline; gradual wavy boundary.

2Cg2—30 to 60 inches; olive gray (5Y 5/2) clay; many fine prominent brownish yellow (10YR 6/8) and strong brown (7.5YR 5/6) mottles; massive; varved; firm; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 11 inches
Depth to the 2C horizon: 20 to 40 inches
Other features: A Cg horizon in some pedons

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

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

2C horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam

Baudette Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Glacial lake plains
Parent material: Calcareous glaciolacustrine sediments
Slope range: 1 to 4 percent
Taxonomic class: Fine-silty, mixed Aquic Eutroboralfs

Typical Pedon

Baudette fine sandy loam, 1 to 4 percent slopes, 1,100 feet west and 2,000 feet north of the southeast corner of sec. 2, T. 160 N., R. 32 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; very friable; neutral; abrupt smooth boundary.

E—6 to 12 inches; brown (10YR 5/3) fine sandy loam; weak fine granular structure; very friable; neutral; clear smooth boundary.

Bt—12 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; strong medium angular blocky structure; firm; many distinct brown (10YR 4/3) clay films on faces of peds and in pores; neutral; clear smooth boundary.

BC—19 to 26 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—26 to 41 inches; light olive brown (2.5Y 5/4) silt loam; few fine distinct light gray (2.5Y 7/2) and dark yellowish brown (10YR 4/6) mottles; massive; varved; very friable; few white (10YR 8/2), soft accumulations of carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—41 to 60 inches; light olive brown (2.5Y 5/4) silt loam; common fine distinct light gray (2.5Y 7/2) and few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; varved; very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 36 inches
Other features: An A horizon in some pedons

Ap horizon:
Hue—10YR
Value—3 to 5
Chroma—1 or 2

Texture—fine sandy loam

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—fine sandy loam, very fine sandy loam, loam, or silt loam

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

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

Bearville Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Rapid in the upper part; moderately slow or slow in the lower part
Landform: Glacial lake plains
Parent material: Sandy sediments overlying loamy and clayey sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy over clayey, mixed, frigid Typic Ochraqualfs

Typical Pedon

Bearville loamy fine sand, 25 feet north and 50 feet west of the southeast corner of sec. 20, T. 162 N., R. 32 W.

A—0 to 4 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; neutral; clear wavy boundary.

E—4 to 13 inches; light brownish gray (2.5Y 6/2) fine sand; common medium prominent strong brown (7.5YR 5/6) mottles; single grain; loose; neutral; abrupt smooth boundary.

Btg1—13 to 16 inches; dark grayish brown (10YR 4/2) sandy clay loam; many medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; friable; few faint dark brown (10YR 4/3) clay films on faces of peds; neutral; clear smooth boundary.

2Btg2—16 to 24 inches; olive gray (5Y 4/2) clay; common fine prominent yellowish brown (10YR 5/6) mottles; strong very fine angular blocky structure; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear smooth boundary.

2Cg—24 to 60 inches; olive gray (5Y 5/2) clay; common fine prominent dark yellowish brown (10YR 4/4) and common fine faint light olive gray (5Y 6/2) mottles; massive; varved; firm; slight effervescence; moderately alkaline.

Range in Characteristics

Thickness of the sandy mantle: 10 to 20 inches
Depth to carbonates: 18 to 35 inches
Content of rock fragments: 0 to 2 percent gravel

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loamy fine sand

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

Btg horizon:
Hue—10YR to 5Y
Value—4 or 5
Chroma—1 or 2
Texture—sandy clay loam or loam

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

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay, silty clay, silty clay loam, or clay loam

Boash Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow in the upper part; moderate in the lower part
Landform: Glacial lake plains
Parent material: Calcareous glaciolacustrine sediments overlying loamy, calcareous glacial till
Slope range: 0 to 2 percent
Taxonomic class: Clayey over loamy, montmorillonitic (calcareous), frigid Typic Haplaquolls

Typical Pedon

Boash clay loam, 1,300 feet south and 150 feet west of the northeast corner of sec. 9, T. 160 N., R. 31 W.

Ap—0 to 7 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; common fine and very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bg—7 to 11 inches; dark gray (2.5Y 4/0) clay; common medium prominent dark yellowish brown (10YR 4/6) mottles; moderate very thick platy structure parting to weak fine subangular blocky; firm; slight effervescence; neutral; clear smooth boundary.

Cg1—11 to 15 inches; dark grayish brown (2.5Y 4/2) clay; common medium prominent dark yellowish brown (10YR 3/6) mottles; massive; very firm; slight effervescence; mildly alkaline; clear smooth boundary.

Cg2—15 to 35 inches; gray (5Y 5/1) clay; many medium prominent dark yellowish brown (10YR 3/6) and few medium faint light olive gray (5Y 6/2) mottles; massive; very firm; 2 percent gravel; slight effervescence; mildly alkaline; gradual wavy boundary.

2Cg3—35 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam; common medium prominent dark yellowish brown (10YR 4/6) and few fine prominent light gray (10YR 7/2) mottles; massive; friable; many irregularly shaped, soft accumulations of lime; 10 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 12 inches
Depth to carbonates: 0 to 10 inches

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

Bg horizon:
Hue—2.5Y, 5Y, or neutral
Value—3 or 4
Chroma—0 to 2
Texture—clay or silty clay

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

2Cg horizon:
Hue—2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—2 to 10 percent gravel

Bullwinkle Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains
Parent material: Woody organic materials overlying loamy mineral material
Slope range: 0 to 2 percent
Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Bullwinkle muck, in an area of Bullwinkle-Cathro mucks, 2,250 feet east and 600 feet north of the southwest corner of sec. 33, T. 160 N., R. 32 W.

Oi—6 inches to 0; living mosses.

Oa1—0 to 28 inches; sapric material, black (5YR 2/1) broken face and rubbed; 25 percent fiber, 10 percent rubbed; massive; 25 percent woody fibers more than 2 millimeters in size; medium acid; clear smooth boundary.

Oa2—28 to 42 inches; sapric material, black (10YR 2/1) broken face and rubbed; 20 percent fiber, 10 percent rubbed; massive; 20 percent woody fibers more than 2 millimeters in size; medium acid; abrupt smooth boundary.

A—42 to 44 inches; black (10YR 2/1) sandy loam; massive; friable; neutral; abrupt smooth boundary.

Cg—44 to 60 inches; gray (5Y 5/1) loam; massive; friable; strong effervescence; mildly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 51 inches
Kind of organic material: Herbaceous material that is more than 15 percent woody fibers

Oa horizon:
Hue—5YR to 10YR
Value—2 to 4
Chroma—1 or 2
Texture—sapric material

A horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 4
Chroma—1 to 4
Texture—loam, sandy clay loam, or sandy loam

Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—5 to 7
Chroma—1 or 2
Texture—loam, clay loam, or sandy loam

Cathro Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains
Parent material: Highly decomposed herbaceous organic material overlying loamy mineral material
Slope range: 0 to 2 percent
Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 3,200 feet south and 100 feet west of the northeast corner of sec. 4, T. 161 N., R. 33 W.

Oa1—0 to 12 inches; sapric material, dark reddish brown (5YR 2/2) broken face, rubbed, and pressed; 25 percent fiber, 12 percent rubbed; weak thick platy structure; primarily herbaceous fibers; strongly acid; gradual wavy boundary.

Oa2—12 to 25 inches; sapric material, black (5YR 2/1) broken face and rubbed; 12 percent fiber, 5 percent rubbed; weak thick platy structure; primarily herbaceous fibers; medium acid; abrupt smooth boundary.

A—25 to 28 inches; black (5YR 2/1) silty clay loam; massive; slightly sticky; neutral; clear smooth boundary.

Cg1—28 to 40 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct brown (7.5YR 4/4) mottles; massive; slightly sticky; neutral; gradual wavy boundary.

Cg2—40 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; slightly sticky; 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 50 inches
Kind of organic material: Herbaceous

Oa horizon:
Hue—5YR to 10YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material that has thin layers of dominantly woody fibers

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam, fine sandy loam, loam, silt loam, very fine sandy loam, or silty clay loam
Content of rock fragments—0 to 15 percent gravel

Cg horizon:
Hue—10YR to 5Y
Value—4 to 6
Chroma—1 to 3
Texture—sandy loam, fine sandy loam, loam, silt loam, very fine sandy loam, or silty clay loam
Content of rock fragments—0 to 15 percent gravel

Chilgren Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Glacial lake plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Ochraqualfs

Typical Pedon

Chilgren fine sandy loam, 1,770 feet north and 150 feet east of the southwest corner of sec. 1, T. 160 N., R. 33 W.

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

E—3 to 8 inches; grayish brown (10YR 5/2) loamy fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; slightly acid; clear smooth boundary.

Btg—8 to 14 inches; grayish brown (10YR 5/2) loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; 2 percent gravel; slightly acid; clear smooth boundary.

Cg—14 to 60 inches; light brownish gray (2.5Y 6/2) loam; common fine prominent yellowish brown (10YR 5/6) and common fine distinct light gray (10YR 7/2) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam
Content of rock fragments—1 to 5 percent gravel

E horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Chroma—1 or 2
Texture—loamy sand, loamy fine sand, sandy loam, fine sandy loam, or loam
Content of rock fragments—1 to 5 percent gravel

Btg horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, sandy clay loam, or clay loam
Content of rock fragments—2 to 15 percent gravel

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam, fine sandy loam, or sandy loam
Content of rock fragments—2 to 15 percent gravel

Clearwater Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Glacial lake plains
Parent material: Clayey, calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine, montmorillonitic (calcareous), frigid Typic Haplaquolls

Typical Pedon

Clearwater clay, 2,600 feet east and 50 feet north of the southwest corner of sec. 28, T. 162 N., R. 33 W.

Ap—0 to 9 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; firm; 2 percent gravel; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bg—9 to 18 inches; dark gray (5Y 4/1) clay; common fine prominent yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure; firm; 2 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—18 to 40 inches; gray (5Y 5/1) clay; few fine prominent yellowish red (5YR 4/6) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

Cg2—40 to 60 inches; light brownish gray (2.5Y 6/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; massive; 2 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches
Depth to carbonates: 0 to 10 inches
Content of rock fragments: 2 to 5 percent gravel
Other features: A Bkg horizon in some pedons

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

Bg horizon:
Hue—2.5Y or 5Y
Value—3 or 4
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam

Cormant Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Rapid
Landform: Glacial lake plains and outwash plains
Parent material: Sandy glaciolacustrine outwash sediments
Slope range: 0 to 2 percent
Taxonomic class: Mixed, frigid Mollic Psammaquents

Typical Pedon

Cormant loamy fine sand, 275 feet east and 60 feet south of the northwest corner of sec. 32, T. 161 N., R. 33 W.

Ap—0 to 6 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

Cg1—6 to 10 inches; light brownish gray (2.5Y 6/2) fine

sand; single grain; loose; neutral; gradual smooth boundary.
Cg2—10 to 33 inches; light brownish gray (2.5Y 6/2) fine sand; common fine distinct light olive brown (2.5Y 5/6) mottles; single grain; loose; neutral; abrupt wavy boundary.
Cg3—33 to 40 inches; grayish brown (2.5Y 5/2) fine sand; few fine faint olive brown (2.5Y 4/4) mottles; single grain; loose; neutral; abrupt wavy boundary.
Cg4—40 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 36 to more than 60 inches
Other features: An O horizon in some pedons

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

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

Donaldson Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; slow in the lower part
Landform: Glacial lake plains
Parent material: Calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy over clayey, mixed Aquic Haploborolls

Typical Pedon

Donaldson loamy very fine sand, 2,500 feet east and 1,700 feet south of the northwest corner of sec. 30, T. 163 N., R. 34 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loamy very fine sand, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.
Bw—10 to 20 inches; dark grayish brown (10YR 4/2) very fine sand; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.
C—20 to 38 inches; light brownish gray (2.5Y 6/2) very fine sand; common fine distinct light yellowish brown (2.5Y 6/4) and few fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; very friable; slight effervescence; mildly alkaline; abrupt wavy boundary.
2Cg1—38 to 54 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine prominent yellowish red (5YR 4/6) and yellowish brown (10YR 5/8) mottles; massive; firm; strong effervescence; moderately alkaline; clear smooth boundary.
2Cg2—54 to 60 inches; olive gray (5Y 5/2) silty clay; common fine prominent yellowish red (5YR 4/6) and yellowish brown (10YR 5/8) mottles; massive; firm; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 11 inches
Depth to carbonates: 12 to 24 inches
Depth to the 2C horizon: 20 to 40 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy very fine sand

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

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

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

Eckvoll Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; moderate in the lower part
Landform: Till-floored glacial lake plains and glacial till plains
Parent material: Sandy glaciolacustrine sediments over loamy, calcareous glacial till
Slope range: 0 to 3 percent

Taxonomic class: Loamy, mixed Aquic Arenic Eutroboralfs

Typical Pedon

Eckvoll loamy fine sand, 400 feet west and 1,400 feet south of the northeast corner of sec. 7, T. 160 N., R. 32 W.

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

E1—4 to 7 inches; grayish brown (10YR 5/2) fine sand; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

E2—7 to 24 inches; brown (10YR 5/3) fine sand; common fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 1 percent gravel; neutral; clear smooth boundary.

2Bt—24 to 28 inches; brown (10YR 5/3) clay loam; common fine distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; common faint grayish brown (10YR 5/2) clay films on faces of peds; 2 percent gravel; mildly alkaline; gradual smooth boundary.

2BC—28 to 35 inches; light brownish gray (2.5Y 6/2) clay loam; common fine prominent light olive brown (2.5Y 5/6) and few fine distinct gray (5Y 6/1) mottles; moderate fine subangular blocky structure; firm; 5 percent gravel; slight effervescence; mildly alkaline; gradual smooth boundary.

2C—35 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct light olive brown (2.5Y 5/6) mottles; massive; friable; 2 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the sandy sediments: 20 to 30 inches

A horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 to 3
- Texture—loamy fine sand
- Content of rock fragments—0 to 5 percent gravel; 0 to 3 percent stones

E horizon:
- Hue—10YR
- Value—4 to 6
- Chroma—2 or 3
- Texture—fine sand, sand, or loamy sand
- Content of rock fragments—0 to 5 percent gravel

2Bt horizon:
- Hue—10YR or 2.5Y
- Value—4 or 5
- Chroma—3 or 4
- Texture—loam or clay loam
- Content of rock fragments—2 to 10 percent gravel

2BC horizon:
- Colors—similar to those of the 2Bt and 2C horizons
- Textures—similar to those of the 2Bt and 2C horizons

2C horizon:
- Hue—10YR or 2.5Y
- Value—5 or 6
- Chroma—2 to 4
- Texture—loam, clay loam, or silt loam
- Content of rock fragments—2 to 10 percent gravel

Effie Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Glacial till plains
Parent material: Calcareous glacial till
Slope range: 0 to 2 percent
Taxonomic class: Fine, mixed, frigid Typic Ochraqualfs

Typical Pedon

Effie loam, 1,500 feet north and 150 feet west of the southeast corner of sec. 24, T. 163 N., R. 34 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam, gray (10YR 6/1) dry; weak medium subangular blocky structure parting to moderate fine granular; friable; 1 percent gravel; neutral; abrupt smooth boundary.

Btg—6 to 14 inches; olive gray (5Y 5/2) clay; few fine faint olive (5Y 5/3) mottles; moderate medium angular blocky structure; firm; common faint olive gray (5Y 4/2) clay films on faces of peds; 1 percent gravel; neutral; clear smooth boundary.

Cg1—14 to 20 inches; light brownish gray (2.5Y 6/2) silty clay loam; few fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; 3 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

Cg2—20 to 40 inches; light brownish gray (2.5Y 6/2) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg3—40 to 50 inches; olive gray (5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg4—50 to 60 inches; grayish brown (2.5Y 5/2) clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 22 inches
Content of rock fragments: 1 to 5 percent gravel
Other features: An Eg horizon in some pedons

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

Btg horizon:
Hue—10YR to 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, silty clay loam, silty clay, or clay

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam, clay loam, silty clay loam, silty clay, or clay

Enstrom Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains
Parent material: Sandy glaciolacustrine sediments over loamy, calcareous glacial till or glaciolacustrine sediments
Slope range: 0 to 3 percent
Taxonomic class: Sandy over loamy, mixed, nonacid, frigid Aquic Udorthents

Typical Pedon

Enstrom loamy sand, 300 feet north and 200 feet west of the southeast corner of sec. 16, T. 162 N., R. 34 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; neutral; clear smooth boundary.

Bw—4 to 20 inches; dark yellowish brown (10YR 4/4) sand; few fine distinct light brownish gray (10YR 6/2) mottles; single grain; loose; neutral; gradual wavy boundary.

C1—20 to 25 inches; brown (10YR 5/3) sand; common fine distinct yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; single grain; loose; mildly alkaline; abrupt wavy boundary.

2C2—25 to 60 inches; grayish brown (10YR 5/2) loam; many fine faint light brownish gray (2.5Y 6/2) and common fine distinct yellowish brown (10YR 5/6) mottles; massive; varved; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches
Thickness of the sandy sediments: 20 to 40 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand
Content of rock fragments—0 to 2 percent gravel

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 2 percent gravel

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 10 percent gravel

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 or 3
Texture—loam, sandy loam, or fine sandy loam
Content of rock fragments—2 to 10 percent

Epoufette Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Landform: Outwash plains
Parent material: Gravelly, calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Epoufette loamy fine sand, 3,400 feet east and 3,800 feet south of the northwest corner of sec. 20, T. 159 N., R. 33 W.

Ap—0 to 6 inches; black (10YR 2/1) loamy fine sand, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

Eg—6 to 10 inches; dark gray (10YR 4/1) loamy sand; common fine faint grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

Btg—10 to 20 inches; dark grayish brown (10YR 4/2) sandy loam; common fine faint grayish brown (10YR 5/2) and common fine distinct dark yellowish brown (10YR 4/6) and dark brown (7.5YR 4/4) mottles; moderate fine and medium subangular blocky structure; friable; common faint clay films on faces of peds and in pores; 5 percent gravel; neutral; gradual wavy boundary.

2Cg1—20 to 28 inches; grayish brown (10YR 5/2) sand; many fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 5 percent gravel; mildly alkaline; clear smooth boundary.

2Cg2—28 to 37 inches; grayish brown (10YR 5/2) coarse sand; many medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 5 percent gravel; mildly alkaline; gradual wavy boundary.

2Cg3—37 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; 20 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Ap horizon:
- Hue—10YR
- Value—2 or 3
- Chroma—1 or 2
- Texture—loamy fine sand
- Content of rock fragments—0 to 10 percent gravel

Eg horizon:
- Hue—10YR
- Value—4 or 5
- Chroma—1 or 2
- Texture—loamy sand
- Content of rock fragments—0 to 15 percent gravel

Btg horizon:
- Hue—10YR or 2.5Y
- Value—4 or 5
- Chroma—1 or 2
- Texture—sandy loam or coarse sandy loam
- Content of rock fragments—5 to 15 percent gravel

2Cg horizon:
- Hue—10YR or 2.5Y
- Value—5 or 6
- Chroma—1 or 2
- Texture—coarse sand, sand, or the gravelly analogs of those textures
- Content of rock fragments—5 to 35 percent gravel

Faunce Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid
Landform: Glacial lake plains
Parent material: Sandy glaciolacustrine sediments
Slope range: 0 to 4 percent
Taxonomic class: Mixed, frigid Alfic Udipsamments

Typical Pedon

Faunce fine sand, 2,100 feet west and 2,100 feet south of the northeast corner of sec. 32, T. 161 N., R. 34 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; strongly acid; clear smooth boundary.

E1—3 to 11 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; moderately acid; clear smooth boundary.

E2—11 to 14 inches; strong brown (7.5YR 5/6) sand; single grain; loose; moderately acid; abrupt smooth boundary.

E&Bt—14 to 20 inches; yellowish brown (10YR 5/4) sand (E); single grain; loose; thin (2 to 3 inches) irregular and discontinuous band of dark yellowish brown (10YR 3/6) gravelly loamy coarse sand (Bt); weak medium subangular blocky structure; 18 percent gravel; neutral; abrupt smooth boundary.

C1—20 to 28 inches; light yellowish brown (10YR 6/4) gravelly sand; single grain; loose; 30 percent gravel; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—28 to 35 inches; very pale brown (10YR 7/3) sand; single grain; loose; 2 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

C3—35 to 60 inches; pale brown (10YR 6/3) gravelly sand; single grain; loose; 30 percent gravel; slight effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 11 to 35 inches
Other features: An O horizon in some pedons

A horizon:
- Hue—10YR

Value—3 or 4
Chroma—1 to 3
Texture—fine sand
Content of rock fragments—0 to 10 percent gravel

E horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—3 to 6
Texture—loamy fine sand, loamy sand, fine sand, or sand
Content of rock fragments—0 to 10 percent gravel

Bt horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—4 to 6
Texture—sandy loam, gravelly loamy coarse sand, or coarse sandy loam
Content of rock fragments—5 to 20 percent gravel

E&Bt horizon:
Colors—similar to those of the E and Bt horizons
Textures—similar to those of the E and Bt horizons

C horizon:
Hue—10YR
Value—5 to 7
Chroma—3 or 4
Texture—sand, coarse sand, or fine sand
Content of rock fragments—10 to 35 percent gravel

Faunce Variant

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Glacial lake plains
Parent material: Sandy glaciolacustrine sediments
Slope range: 0 to 3 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Faunce Variant loamy fine sand, 1,350 feet south and 700 feet west of the northeast corner of sec. 19, T. 159 N., R. 33 W.

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

E&Bt—3 to 15 inches; brown (10YR 4/3) loamy sand (E); thin (2 to 3 inches) irregular and discontinuous band of dark brown (7.5YR 4/4) coarse sandy loam (Bt); weak fine subangular blocky structure; very friable; clay occurring as bridges holding mineral grains together; 10 percent gravel; neutral; abrupt smooth boundary.

C—15 to 29 inches; light yellowish brown (2.5Y 6/4) fine sand; common medium distinct light gray (2.5Y 7/2) and common fine prominent dark yellowish brown (10YR 4/6) mottles; single grain; loose; 2 percent gravel; neutral; gradual smooth boundary.

Cg1—29 to 39 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; few fine faint light gray (2.5Y 7/2) mottles; single grain; loose; 15 percent gravel; neutral; gradual smooth boundary.

Cg2—39 to 46 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; single grain; loose; 25 percent gravel; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg3—46 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; single grain; loose; 5 percent gravel; slight effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches
Other features: An O horizon in some pedons

A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—loamy fine sand
Content of rock fragments—0 to 2 percent gravel

E&Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5 (E); 3 or 4 (Bt)
Chroma—2 to 6 (E); 4 (Bt)
Texture—loamy fine sand, loamy sand, fine sand, or sand (E); sandy loam or coarse sandy loam (Bt)
Content of rock fragments—0 to 10 percent gravel

C horizon:
Hue—10YR or 2.5Y
Value—3 to 7
Chroma—3 or 4
Texture—fine sand, sand, coarse sand, or the gravelly analogs of those textures
Content of rock fragments—2 to 25 percent gravel

Cg horizon:
Hue—2.5Y
Value—5 or 6
Chroma—2
Texture—fine sand, sand, coarse sand, or the gravelly analogs of those textures
Content of rock fragments—2 to 25 percent gravel

Fordum Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate or moderately rapid in the upper

part; moderately rapid in the lower part
Landform: Flood plains
Parent material: Loamy alluvium
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents

Typical Pedon

Fordum fine sandy loam, 1,900 feet north and 75 feet east of the southwest corner of sec. 18, T. 160 N., R. 33 W.

A—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; common fine and medium roots; slightly acid; clear smooth boundary.
Cg1—8 to 17 inches; light brownish gray (10YR 6/2) fine sand; common fine distinct dark yellowish brown (10YR 4/6) mottles; single grain; loose; slightly acid; clear smooth boundary.
Cg2—17 to 24 inches; dark gray (5Y 4/1) silt loam; common medium prominent dark yellowish brown (10YR 3/4) and few medium faint gray (10YR 5/1) mottles; massive; friable; neutral; clear smooth boundary.
Cg3—24 to 39 inches; dark gray (5Y 4/1) fine sandy loam; common medium prominent dark brown (10YR 3/3) mottles; massive; very friable; neutral; gradual smooth boundary.
Cg4—39 to 60 inches; dark gray (5Y 4/1) and gray (5Y 5/1), stratified fine sandy loam, loamy fine sand, and sandy loam; common fine and medium prominent dark brown (7.5YR 3/4) and common medium prominent gray (N 5/0) mottles; massive; friable; neutral.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel

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

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

Garnes Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Glacial lake plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 4 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Garnes fine sandy loam, 1 to 4 percent slopes, 1,900 feet north and 400 feet west of the southeast corner of sec. 12, T. 160 N., R. 33 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; 2 percent gravel; slightly acid; clear wavy boundary.
E—3 to 7 inches; brown (10YR 5/3) loamy fine sand; common fine faint light gray (10YR 7/2) mottles; weak fine subangular blocky structure; 2 percent gravel; very friable; neutral; abrupt smooth boundary.
Bt1—7 to 13 inches; dark brown (7.5YR 4/4) clay loam; moderate medium prismatic structure parting to strong fine angular blocky; firm; few thin clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.
Bt2—13 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few dark brown (7.5YR 4/2) clay films on faces of peds and in pores; 3 percent gravel; mildly alkaline; clear smooth boundary.
C1—15 to 35 inches; brown (10YR 5/3) fine sandy loam; common fine prominent strong brown (7.5YR 5/6) and common fine faint light brownish gray (10YR 6/2) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.
C2—35 to 60 inches; brown (10YR 5/3) fine sandy loam; common fine prominent strong brown (7.5YR 5/6) and common fine faint light brownish gray (10YR 6/2) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 10 to 20 inches
Content of rock fragments: 1 to 15 percent gravel; 0 to 3 percent stones
Other features: An Ap horizon in some pedons

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

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—loamy fine sand, fine sandy loam, sandy loam, or loam

Bt horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam, fine sandy loam, or sandy loam

Greenwood Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Rapid in the upper part; moderate or moderately rapid in the lower part
Landform: Glacial lake plains
Parent material: Partially decomposed herbaceous organic material
Slope range: 0 to 1 percent
Taxonomic class: Dysic Typic Borohemists

Typical Pedon

Greenwood peat, 2,200 feet north and 200 feet east of the southwest corner of sec. 18, T. 159 N., R. 30 W.

Oi—0 to 18 inches; fibric material, grayish brown (10YR 5/2) broken face, pale brown (10YR 6/3) rubbed; 95 percent fiber, 80 percent rubbed; massive; primarily sphagnum moss; extremely acid; clear smooth boundary.

Oe1—18 to 56 inches; hemic material, dark brown (7.5YR 4/2) broken face, dark brown (7.5YR 3/2) rubbed; 80 percent fiber, 50 percent rubbed; massive; primarily herbaceous fibers; extremely acid; clear smooth boundary.

Oe2—56 to 60 inches; hemic material, dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 3/3) rubbed; 70 percent fiber, 40 percent rubbed; massive; primarily herbaceous fiber; extremely acid.

Range in Characteristics

Thickness of the organic material: More than 60 inches
Kind of organic material: Mostly herbaceous

Oi horizon:
Hue—5YR to 10YR
Value—2 to 6
Chroma—1 to 4
Texture—fibric material

Oe horizon:
Hue—5YR to 10YR
Value—2 to 6
Chroma—1 to 4
Texture—hemic material

Grygla Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Rapid in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains
Parent material: Sandy glaciolacustrine sediments over loamy, calcareous glacial till or glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents

Typical Pedon

Grygla loamy fine sand, 1,800 feet south and 1,000 feet west of the northeast corner of sec. 14, T. 162 N., R. 34 W.

Ap—0 to 6 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; single grain; loose; neutral; clear smooth boundary.

Cg1—6 to 12 inches; grayish brown (2.5Y 5/2) fine sand; common fine prominent yellowish brown (10YR 5/6) and common fine distinct light brownish gray (10YR 6/2) mottles; single grain; loose; neutral; clear smooth boundary.

Cg2—12 to 21 inches; light brownish gray (2.5Y 6/2) fine sand; common medium prominent yellowish brown (10YR 5/6) and common medium distinct light gray (10YR 7/2) mottles; single grain; loose; neutral; clear smooth boundary.

2Cg3—21 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; many large prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the sandy sediments: 20 to 40 inches
Depth to carbonates: 20 to 30 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2

Texture—loamy fine sand or fine sandy loam
Content of rock fragments—0 to 3 percent gravel; 0 to 3 percent stones

Cg horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Chroma—1 or 2
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 10 percent gravel

2Cg horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—1 or 2
Texture—loam, sandy loam, silt loam, or silty clay loam
Content of rock fragments—1 to 10 percent gravel

Haug Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Glacial lake plains
Parent material: Highly decomposed organic material and the underlying loamy, calcareous glacial till
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, mixed (calcareous), frigid Histic Humaquepts

Typical Pedon

Haug muck, 750 feet north and 200 feet east of the southwest corner of sec. 27, T. 160 N., R. 32 W.

Oa—0 to 15 inches; sapric material, black (10YR 2/1) broken face and rubbed; 25 percent fiber, 10 percent rubbed; weak fine granular structure; very friable; herbaceous fiber; neutral; clear smooth boundary.

A—15 to 18 inches; very dark gray (10YR 3/1) fine sandy loam; common medium faint dark gray (10YR 4/1) mottles; weak fine granular structure; very friable; 5 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—18 to 30 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine and medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

Cg2—30 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; common fine and medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; 8 percent gravel; strong effervescence; mildly alkaline.

Range in Characteristics

Depth to the loamy underlying material: 8 to 16 inches

Oa horizon:
Hue—5YR to 10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—sapric material

A horizon:
Hue—10YR to 5Y
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam, fine sandy loam, loam, or silt loam
Content of rock fragments—2 to 10 percent gravel

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—sandy loam, fine sandy loam, loam, or silt loam
Content of rock fragments—2 to 10 percent gravel

Hiwood Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Glacial lake plains or outwash plains
Parent material: Sandy glaciolacustrine or outwash sediments
Slope range: 0 to 6 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Hiwood fine sand, 0 to 6 percent slopes, 900 feet north and 110 feet east of the southwest corner of sec. 33, T. 161 N., R. 33 W.

Oe—2 inches to 0; partially decomposed forest litter.

A—0 to 2 inches; very dark brown (10YR 2/2) fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose; moderately acid; abrupt smooth boundary.

E—2 to 6 inches; light brownish gray (10YR 6/2) fine sand, light gray (10YR 7/2) dry; single grain; loose; moderately acid; clear smooth boundary.

Bw1—6 to 15 inches; yellowish brown (10YR 5/6) fine sand; few fine faint yellowish brown (10YR 5/4) mottles; single grain; loose; moderately acid; gradual wavy boundary.

Bw2—15 to 28 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; moderately acid; gradual wavy boundary.

Bw3—28 to 46 inches; light yellowish brown (10YR 6/4)

fine sand; common medium distinct light brownish gray (10YR 6/2), common fine and medium distinct yellowish brown (10YR 5/6), and common fine prominent yellowish brown (10YR 5/8) mottles; single grain; loose; moderately acid; gradual wavy boundary.

C1—46 to 56 inches; light brownish gray (2.5Y 6/2) fine sand; common fine and medium prominent yellowish brown (10YR 5/8) and few fine prominent yellowish red (5YR 5/8) mottles; single grain; loose; slightly acid; gradual wavy boundary.

C2—56 to 60 inches; pale brown (10YR 6/3) fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; slightly acid.

Range in Characteristics

Depth to carbonates: More than 60 inches
Content of rock fragments: 0 to 2 percent
Other features: An Ap horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sand

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—fine sand, loamy sand, loamy fine sand, or sand

Bw horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—3 to 8
Texture—fine sand, sand, loamy fine sand, or loamy sand

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

Indus Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Glacial lake plains
Parent material: Clayey, calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Very fine, montmorillonitic, frigid Typic Ochraqualfs

Typical Pedon

Indus clay loam, 1,900 feet west and 500 feet north of the southeast corner of sec. 11, T. 162 N., R. 33 W.

Oe—1 inch to 0; partially decomposed forest litter.

A—0 to 2 inches; black (10YR 2/1) clay loam, gray (10YR 5/1) dry; moderate fine and medium granular structure; friable; strongly acid; clear smooth boundary.

Eg—2 to 4 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium granular structure; friable; slightly acid; clear smooth boundary.

Btg—4 to 18 inches; olive gray (5Y 4/2) clay; moderate coarse prismatic structure parting to strong fine and medium angular blocky; very firm; common distinct very dark gray (5Y 3/1) clay films on faces of peds; slightly acid; clear smooth boundary.

BCg—18 to 31 inches; grayish brown (2.5Y 5/2) clay; few fine faint light brownish gray (2.5Y 6/2) mottles; moderate fine subangular blocky structure; very firm; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—31 to 60 inches; dark grayish brown (2.5Y 6/2) clay; few fine faint light brownish gray (2.5Y 6/2), few fine distinct light gray (2.5Y 7/2), and common fine distinct light olive brown (2.5Y 5/6) mottles; massive; very firm; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 25 inches
Content of rock fragments: 0 to 3 percent gravel
Other features: An Ap horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—clay loam

Eg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay, silty clay loam, silty clay, or clay loam

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

BCg horizon:
Colors—similar to those of the B and C horizons
Textures—similar to those of the B and C horizons

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—clay, silty clay, silt loam, clay loam, or silty clay loam

Insula Series

Depth class: Shallow
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Uplands
Parent material: 10 to 20 inches of loamy material overlying bedrock
Slope range: 2 to 30 percent
Taxonomic class: Loamy, mixed, frigid Lithic Dystrochrepts
Taxadjunct features: The Insula soils in this survey area have a higher content of rock fragments than is defined as the range for the series. They are classified as loamy-skeletal, mixed, frigid Lithic Dystrochrepts.

Typical Pedon

Insula gravelly loam, in an area of Insula-Mesaba gravelly loams, 2 to 30 percent slopes, 2,300 feet east and 400 feet south of the northwest corner of sec. 1, T. 167 N., R. 33 W.

Oe—2 inches to 0; partially decomposed forest litter.
E—0 to 3 inches; dark grayish brown (10YR 4/2) gravelly loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; 25 percent gravel; very strongly acid; clear smooth boundary.
Bw—3 to 11 inches; dark brown (7.5YR 3/2) very gravelly loam, brown (7.5YR 5/2) dry; moderate fine subangular blocky structure; friable; 40 percent gravel; very strongly acid; abrupt wavy boundary.
R—11 inches; granite bedrock.

Range in Characteristics

Thickness of the solum: 10 to 20 inches
Depth to bedrock: 10 to 20 inches

E horizon:
Hue—10YR
Value—4 or 5
Chroma—1 or 2
Texture—gravelly loam
Content of rock fragments—25 to 35 percent gravel

Bw horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—2 to 4
Texture—very gravelly loam or very cobbly loam
Content of rock fragments—35 to 50 percent gravel; 0 to 40 percent cobbles

Karlstad Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; rapid or very rapid in the lower part
Landform: Glacial lake beaches or outwash plains
Parent material: Loamy or sandy mantle overlying calcareous sandy and gravelly outwash
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Karlstad loamy sand, 2,500 feet west and 1,100 feet north of the southeast corner of sec. 36, T. 161 N., R. 33 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; single grain; loose; slightly acid; clear smooth boundary.
E—6 to 10 inches; brown (10YR 5/3) loamy sand, pale brown (10YR 6/3) dry; single grain; loose; slightly acid; clear smooth boundary.
Bt—10 to 15 inches; brown (7.5YR 5/4) sandy loam; few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; very friable; common faint brown (7.5YR 4/2) clay films on faces of peds; neutral; clear smooth boundary.
2C—15 to 60 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; few fine prominent yellowish brown (10YR 5/4) and faint grayish brown (10YR 5/2) mottles; single grain; loose; 15 percent gravel; strong effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 8 to 20 inches
Depth to the 2C horizon: 8 to 20 inches

Ap horizon:
Hue—10YR
Value—3 or 4
Chroma—1 to 3
Texture—loamy sand
Content of rock fragments—0 to 2 percent gravel

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3

Texture—loamy sand, sandy loam, or fine sandy loam
Content of rock fragments—0 to 2 percent gravel

Bt horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—2 to 4
Texture—coarse sandy loam, sandy loam, or fine sandy loam
Content of rock fragments—0 to 2 percent gravel

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 to 4
Texture—coarse sand, sand, fine sand, loamy fine sand, loamy sand, loamy coarse sand, or the gravelly analogs of those textures
Content of rock fragments—0 to 35 percent gravel

Kratka Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains or moraines
Parent material: Sandy glaciolacustrine sediments over loamy, calcareous glacial till or glaciolacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Sandy over loamy, mixed, frigid Typic Haplaquolls

Typical Pedon

Kratka fine sandy loam, 1,400 feet south and 100 feet east of the northwest corner of sec. 30, T. 162 N., R. 34 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam; moderate medium subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.
Bg—9 to 12 inches; dark grayish brown (10YR 4/2) loamy fine sand; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; mildly alkaline; clear wavy boundary.
Cg1—12 to 25 inches; pale brown (10YR 6/3) fine sand; common medium distinct yellowish brown (10YR 5/4) and light gray (10YR 7/2) mottles; single grain; loose; mildly alkaline; abrupt smooth boundary.
2Cg2—25 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.
2Cg3—36 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; 2 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 15 inches
Depth to carbonates: 20 to 40 inches
Depth to loamy material: 20 to 40 inches

Ap horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam
Content of rock fragments—0 to 2 percent gravel

Bg horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loamy fine sand, fine sand, loamy sand, or sand
Content of rock fragments—0 to 2 percent gravel

Cg horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—sand, fine sand, loamy fine sand, or loamy sand
Content of rock fragments—0 to 2 percent gravel

2Cg horizon:
Hue—10YR to 5Y
Value—5 or 6
Chroma—1 to 3
Texture—loam, sandy loam, silty clay loam, silt loam, or fine sandy loam
Content of rock fragments—2 to 8 percent

Leafriver Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part; rapid in the lower part
Landform: Glacial lake plains
Parent material: Organic material and the underlying sandy glaciolacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Sandy, mixed, frigid Histic Humaquepts

Typical Pedon

Leafriver muck, 400 feet east and 100 feet south of the northwest corner of sec. 3, T. 159 N., R. 34 W.

Oa1—0 to 6 inches; sapric material, black (10YR 2/1) broken face and rubbed; 30 percent fiber, 15 percent rubbed; weak medium granular structure; very friable; mostly herbaceous fiber; slightly acid; clear smooth boundary.

Oa2—6 to 11 inches; sapric material, very dark brown (10YR 2/2) broken face and rubbed; 20 percent fiber, 5 percent rubbed; moderate medium granular structure; friable; mostly herbaceous fiber; slightly acid; abrupt smooth boundary.

A—11 to 16 inches; very dark gray (10YR 3/1) loamy sand; single grain; loose; neutral; clear smooth boundary.

Cg1—16 to 25 inches; dark grayish brown (2.5Y 4/2) fine sand; single grain; loose; slightly acid; gradual wavy boundary.

Cg2—25 to 60 inches; olive gray (5Y 5/2) fine sand; single grain; loose; neutral.

Range in Characteristics

Depth to the sandy underlying material: 8 to 16 inches

Oa horizon:
Hue—5YR to 10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—sapric material

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

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

Lobo Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Rapid in the upper part; moderate or moderately rapid in the lower part
Landform: Glacial lake plains
Parent material: Slightly decomposed material that is mostly sphagnum moss fiber and an underlying layer of moderately decomposed material that is mostly herbaceous and sphagnum moss fiber
Slope range: 0 to 1 percent
Taxonomic class: Dysic, frigid Hemic Sphagnofibrists

Typical Pedon

Lobo peat, in an area of Greenwood-Lobo peats, 1,700 feet north and 2,100 feet west of the southeast corner of sec. 23, T. 163 N., R. 34 W.

Oi—0 to 38 inches; fibric material, dark brown (7.5YR 3/2) broken face, brown (7.5YR 4/4) rubbed; 95 percent fiber, 90 percent rubbed; weak medium platy structure; nonplastic, nonsticky; mostly sphagnum moss fibers; extremely acid; clear smooth boundary.

Oe—38 to 60 inches; hemic material, dark brown (7.5YR 3/2) broken face, brown (7.5YR 4/2) rubbed; 65 percent fiber, 45 percent rubbed; weak medium platy structure; nonplastic, nonsticky; stratified layers dominated by sphagnum moss fiber or herbaceous fiber; 5 percent woody fragments; extremely acid.

Range in Characteristics

Thickness of the organic material: More than 60 inches
Kind of organic material: Mostly herbaceous and sphagnum moss fiber

Oi horizon:
Hue—5YR to 10YR
Value—3 to 7
Chroma—2 to 4
Texture—fibric material

Oe horizon:
Hue—5YR to 10YR
Value—2 or 3
Chroma—1 or 2
Texture—hemic material

Lupton Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Glacial lake plains
Parent material: Highly decomposed organic material
Slope range: 0 to 2 percent
Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Lupton mucky peat, 1,700 feet west and 250 feet north of the southeast corner of sec. 8, T. 159 N., R. 32 W.

Oe—0 to 8 inches; hemic material, black (10YR 2/1) broken face and rubbed; 40 percent fiber, 25 percent rubbed; weak medium granular structure;

primarily herbaceous fibers; moderately acid; clear smooth boundary.

Oa1—8 to 18 inches; sapric material, black (5YR 2/1) broken face and rubbed; 25 percent fiber, 15 percent rubbed; weak medium granular structure; primarily woody fibers; 8 percent woody fragments; moderately acid; clear smooth boundary.

Oa2—18 to 48 inches; sapric material, dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 2/2) rubbed; 20 percent fiber, 10 percent rubbed; massive; primarily woody fibers; 15 percent woody fragments; moderately acid; gradual smooth boundary.

Oa3—48 to 60 inches; sapric material, very dark brown (10YR 2/2) broken face, very dark grayish brown (10YR 3/2) rubbed; 18 percent fiber, 9 percent rubbed; massive; primarily herbaceous fibers; 5 percent woody fragments; moderately acid.

Range in Characteristics

Thickness of the organic material: More than 60 inches
Kind of organic material: Herbaceous and woody fragments

Oe horizon:
Hue—5YR to 10YR or neutral
Value—2 or 3
Chroma—0 to 3
Texture—hemic material

Oa horizon:
Hue—5YR to 10YR or neutral
Value—2 or 3
Chroma—0 to 3
Texture—sapric material

Markey Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; rapid in the lower part
Landform: Glacial lake plains
Parent material: Highly decomposed herbaceous organic material overlying sandy glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Markey muck, 1,000 feet west and 750 feet south of the northeast corner of sec. 21, T. 159 N., R. 34 W.

Oa1—0 to 4 inches; sapric material, black (10YR 2/1) broken face and rubbed; 30 percent fiber, 10 percent rubbed; weak thin platy structure; mostly herbaceous fiber; neutral; clear smooth boundary.

Oa2—4 to 18 inches; sapric material, black (10YR 2/1) broken face and rubbed; 40 percent fiber, 15 percent rubbed; moderate medium platy structure; mostly herbaceous fiber; 5 percent woody fragments; neutral; clear smooth boundary.

Oa3—18 to 26 inches; sapric material, very dark brown (10YR 2/2) broken face and rubbed; 30 percent fiber, 10 percent rubbed; moderate medium platy structure; mostly herbaceous fiber; neutral; clear wavy boundary.

Oa4—26 to 28 inches; sapric material, very dark gray (10YR 3/1) broken face, very dark brown (10YR 2/2) rubbed; 25 percent fiber, 5 percent rubbed; weak coarse subangular blocky structure; mostly herbaceous fiber; mildly alkaline; abrupt smooth boundary.

Cg1—28 to 32 inches; gray (5Y 6/1) sand; single grain; loose; mildly alkaline; clear smooth boundary.

Cg2—32 to 60 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; mildly alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 50 inches
Kind of organic material: Herbaceous

Oa horizon:
Hue—10YR or 7.5YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material

Cg horizon:
Hue—10YR to 5Y or neutral
Value—4 to 6
Chroma—0 to 4
Texture—sand, fine sand, or loamy sand

Marquette Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Landform: Outwash plains
Parent material: Gravelly and sandy sediments
Slope range: 1 to 25 percent
Taxonomic class: Loamy-skeletal, mixed Psammentic Eutroboralfs

Typical Pedon

Marquette loamy sand, 1 to 8 percent slopes, 1,400 feet west and 150 feet north of the southeast corner of sec. 18, T. 163 N., R. 33 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; single grain; loose; 2 percent gravel; neutral; abrupt smooth boundary.
E—3 to 16 inches; light brownish gray (10YR 6/2) sand, light gray (10YR 7/2) dry; single grain; loose; 2 percent gravel; neutral; clear smooth boundary.
Bt—16 to 21 inches; brown (10YR 4/3) very gravelly loam; weak fine subangular blocky structure; friable; 60 percent gravel; few faint dark brown (10YR 3/3) clay films on faces of peds; neutral; clear smooth boundary.
C1—21 to 32 inches; grayish brown (10YR 5/2) very gravelly loamy sand; single grain; loose; 60 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.
C2—32 to 60 inches; brown (10YR 5/3) very gravelly sand; single grain; loose; 60 percent gravel; slight effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 10 to 24 inches
Other features: An Ap horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand or loamy sand
Content of rock fragments—0 to 10 percent gravel

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 4
Texture—loamy fine sand, loamy sand, loamy coarse sand, fine sand, sand, or coarse sand
Content of rock fragments—0 to 10 percent gravel

Bt horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 or 4 (3 chroma does not occur with 3 value)
Texture—the very gravelly or extremely gravelly analogs of loam, sandy loam, fine sandy loam, or coarse sandy loam
Content of rock fragments—35 to 70 percent gravel

C horizon:
Hue—10YR
Value—5 or 6
Chroma—2 to 4
Texture—the gravelly, very gravelly, or extremely gravelly analogs of loamy sand, loamy coarse sand, sand, or coarse sand
Content of rock fragments—15 to 70 percent

Meehan Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy sediments
Slope range: 0 to 3 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Meehan loamy sand, 2,100 feet south and 1,600 feet east of the northwest corner of sec. 15, T. 159 N., R. 34 W.

Oe—1 inch to 0; partially decomposed forest litter.
A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; single grain; loose; slightly acid; abrupt smooth boundary.
E—4 to 15 inches; light brownish gray (10YR 6/2) loamy sand; single grain; loose; slightly acid; clear smooth boundary.
Bw1—15 to 27 inches; yellowish brown (10YR 5/6) sand; few fine distinct strong brown (7.5YR 5/8) mottles; single grain; loose; 2 percent gravel; slightly acid; clear smooth boundary.
Bw2—27 to 40 inches; brownish yellow (10YR 6/6) sand; common fine distinct strong brown (7.5YR 5/6 and 5/8) and few fine distinct light brownish gray (10YR 6/2) mottles; slightly acid; gradual wavy boundary.
C1—40 to 47 inches; light yellowish brown (10YR 6/4) sand; common medium prominent strong brown (7.5YR 5/6 and 5/8) and common fine distinct light brownish gray (10YR 6/2) mottles; single grain; loose; 4 percent gravel; neutral; clear smooth boundary.
C2—47 to 60 inches; pale brown (10YR 6/3) sand; many medium prominent strong brown (7.5YR 5/6 and 5/8) and common fine faint light brownish gray (10YR 6/2) and light gray (10YR 7/2) mottles; single grain; loose; 4 percent gravel; neutral.

Range in Characteristics

Content of rock fragments: 0 to 5 percent gravel

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

E horizon:
Hue—10YR or 7.5YR
Value—5 or 6
Chroma—2 or 3
Texture—loamy sand or sand

Bw horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 to 6
Texture—loamy sand, loamy coarse sand, or sand

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

Menahga Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy sediments
Slope range: 0 to 18 percent
Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Menahga loamy sand, 0 to 6 percent slopes, 300 feet north and 100 feet west of the southeast corner of sec. 25, T. 159 N., R. 34 W.

Oe—2 inches to 0; partially decomposed forest litter.
A—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; single grain; loose; moderately acid; clear smooth boundary.
Bw1—3 to 16 inches; brown (7.5YR 4/4) sand; single grain; loose; 5 percent gravel; moderately acid; gradual wavy boundary.
Bw2—16 to 32 inches; yellowish brown (10YR 5/6) sand; single grain; loose; 5 percent gravel; moderately acid; gradual wavy boundary.
C1—32 to 50 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; 5 percent gravel; neutral; gradual wavy boundary.
C2—50 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; 5 percent gravel; neutral.

Range in Characteristics

Content of rock fragments: 0 to 10 percent gravel
Other features: An E horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

Bw horizon:
Hue—7.5YR or 10YR
Value—4 or 5
Chroma—4 to 6
Texture—coarse sand or sand

C horizon:
Hue—7.5YR or 10YR
Value—5 or 6
Chroma—3 to 5
Texture—coarse sand or sand

Mesaba Series

Depth class: Moderately deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Uplands
Parent material: 20 to 40 inches of loamy material overlying bedrock
Slope range: 2 to 30 percent
Taxonomic class: Coarse-loamy, mixed, frigid Typic Dystrochrepts
Taxadjunct features: The Mesaba soils in this survey area have an umbric epipedon and have a higher content of rock fragments than is defined as the range for the series. They are classified as loamy-skeletal, mixed, frigid Typic Haplumbrepts.

Typical Pedon

Mesaba gravelly loam, in an area of Insula-Mesaba gravelly loams, 2 to 30 percent slopes, 2,300 feet east and 800 feet south of the northwest corner of sec. 1, T. 167 N., R. 33 W.

Oe—3 inches to 0; partially decomposed forest litter.
Bhs—0 to 14 inches; dark brown (7.5YR 3/2) gravelly loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; 25 percent gravel, 5 percent cobbles; strongly acid; clear smooth boundary.
Bw—14 to 22 inches; brown (7.5YR 4/3) very cobbly coarse sandy loam; weak fine subangular blocky structure; friable; 40 percent cobbles, 10 percent gravel; strongly acid; abrupt smooth boundary.
R—22 inches; granite bedrock.

Range in Characteristics

Depth to bedrock: 20 to 40 inches

Bhs horizon:
Hue—7.5YR
Value—3 or 4
Chroma—2 or 3
Texture—gravelly loam
Content of rock fragments—15 to 35 percent gravel; 0 to 5 percent cobbles

Bw horizon:
Hue—7.5YR

Value—3 or 4
Chroma—2 or 3
Texture—very cobbly coarse sandy loam, very gravelly coarse sandy loam, or very gravelly sandy loam
Content of rock fragments—35 to 50 percent cobbles; 10 to 40 percent gravel (average content of gravel less than 35 percent)

Northwood Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid or rapid in the upper part; moderate in the lower part
Landform: Glacial lake plains
Parent material: Thin layer of organic material over glaciolacustrine sands that are underlain by loamy, calcareous glacial till or glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Sandy over loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Northwood muck, about 2,000 feet west and 400 feet north of the southeast corner of sec. 14, T. 162 N., R. 34 W.

Oa—0 to 9 inches; black (10YR 2/1) sapric material, very dark gray (10YR 3/1) dry; 20 percent fiber, 10 percent rubbed; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
A—9 to 12 inches; black (10YR 2/1) loamy sand; single grain; loose; neutral; clear smooth boundary.
Bg—12 to 27 inches; grayish brown (2.5Y 5/2) fine sand; common fine faint light brownish gray (2.5Y 6/2) and common fine distinct light olive brown (2.5Y 5/6) mottles; single grain; loose; neutral; clear wavy boundary.
2Cg—27 to 60 inches; light brownish gray (2.5Y 6/2) clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; mildly alkaline.

Range in Characteristics

Depth to mineral soil: 8 to 16 inches
Depth to loamy glacial till: 20 to 40 inches
Depth to carbonates: 20 to 40 inches

Oa horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material

A horizon:
Hue—10YR to 5Y or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loamy sand, loamy fine sand, sand, fine sand, sandy loam, or fine sandy loam
Content of rock fragments—0 to 8 percent gravel

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 8 percent gravel

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, silty clay loam, or clay loam
Content of rock fragments—1 to 8 percent gravel

Pelan Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderate in the lower part
Landform: Glacial lake plains
Parent material: Calcareous glacial till
Slope range: 0 to 3 percent
Taxonomic class: Loamy-skeletal, mixed Psammentic Eutroboralfs
Taxadjunct features: The Pelan soils in this survey area have a lower content of rock fragments than is defined as the range for the series. They are classified as fine-loamy, mixed Aquic Eutroboralfs.

Typical Pedon

Pelan sandy loam, 1,400 feet north and 200 feet east of the southwest corner of sec. 10, T. 161 N., R. 33 W.

A—0 to 4 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; 2 percent gravel; neutral; clear smooth boundary.
E—4 to 6 inches; brown (10YR 5/3) loamy sand; weak fine subangular blocky structure; very friable; 2 percent gravel; neutral; clear smooth boundary.
Bt1—6 to 9 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; 10 percent gravel; neutral; abrupt wavy boundary.
Bt2—9 to 15 inches; dark yellowish brown (10YR 4/4)

very gravelly sandy loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; few thin clay films on faces of peds; friable; 40 percent gravel; neutral; abrupt wavy boundary.

C1—15 to 20 inches; pale brown (10YR 6/3) coarse sand; common medium prominent strong brown (7.5YR 5/8) and few fine faint light brownish gray (10YR 6/2) mottles; single grain; loose; 10 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C2—20 to 38 inches; brown (10YR 5/3) gravelly coarse sand; many medium distinct light brownish gray (10YR 6/2) mottles; single grain; loose; 25 percent gravel; slight effervescence; mildly alkaline; abrupt wavy boundary.

2Cg—38 to 60 inches; light brownish gray (2.5Y 6/2) loam; common fine faint light gray (2.5Y 7/2) and common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 10 to 24 inches
Depth to loamy glacial till: 20 to 40 inches

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

E horizon:
Hue—10YR
Value—4 or 5
Chroma—2 or 3
Texture—coarse sand, sand, fine sand, loamy coarse sand, loamy sand, or loamy fine sand
Content of rock fragments—2 to 10 percent gravel

Bt horizon:
Hue—10YR
Value—3 or 4
Chroma—2 to 4
Texture—coarse sandy loam, sandy loam, sandy clay loam, or the gravelly or very gravelly analogs of those textures
Content of rock fragments—10 to 40 percent gravel; average content less than 35 percent

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—coarse sand, sand, fine sand, loamy coarse sand, loamy sand, loamy fine sand, coarse sandy loam, sandy loam, fine sandy loam, or the gravelly analogs of those textures
Content of rock fragments—10 to 35 percent gravel

2Cg horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 or 3
Texture—sandy loam, fine sandy loam, loam, or the gravelly analogs of those textures
Content of rock fragments—5 to 25 percent

Percy Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Glacial lake plains and till plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, frigid Typic Calciaquolls

Typical Pedon

Percy fine sandy loam, 1,200 feet north and 150 feet west of the southeast corner of sec. 30, T. 163 N., R. 34 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

Bg—8 to 11 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; common fine prominent yellowish brown (10YR 5/6 and 5/4) mottles; weak fine and medium subangular blocky structure; friable; slight effervescence; moderately alkaline; clear smooth boundary.

Bkg—11 to 15 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common fine soft accumulations of lime; 5 percent gravel; violent effervescence; moderately alkaline; clear smooth boundary.

Cg1—15 to 31 inches; light brownish gray (2.5Y 6/2) loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; 10 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

Cg2—31 to 60 inches; light brownish gray (2.5Y 6/2) loam; common coarse distinct light olive gray (5Y 6/2) and many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; 10 percent

gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 10 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam or loam
Content of rock fragments—0 to 10 percent gravel; 0 to 3 percent stones

Bg and Bkg horizons:
Hue—10YR to 5Y
Value—4 to 6
Chroma—1 or 2
Texture—fine sandy loam, loam, or sandy loam
Content of rock fragments—2 to 15 percent gravel

Cg horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—1 or 2
Texture—loam, fine sandy loam, or sandy loam
Content of rock fragments—10 to 15 percent gravel

Quetico Series

Depth class: Very shallow
Drainage class: Somewhat excessively drained
Permeability: Moderate
Landform: Uplands
Parent material: Loamy glacial material overlying bedrock
Slope range: 6 to 35 percent
Taxonomic class: Loamy, mixed, acid, frigid Lithic Udorthents
Taxadjunct features: The Quetico soils in this survey area have an umbric epipedon, which is not defined for the series. They are classified as loamy, mixed, frigid Lithic Haplumbrepts.

Typical Pedon

Quetico loam, in an area of Quetico-Rock outcrop complex, 6 to 35 percent slopes, 2,500 feet east and 200 feet north of the southwest corner of sec. 14, T. 163 N., R. 34 W.

Oe—2 inches to 0; partially decomposed forest litter.
A—0 to 3 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable; 3 percent gravel; very strongly acid; clear smooth boundary.
Bw—3 to 8 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable; 3 percent gravel; very strongly acid; abrupt smooth boundary.
R—8 inches; granite bedrock.

Range in Characteristics

Depth to bedrock: 6 to 10 inches
Content of rock fragments: 3 to 15 percent gravel

A horizon:
Hue—10YR
Value—2 to 5
Chroma—2 or 3
Texture—loam

Bw horizon:
Hue—10YR
Value—2 to 5
Chroma—2 or 3
Texture—loam

Redby Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Rapid
Landform: Glacial lake beaches
Parent material: Sandy sediments
Slope range: 0 to 3 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Redby loamy fine sand, 200 feet north and 150 feet east of the southwest corner of sec. 3, T. 160 N., R. 32 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark gray (10YR 4/1) dry; single grain; loose; slightly acid; clear smooth boundary.
E—3 to 5 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; slightly acid; clear smooth boundary.
Bw—5 to 19 inches; yellowish brown (10YR 5/4) fine sand; common fine prominent gray (N 5/0) and strong brown (7.5YR 5/8) mottles; single grain; loose; slightly acid; gradual wavy boundary.
C—19 to 60 inches; grayish brown (10YR 5/2) fine sand; common medium distinct yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; single grain; loose; slightly acid.

Range in Characteristics

Depth to carbonates: More than 30 inches
Content of rock fragments: 0 to 2 percent gravel
Other features: An Ap horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

E horizon:
Hue—10YR
Value—5 or 6
Chroma—1 to 3
Texture—fine sand or loamy fine sand

Bw horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—fine sand or sand

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 or 3
Texture—fine sand or sand

Rifle Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Landform: Glacial lake plains
Parent material: Moderately decomposed herbaceous material
Slope range: 0 to 2 percent
Taxonomic class: Euic Typic Borohemists

Typical Pedon

Rifle mucky peat, about 1,700 feet south and 2,100 feet west of the northeast corner of sec. 9, T. 162 N., R. 34 W.

Oe1—0 to 3 inches; hemic material, dark brown (7.5YR 3/2) broken face and pressed, black (10YR 2/1) rubbed; 40 percent fiber, 20 percent rubbed; weak medium subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; moderately acid; clear smooth boundary.

Oe2—3 to 13 inches; hemic material, very dark grayish brown (10YR 3/2) broken face, very dark brown (10YR 2/2) rubbed; 40 percent fiber, 20 percent rubbed; weak medium subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; strongly acid; gradual smooth boundary.

Oe3—13 to 28 inches; hemic material, dark brown (7.5YR 3/2) broken face and rubbed; 60 percent fiber, 35 percent rubbed; weak medium subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; strongly acid; gradual smooth boundary.

Oe4—28 to 52 inches; hemic material, dark brown (7.5YR 3/2) broken face, brown (7.5YR 4/2) rubbed; 75 percent fiber, 40 percent rubbed; weak medium subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; strongly acid; gradual smooth boundary.

Oe5—52 to 60 inches; hemic material, very dark grayish brown (10YR 3/2) broken face, very dark brown (10YR 2/2) rubbed; 40 percent fiber, 25 percent rubbed; weak medium subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; moderately acid.

Range in Characteristics

Thickness of the organic material: More than 60 inches
Kind of organic material: Herbaceous

Oe horizon:
Hue—5YR to 10YR
Value—2 to 5
Chroma—2 to 4
Texture—hemic material

Roliss Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Moderately slow or moderate
Landform: Glacial lake plains
Parent material: Loamy, calcareous glacial till
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed (calcareous), frigid Typic Haplaquolls

Typical Pedon

Roliss clay loam, 2,500 feet west and 100 feet north of the southeast corner of sec. 32, T. 162 N., R. 33 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; 3 percent gravel; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bg—9 to 15 inches; grayish brown (2.5Y 5/2) clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; 3 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

Cg1—15 to 26 inches; light brownish gray (2.5Y 6/2) clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; 3 percent gravel; strong effervescence; moderately alkaline; clear wavy boundary.

Cg2—26 to 60 inches; light brownish gray (2.5Y 6/2)

loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 12 inches
Content of rock fragments: 2 to 15 percent gravel
Depth to carbonates: 0 to 10 inches

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

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

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam or clay loam

Sago Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Glacial lake plains
Parent material: Thin layer of organic material over stratified glaciolacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Histic Humaquepts
Taxadjunct features: The Sago soils in this survey area have less fine sand than is defined as the range for the series. They are classified as coarse-silty, mixed, nonacid, frigid Histic Humaquepts.

Typical Pedon

Sago muck, 1,200 feet north and 500 feet east of the southwest corner of sec. 12, T. 161 N., R. 32 W.

Oa—0 to 13 inches; sapric material, very dark brown (10YR 2/2) broken face and rubbed; 25 percent fiber, 10 percent rubbed; weak fine and medium granular structure; very friable; mostly herbaceous fiber; very strongly acid; abrupt smooth boundary.
A—13 to 19 inches; dark grayish brown (10YR 4/2) very fine sandy loam; weak medium granular structure; friable; neutral; gradual smooth boundary.
Cg1—19 to 28 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; mildly alkaline; gradual wavy boundary.
Cg2—28 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to the sandy and loamy underlying material: 8 to 16 inches
Depth to carbonates: 16 to 36 inches

Oa horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material

A horizon:
Hue—10YR to 5Y
Value—3 or 4
Chroma—1 or 2
Texture—very fine sandy loam, very fine sand, or silt loam

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

Seelyeville Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Landform: Glacial lake plains
Parent material: Highly decomposed herbaceous organic material
Slope range: 0 to 2 percent
Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Seelyeville mucky peat, 1,400 feet south and 350 feet east of the northwest corner of sec. 16, T. 160 N., R. 31 W.

Oe—0 to 3 inches; hemic material, very dark grayish brown (10YR 3/2) broken face and rubbed; 60 percent fiber unrubbed, 25 percent rubbed; weak fine granular structure; nonsticky, nonplastic; mostly herbaceous fiber; moderately acid; clear smooth boundary.
Oa1—3 to 20 inches; sapric material, very dark grayish brown (10YR 3/2) broken face and rubbed; 30 percent fiber unrubbed, 10 percent rubbed; weak

very fine granular structure; nonsticky, nonplastic; mostly herbaceous fiber; moderately acid; clear wavy boundary.

Oa2—20 to 49 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; 20 percent fiber unrubbed, 5 percent rubbed; massive; nonsticky, nonplastic; mostly herbaceous fiber; moderately acid; clear wavy boundary.

Oa3—49 to 60 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; 15 percent fiber unrubbed, 3 percent rubbed; massive; nonsticky, nonplastic; mostly herbaceous fiber; moderately acid.

Range in Characteristics

Thickness of the organic material: More than 60 inches
Kind of organic material: Herbaceous

Oe horizon:
Hue—7.5YR or 10YR
Value—2 or 3
Chroma—2 or 3
Texture—hemic material

Oa horizon:
Hue—7.5YR or 10YR
Value—2 or 3
Chroma—1 to 3
Texture—sapric material

Spooner Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate or moderately rapid
Landform: Glacial lake plains
Parent material: Silty, calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed, frigid Typic Ochraqualfs

Typical Pedon

Spooner very fine sandy loam, 2,094 feet west and 574 feet south of the northeast corner of sec. 20, T. 161 N., R. 31 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 6/1) dry; weak very fine subangular blocky structure; very friable; mildly alkaline; abrupt smooth boundary.

E—6 to 15 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; common fine faint light gray (2.5Y 7/2) and common fine prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak very thin platy structure; very friable; neutral; clear smooth boundary.

Btg—15 to 22 inches; olive gray (5Y 5/2) loam; common fine distinct olive brown (2.5Y 4/4) and few fine prominent yellowish red (5YR 4/8) mottles; moderate very fine angular blocky structure; friable; common thin grayish brown (2.5Y 5/2) clay films on faces of peds; mildly alkaline; clear smooth boundary.

Cg1—22 to 30 inches; light olive gray (5Y 6/2) silt loam; common fine distinct light olive brown (2.5Y 5/4), common fine prominent yellowish brown (10YR 5/6), and common fine faint light gray (5Y 7/2) mottles; massive; varved; very friable; strong effervescence; mildly alkaline; gradual wavy boundary.

Cg2—30 to 60 inches; light olive gray (5Y 6/2) silt; common fine prominent yellowish brown (10YR 5/6), common fine distinct light olive brown (2.5Y 5/4), common fine prominent strong brown (7.5YR 5/8), and common fine faint light gray (5Y 7/2) mottles; massive; varved; very friable; strong effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 25 inches
Other features: An A horizon in some pedons

Ap horizon:
Hue—10YR
Value—3 to 5
Chroma—1 or 2
Texture—very fine sandy loam

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

Btg horizon:
Hue—10YR to 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, silty clay loam, silt loam, or clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 3
Texture—silty clay loam, clay loam, silt loam, very fine sandy loam, or silt

Strandquist Series

Depth class: Very deep
Drainage class: Poorly drained

Permeability: Rapid in the upper part; moderate in the lower part
Landform: Glacial lake plains
Parent material: Sandy and gravelly glaciolacustrine sediments over loamy, calcareous glacial till
Slope range: 0 to 1 percent
Taxonomic class: Sandy-skeletal over loamy, mixed (calcareous), frigid Typic Haplaquolls

Typical Pedon

Strandquist sandy loam, 250 feet north and 250 feet west of the southeast corner of sec. 33, T. 163 N., R. 33 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; 10 percent gravel; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bg—8 to 14 inches; grayish brown (2.5Y 5/2) very gravelly sand; single grain; loose; 35 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—14 to 36 inches; grayish brown (2.5Y 5/2) very gravelly coarse sand; single grain; loose; 45 percent gravel; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Cg2—36 to 60 inches; light brownish gray (2.5Y 6/2) loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Depth to the 2Cg horizon: 20 to 40 inches

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

Bg horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—the very gravelly analogs of sand, coarse sand, loamy coarse sand, loamy sand, or coarse sandy loam
Content of rock fragments—35 to 60 percent

Cg horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—the very gravelly analogs of coarse sand, sand, loamy coarse sand, or loamy sand
Content of rock fragments—35 to 60 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, sandy loam, fine sandy loam, silt loam, clay loam, or silty clay loam
Content of rock fragments—2 to 10 percent gravel

Suomi Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Glacial moraines
Parent material: Clayey, calcareous glacial till
Slope range: 1 to 4 percent gravel
Taxonomic class: Fine, mixed Glossaquic Eutroboralfs

Typical Pedon

Suomi loam, 1 to 4 percent slopes, 2,200 feet north and 200 feet east of the southwest corner of sec. 17, T. 162 N., R. 34 W.

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

E—4 to 8 inches; brown (10YR 5/3) sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; 1 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—8 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; strong fine angular blocky structure; firm; many distinct dark brown (10YR 3/3) clay films on faces of peds and in pores; 1 percent gravel; slightly acid; clear wavy boundary.

Bt2—15 to 20 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct yellowish brown (10YR 5/8) and light brownish gray (10YR 6/2) mottles; strong fine angular blocky structure; firm; common distinct brown (10YR 4/3) clay films on faces of peds and in pores; 1 percent gravel; neutral; clear wavy boundary.

C1—20 to 26 inches; pale brown (10YR 6/3) clay loam; common fine distinct yellowish brown (10YR 5/6) and common fine faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; 5 percent gravel; strong effervescence; mildly alkaline; clear wavy boundary.

C2—26 to 40 inches; dark grayish brown (10YR 4/2) clay loam; few fine prominent brown (7.5YR 5/4) and common fine distinct light gray (10YR 7/2) mottles; massive; firm; 3 percent gravel; strong

effervescence; mildly alkaline; clear wavy boundary.
C3—40 to 60 inches; pale brown (10YR 6/3) clay loam; few fine prominent brown (7.5YR 5/4) and common fine distinct light gray (10YR 7/2) mottles; massive; friable; 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 25 inches
Content of rock fragments: 1 to 8 percent gravel

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

E horizon:
Hue—10YR
Value—5 or 6
Chroma—1 to 3
Texture—sandy loam or fine sandy loam

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—3 or 4
Texture—clay loam or silty clay loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 3
Texture—loam, clay loam, clay, silty clay loam, silty clay, or sandy loam

Tacoosh Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid or moderate in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains
Parent material: Moderately decomposed organic material over mineral material
Slope range: 0 to 2 percent
Taxonomic class: Loamy, mixed, euic Terric Borohemists

Typical Pedon

Tacoosh muck, 2,200 feet east and 250 feet south of the northwest corner of sec. 20, T. 162 N., R. 33 W.

Oi—5 inches to 0; living mosses.
Oa—0 to 6 inches; sapric material, black (10YR 2/1) broken face and rubbed; 20 percent fiber, 15 percent rubbed; weak fine granular structure; nonsticky, nonplastic; mostly herbaceous fiber; slightly acid; clear smooth boundary.
Oe1—6 to 19 inches; hemic material, very dark brown (10YR 2/2) broken face and rubbed; 50 percent fiber, 30 percent rubbed; weak fine subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; 10 percent woody fragments; slightly acid; gradual wavy boundary.
Oe2—19 to 36 inches; hemic material, very dark grayish brown (10YR 3/2) broken face and rubbed; 70 percent fiber, 40 percent rubbed; weak fine subangular blocky structure; nonsticky, nonplastic; mostly herbaceous fibers; 10 percent woody fragments; neutral; abrupt smooth boundary.
A—36 to 38 inches; black (5Y 2/1) loam; massive; friable; strong effervescence; mildly alkaline; clear smooth boundary.
Cg1—38 to 42 inches; dark grayish brown (2.5Y 4/2) loam; few fine distinct light gray (N 7/0) mottles; massive; friable; strong effervescence; mildly alkaline; clear wavy boundary.
Cg2—42 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; many fine distinct light olive brown (2.5Y 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the organic material: 16 to 50 inches
Kind of organic material: Herbaceous with woody fragments

Oa horizon:
Hue—5YR to 10YR
Value—2 to 4
Chroma—1 or 2
Texture—sapric material

Oe horizon:
Hue—5YR to 10YR
Value—2 to 4
Chroma—1 or 2
Texture—hemic material

A horizon:
Hue—2.5Y, 5Y, or neutral
Value—1 or 2
Chroma—0 to 2
Texture—loam, clay loam, silty clay loam, or sandy loam

Cg horizon:
Hue—2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, clay loam, silty clay loam, or sandy loam

Tawas Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; rapid in the lower part
Landform: Glacial lake plains
Parent material: Woody organic material overlying sandy mineral material
Slope range: 0 to 2 percent
Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Tawas muck, 1,200 feet north and 100 feet east of the southwest corner of sec. 6, T. 159 N., R. 33 W.

Oa1—0 to 8 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; 20 percent fiber, 5 percent rubbed; weak medium granular structure; nonsticky; mostly herbaceous fiber; very strongly acid; clear smooth boundary.

Oa2—8 to 16 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; 25 percent fiber, 8 percent rubbed; weak medium and coarse subangular blocky structure; nonsticky; herbaceous and woody fiber; very strongly acid; gradual smooth boundary.

Oa3—16 to 25 inches; sapric material, very dark brown (10YR 2/2) broken face and rubbed; about 30 percent fiber, 10 percent rubbed; weak coarse subangular blocky structure; very friable; mostly woody fiber; 5 percent wood fragments; very strongly acid; gradual smooth boundary.

Oa4—25 to 33 inches; sapric material, very dark brown (10YR 2/2) broken face and rubbed; 25 percent fiber, 8 percent rubbed; weak coarse subangular blocky structure; very friable; mostly woody fiber; 5 percent wood fragments; strongly acid; clear smooth boundary.

Oa5—33 to 36 inches; sapric material, black (10YR 2/1) broken face and rubbed; 15 percent fiber, about 5 percent rubbed; massive; nonsticky; herbaceous and woody fiber; strongly acid; abrupt smooth boundary.

Cg—36 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; single grain; loose; neutral.

Range in Characteristics

Thickness of the organic material: 20 to 50 inches
Kind of organic material: Herbaceous and woody fiber
Other features: An A horizon in some pedons

Oa horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—sapric material

Cg horizon:
Hue—10YR to 5Y
Value—4 to 6
Chroma—1 to 3
Texture—sand, loamy sand, coarse sand, fine sand, loamy coarse sand, loamy fine sand, or gravelly sand
Content of rock fragments—0 to 30 percent gravel

Taylor Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Glacial lake plains
Parent material: Clayey, calcareous glaciolacustrine sediments
Slope range: 1 to 8 percent
Taxonomic class: Very fine, montmorillonitic Aquic Eutroboralfs

Typical Pedon

Taylor loam, 1 to 8 percent slopes, 1,500 feet east and 1,800 feet north of the southwest corner of sec. 11, T. 160 N., R. 31 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; friable; slightly acid; clear smooth boundary.

E—6 to 12 inches; brown (10YR 5/3) sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak thick platy structure; very friable; slightly acid; clear wavy boundary.

Bt1—12 to 17 inches; brown (10YR 4/3) clay; common fine distinct yellowish brown (10YR 5/6) mottles; strong medium and coarse angular blocky structure; firm; many faint dark brown (10YR 3/3) clay films on faces of peds and in pores; neutral; gradual wavy boundary.

Bt2—17 to 29 inches; dark grayish brown (10YR 4/2) clay; few fine distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; common faint dark brown (10YR 3/3) clay films on faces of peds and in pores; mildly alkaline; gradual wavy boundary.

C—29 to 60 inches; grayish brown (2.5Y 5/2) silty clay; many fine faint light brownish gray (2.5Y 6/2) mottles; massive; firm; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 39 inches

Ap horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—loam or loamy fine sand

E horizon:
Hue—10YR
Value—4 or 5
Chroma—1 to 3
Texture—silt loam, silty clay loam, loam, sandy loam, very fine sandy loam, loamy very fine sand, loamy fine sand, or fine sand

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—clay

C horizon:
Hue—10YR to 5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay or silty clay loam; varves of very fine sandy loam to silty clay loam in some pedons

Wabanica Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Glacial lake plains
Parent material: Silty, calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed (calcareous), frigid Typic Haplaquolls

Typical Pedon

Wabanica silt loam, about 100 feet east and 150 feet north of the southwest corner of sec. 4, T. 162 N., R. 33 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium and fine granular structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Bg—8 to 11 inches; dark gray (10YR 4/1) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—11 to 28 inches; grayish brown (2.5Y 5/2) silt loam; many fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—28 to 39 inches; grayish brown (10YR 5/2) silt loam; many medium and fine distinct yellowish brown (10YR 5/6) and common fine faint light gray (10YR 7/1) mottles; massive; friable; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg3—39 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; many medium and fine distinct yellowish brown (10YR 5/6) and common fine faint light gray (10YR 7/1) mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 14 inches
Content of rock fragments: 0 to 3 percent gravel
Depth to carbonates: 0 to 5 inches

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

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

Cg horizon:
Hue—10YR to 5Y
Value—4 to 6
Chroma—1 or 2
Texture—silt loam or silty clay loam

Waupaca Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Water-laid sediments
Slope range: 0 to 2 percent
Taxonomic class: Coarse-silty, mixed, nonacid, frigid Mollic Fluvaquents

Typical Pedon

Waupaca very fine sandy loam, in an area of Waupaca-Eutroboralfs complex, 0 to 60 percent slopes, 400 feet east and 2,150 feet north of the southwest corner of sec. 9, T. 160 N., R. 32 W.

A—0 to 8 inches; black (10YR 2/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

Cg1—8 to 16 inches; dark grayish brown (2.5Y 4/2) very fine sandy loam; common fine prominent dark yellowish brown (10YR 3/6) and light gray (10YR 7/1) mottles; massive; very friable; neutral; clear smooth boundary.

Cg2—16 to 21 inches; dark grayish brown (2.5Y 4/2) silt loam; common fine prominent dark brown (7.5YR 3/4) and few fine faint grayish brown (2.5Y 5/2) mottles; massive; friable; mildly alkaline; clear wavy boundary.

Cg3—21 to 60 inches; light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2), stratified silt, silt loam, and very fine sand; common fine prominent strong brown (7.5YR 4/4) and few fine faint gray (5Y 5/1) mottles; massive; varved; very friable; slight effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 40 inches

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

Cg horizon:
Hue—10YR to 5Y or neutral
Value—4 to 6
Chroma—0 to 2
Texture—very fine sandy loam, silt loam, silt, very fine sand, or strata with those textures

Wega Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Water-laid sediments
Slope range: 0 to 3 percent
Taxonomic class: Coarse-silty, mixed, nonacid, frigid Aquic Udifluvents

Typical Pedon

Wega silt loam, 700 feet west and 1,850 feet north of the southeast corner of sec. 22, T. 159 N., R. 30 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; neutral; clear smooth boundary.

C1—8 to 14 inches; dark grayish brown (2.5Y 4/2) silt loam; massive; friable; neutral; clear smooth boundary.

C2—14 to 19 inches; brown (10YR 4/3) silt loam; massive; very friable; neutral; clear wavy boundary.

C3—19 to 24 inches; brown (10YR 4/3) very fine sandy loam; massive; very friable; mildly alkaline; gradual wavy boundary.

C4—24 to 54 inches; brown (10YR 5/3) and grayish brown (2.5Y 5/2), stratified very fine sandy loam, loamy very fine sand, silt, and silt loam; common fine distinct yellowish brown (10YR 5/6) and dark brown (7.5YR 4/4) mottles; massive; varved; mildly alkaline; gradual wavy boundary.

C5—54 to 60 inches; yellowish brown (10YR 5/4), stratified silt and silt loam; common fine distinct light brownish gray (10YR 6/2) mottles; massive; varved; slight effervescence; mildly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—silt loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—stratified very fine sandy loam, silt, silt loam, fine sand, and sand

Wildwood Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper part; slow in the lower part
Landform: Glacial lake plains
Parent material: Thin layer of organic material over clayey glaciolacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Very fine, montmorillonitic, nonacid, frigid Histic Humaquepts

Typical Pedon

Wildwood mucky peat, 1,300 feet south and 1,150 feet east of the northwest corner of sec. 6, T. 160 N., R. 30 W.

Oe—0 to 6 inches; hemic material, very dark grayish brown (10YR 3/2) broken face, very dark brown (10YR 2/2) rubbed; 35 percent fiber, 20 percent rubbed; weak moderate subangular blocky structure parting to weak fine granular; friable; mostly

herbaceous fiber; slightly acid; clear smooth boundary.

Oa—6 to 10 inches; sapric material, black (10YR 2/1) broken face and rubbed; 15 percent fiber, 5 percent rubbed; weak moderate subangular blocky structure parting to weak thin platy; very friable; mostly herbaceous fiber; slightly acid; clear smooth boundary.

A—10 to 12 inches; black (5Y 2/1) silty clay loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bg—12 to 18 inches; very dark gray (5Y 3/1) clay; weak moderate subangular blocky structure; firm; neutral; gradual wavy boundary.

Cg1—18 to 34 inches; dark gray (5Y 4/1) clay; few fine prominent yellowish brown (10YR 5/8) and common fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; mildly alkaline; gradual wavy boundary.

Cg2—34 to 60 inches; olive gray (5Y 5/2) clay; common medium prominent yellowish brown (10YR 5/6) and few fine faint light olive gray (5Y 6/2) mottles; massive; firm; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the organic material: 8 to 16 inches
Kind of organic material: Herbaceous

Oe horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—hemic material

Oa horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material

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

Bg horizon:
Hue—10YR to 5Y
Value—3 or 4
Chroma—1 or 2
Texture—clay

Cg horizon:
Hue—2.5Y or 5Y
Value—3 or 4
Chroma—1 or 2
Texture—clay or silty clay

Woodslake Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Very slow
Landform: Glacial lake plains
Parent material: Clayey glaciolacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Very fine, montmorillonitic, frigid Typic Haplaquolls

Typical Pedon

Woodslake clay, 1,400 feet east and 2,600 feet south of the northwest corner of sec. 6, T. 160 N., R. 30 W.

Ap—0 to 7 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; weak fine granular structure; firm; mildly alkaline; clear smooth boundary.

Bg—7 to 10 inches; dark gray (5Y 4/1) clay; common fine prominent yellowish brown (10YR 5/6) and brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; very firm; neutral; gradual smooth boundary.

BCg—10 to 19 inches; dark grayish brown (2.5Y 4/2) clay; many medium prominent yellowish brown (10YR 5/6) and few fine prominent light gray (10YR 7/2) mottles; moderate very fine subangular blocky structure; firm; mildly alkaline; gradual wavy boundary.

Cg1—19 to 45 inches; grayish brown (2.5Y 5/2) clay; many fine prominent yellowish brown (10YR 5/6) and common fine distinct light gray (10YR 7/2) mottles; massive; firm; slight effervescence; mildly alkaline; gradual wavy boundary.

Cg2—45 to 60 inches; gray (5Y 5/1) clay; common fine prominent yellowish brown (10YR 5/6), few fine prominent pink (7.5YR 7/4), common medium prominent light brownish gray (10YR 6/2), and few fine prominent light gray (10YR 7/1) mottles; massive; firm; strong effervescence; mildly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 9 inches
Depth to carbonates: 11 to 24 inches
Other features: An Ap horizon in some pedons

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

Bg horizon:
Hue—10YR to 5Y
Value—3 to 5
Chroma—1 or 2
Texture—clay

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—clay

Zippel Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Glacial lake plains
Parent material: Silty and loamy, calcareous glaciolacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Coarse-silty, mixed (calcareous), frigid Typic Haplaquolls

Typical Pedon

Zippel very fine sandy loam, 2,300 feet north and 400 feet west of the southeast corner of sec. 11, T. 162 N., R. 34 W.

Ap—0 to 7 inches; black (10YR 2/1) very fine sandy loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; very friable; slight effervescence; neutral; abrupt smooth boundary.

Bg—7 to 12 inches; dark brownish gray (2.5Y 4/2) very fine sandy loam; few fine faint dark gray (10YR 4/1) and common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—12 to 25 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

Cg2—25 to 27 inches; light brownish gray (2.5Y 6/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; very friable; strong effervescence; moderately alkaline; clear wavy boundary.

Cg3—27 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches

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

Bg horizon:
Hue—2.5Y
Value—3 to 5
Chroma—1 or 2
Texture—very fine sand, very fine sandy loam, loamy very fine sand, loam, or silt loam

Cg horizon:
Hue—2.5Y or 5Y
Value—6 or 7
Chroma—1 or 2
Texture—very fine sand, very fine sandy loam, loamy very fine sand, loam, or silt loam

Formation of the Soils

Soils form as a result of the interaction of five factors. These factors are parent material, climate, plant and animal life, relief, and time (Jenny, 1941). Climate and plant and animal life are the active factors of soil genesis. Their effect on the parent material is conditioned by relief and time. Together, these factors slowly change the parent material into a natural body that has genetically related horizons. The factors of soil formation and their effects on the soils in the survey area are described in this section.

Parent Material

Parent material is the physical medium in which a soil forms. The parent material in most of the survey area is derived from calcareous, loamy glacial till, which was deposited during the last glaciation. This glacial till was worked and reworked by glacial Lake Agassiz, which covered the survey area after the glacier receded. Loamy glacial till underlies all of the glacial lake sediments in Lake of the Woods County. It is at or near the surface in the northern, central, and eastern portions of the county. Differences in the depth of these glacial deposits account for many of the differences in the soils.

Soils along the Rainy River and in areas south of Zippel Bay are primarily derived from material deposited by the waters of glacial Lake Agassiz. Lacustrine silt and clay were deposited in lake basins, and lacustrine sand was deposited on sandbars and deltas and in interbeach areas.

Many gently sloping beach ridges and sandbars were left interspersed throughout the area after glacial Lake Agassiz receded. Soils that formed in these sandy and gravelly sediments are in the western and central parts of the survey area.

Organic soils are in many parts of the survey area. These soils formed in herbaceous and woody plant materials and in material derived from sphagnum moss. The various stages of decomposition of the organic material and the depth of the material account for the differences in the organic soils.

Shallow soils are on islands in the part of Lake of the Woods County known as the Northwest Angle. These soils formed in loamy material overlying bedrock in areas of bedrock-controlled terrain.

Climate

Climate has affected the formation of soils in the survey area. The parent material originated during a period of continental glaciers. The survey area was covered by glacial Lake Agassiz after the climate warmed and the glaciers melted and receded. Eventually, the climate stabilized at present temperatures and the glacial lake drained.

As a soil-forming factor, climate affects the physical, chemical, and biological characteristics of the soils. Lake of the Woods County has a cool, subhumid climate with wide variations in temperature from summer to winter. During the winter, the soil is frozen to a depth of 3 to 5 feet for 6 months and the soil-forming processes, except for frost action, are dormant.

Climate has the greatest effect on the soil-forming processes during the growing season. The amount of rainfall influences the rate at which soluble and colloidal materials are removed from the upper part of the soil and deposited in the lower part of the profile. Under perennial wet and cool conditions, the decomposition of vegetation is inhibited and peat accumulates. There is slightly more precipitation in the eastern part of the county than in the western part. This difference in precipitation has affected the types of native vegetation. Soils in the northern and central parts of the survey area formed under prairie vegetation, and soils in the southern and eastern parts formed under forest vegetation.

Plants and Animals

Lake of the Woods County is located on the prairie-forest ecological border. Small areas of prairie are interspersed throughout the county. Prairie vegetation and cool temperatures promote the accumulation of organic matter.

Organic soils form in partially decomposed plant material. The organic soils in this survey area are categorized on the basis of their parent material, which

is herbaceous or woody or consists mostly of sphagnum moss.

The sandy, glacial lake beach areas are dominated by jack pine and red pine. Soils that formed in these southern and western regions are characterized by a low content of organic matter in the surface layer and a greater depth to free lime because of leaching.

The areas of glacial till in the northern, central, and eastern parts of the county support quaking aspen, paper birch, balsam fir, white spruce, or a mixture of these species. The soils in these regions contain a moderate amount of organic matter and have a moderate level of fertility. They have well developed profiles because of the translocation of clay particles.

The effects of animal activities on the formation of soils in the survey area are slight in comparison with the influence of plants. Earthworms and rodents mix the surface soil, subsoil, and parent material. Human activities also have influenced soil formation. In cultivated areas, tillage has partially altered the original structure of the surface soil and has mixed the darker surface layer with the lighter colored subsoil. Applications of fertilizer, crop residue, and manure have increased soil fertility.

Relief

Relief influences soil formation through its effect on temperature, drainage, erosion, and vegetation. Relief, or topography, is the most important factor in the differentiation of soils that formed in similar parent materials.

The topography in most of Lake of the Woods County is nearly level or gently sloping. Because of the low relief of the glacial lake plain, many soils in the county are poorly drained, have a high content of organic matter, and are mottled to varying degrees of intensity. About half of the acreage in the survey area is classified as very poorly drained and is covered with organic material.

Gently sloping areas are on beach ridges, which formed as a result of the wave action of glacial Lake Agassiz. The sandy and gravelly soils in these areas commonly are better drained, have less clay and organic matter, and have a lower water-holding capacity than the soils on the nearly level glacial lake plain.

Time

The soils in the survey area are geologically young. The soil-forming processes have been active for only about 9,000 to 12,000 years. Parent material was deposited by the most recent glacier and was worked and reworked by the waters of glacial Lake Agassiz.

Because of the relatively short period of soil formation, the soils in the survey area have thinner profiles than soils that formed over a longer period. The degree of profile development is determined by other soil-forming factors, but time is always needed for any of the other factors to have an effect.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root

channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Congeliturbate. Soil material disturbed by frost action.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

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.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods.

Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys

and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when

thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and

low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, 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.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing

a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then

multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, the slope classes are as follows:

Nearly level	0 to 2 percent
Gently sloping	2 to 8 percent
Moderately steep	8 to 30 percent
Steep	30 to 60 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil

material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

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Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-85 at Baudette, Minnesota)

Month	Temperature						Precipitation				
				2 years in 10 will have--		Average		2 years in 10 will have--		Average	
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	number of growing degree days*	Average	Less than--	More than--	number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	13.6	-10.2	1.7	40	-41	0	0.57	0.20	0.88	2	6.7
February----	21.8	-4.6	8.6	46	-39	0	.44	.20	.67	1	5.2
March-------	33.8	8.2	21.0	56	-30	3	.68	.19	1.12	2	5.8
April-------	51.7	27.7	39.7	80	-1	112	1.49	.62	2.23	3	2.5
May---------	66.4	39.9	53.1	88	20	410	2.46	1.19	3.56	6	.2
June--------	74.4	49.8	62.1	91	31	657	3.87	2.35	5.24	8	.0
July--------	80.1	54.9	67.5	94	40	838	3.49	2.32	4.55	6	.0
August------	77.6	52.5	65.0	93	36	758	3.44	1.76	4.92	5	.0
September---	66.9	43.2	55.0	88	24	447	2.65	1.38	3.76	6	.0
October-----	55.6	34.1	44.8	79	15	193	2.08	.88	3.10	4	.5
November----	35.8	18.5	27.1	63	-17	19	.98	.43	1.45	2	6.6
December----	20.1	-0.6	9.7	43	-34	0	.64	.28	.97	2	6.8
Yearly:											
Average---	49.8	26.1	38.0	---	---	---	---	---	---	---	---
Extreme---	101	-46	---	98	-42	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,438	22.80	14.24	28.80	47	34.4

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

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-85 at Baudette, Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 23	May 28	June 6
2 years in 10 later than--	May 16	May 22	June 1
5 years in 10 later than--	May 2	May 11	May 22
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 26	Sept. 13	Sept. 8
2 years in 10 earlier than--	Oct. 1	Sept. 19	Sept. 11
5 years in 10 earlier than--	Oct. 11	Sept. 30	Sept. 19

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-85 at Baudette, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	134	116	99
8 years in 10	143	125	106
5 years in 10	161	141	120
2 years in 10	178	158	133
1 year in 10	187	167	140

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
48B	Hiwood fine sand, 0 to 6 percent slopes	22,470	2.9
52	Augsburg loam	4,820	0.6
77B	Garnes fine sandy loam, 1 to 4 percent slopes	12,390	1.6
116	Redby loamy fine sand	28,860	3.8
117	Cormant loamy fine sand	27,710	3.6
122B	Taylor loam, 1 to 8 percent slopes	5,540	0.7
145	Enstrom loamy sand	11,210	1.5
147	Spooner very fine sandy loam	6,050	0.8
167B	Baudette fine sandy loam, 1 to 4 percent slopes	5,620	0.7
172	Indus clay loam	9,850	1.3
187	Haug muck	26,490	3.5
191	Epoufette loamy fine sand	4,820	0.6
195B	Taylor loamy fine sand, 1 to 4 percent slopes	3,080	0.4
202	Meehan loamy sand	8,800	1.1
205	Karlstad loamy sand	4,620	0.6
242B	Marquette loamy sand, 1 to 8 percent slopes	1,925	0.3
242D	Marquette loamy fine sand, 8 to 25 percent slopes	280	*
280	Pelan sandy loam	2,465	0.3
379	Percy loam, very stony	3,000	0.4
387	Roliss loam, depressional	7,470	1.0
404	Chilgren fine sandy loam	31,040	4.0
425	Donaldson loamy very fine sand	1,540	0.2
432	Strandquist sandy loam	2,030	0.3
458B	Menahga loamy sand, 0 to 6 percent slopes	8,920	1.2
481	Kratka fine sandy loam	17,500	2.3
482	Grygla loamy fine sand	34,000	4.4
514	Tacoosh muck	22,260	2.9
532	Sago muck	5,390	0.7
540	Seelyeville mucky peat	20,170	2.6
541	Rifle mucky peat	78,750	10.2
543	Markey muck	35,420	4.6
544	Cathro muck	40,000	5.2
546	Lupton mucky peat	31,260	4.1
549	Greenwood peat	22,790	3.0
560	Greenwood-Lobo peats	10,795	1.4
563	Northwood muck	18,400	2.4
565	Eckvoll loamy fine sand	9,870	1.3
568	Zippel very fine sandy loam	3,150	0.4
569	Wabanica silt loam	2,835	0.4
570	Faunce fine sand	3,620	0.5
581	Percy fine sandy loam	17,090	2.2
582	Roliss clay loam	8,850	1.2
616	Effie loam	11,320	1.5
626	Suomi loam, 1 to 4 percent slopes	6,390	0.8
627	Tawas muck	12,330	1.6
630	Wildwood mucky peat	4,390	0.6
641	Clearwater clay	9,320	1.2
644	Boash clay loam	4,470	0.6
655	Bearville loamy fine sand	4,930	0.6
702	Bullwinkle-Cathro mucks	24,900	3.2
755	Woodslake clay	4,775	0.6
792	Fordum fine sandy loam	3,175	0.4
794	Faunce Variant loamy fine sand	1,480	0.2
828D	Insula-Mesaba gravelly loams, 2 to 30 percent slopes	1,470	0.2
952E	Quetico-Rock outcrop complex, 6 to 35 percent slopes	1,840	0.2
1030	Udorthents-Pits, gravel, complex	630	0.1
1033	Beaches-Menahga complex	580	0.1
1059	Wega silt loam	3,260	0.4
1066	Rock outcrop-Garnes complex, very stony	540	0.1
1067	Waupaca-Eutroboralfs complex, 0 to 60 percent slopes	4,990	0.7
1807	Cathro muck, ponded	6,930	0.9
1808	Markey muck, ponded	7,620	1.0
1923	Garnes loam, very stony	2,240	0.3

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1924	Grygla fine sandy loam, very stony	610	0.1
1925	Eckvoll loamy fine sand, very stony	700	0.1
1984	Leafriver muck	23,560	3.1
	Water	1,400	0.2
	Total	767,000	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
52	Augsburg loam (where drained)
77B	Garnes fine sandy loam, 1 to 4 percent slopes
122B	Taylor loam, 1 to 8 percent slopes
147	Spooner very fine sandy loam (where drained)
167B	Baudette fine sandy loam, 1 to 4 percent slopes
172	Indus clay loam (where drained)
195B	Taylor loamy fine sand, 1 to 4 percent slopes
280	Pelan sandy loam
404	Chilgren fine sandy loam (where drained)
425	Donaldson loamy very fine sand
432	Strandquist sandy loam (where drained)
481	Kratka fine sandy loam (where drained)
568	Zippel very fine sandy loam (where drained)
569	Wabanica silt loam (where drained)
581	Percy fine sandy loam (where drained)
582	Roliss clay loam (where drained)
616	Effie loam (where drained)
626	Suomi loam, 1 to 4 percent slopes
641	Clearwater clay (where drained)
644	Boash clay loam (where drained)
1059	Wega silt loam (where drained)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Irish potatoes	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Cwt	Tons	AUM*
48B---------- Hiwood	IVs	25	50	35	---	2.5	3.7
52---------- Augsburg	IIw	45	78	55	175	4.0	5.2
77B---------- Garnes	IIe	40	80	55	---	4.2	5.8
116---------- Redby	IIIw	30	60	40	---	2.8	4.1
117---------- Cormant	IVw	30	55	40	---	2.5	3.7
122B---------- Taylor	IIe	30	85	60	---	4.8	6.8
145---------- Enstrom	IVs	25	60	35	---	3.0	4.0
147---------- Spooner	IIw	40	85	55	240	4.5	6.0
167B---------- Baudette	IIe	45	95	60	300	4.8	6.4
172---------- Indus	IIIw	30	65	45	---	4.0	4.5
187---------- Haug	VIw	10	20	15	---	---	3.0
191---------- Epoufette	IIIw	20	55	30	---	2.5	3.5
195B---------- Taylor	IIe	35	85	60	---	4.8	6.8
202---------- Meehan	IVw	30	65	45	---	2.5	3.2
205---------- Karlstad	IVs	30	55	40	---	2.6	4.0
242B---------- Marquette	IVs	20	40	30	---	2.3	2.5
242D---------- Marquette	VIs	5	20	15	---	1.5	2.0
280---------- Pelan	IIIs	35	70	50	---	3.2	4.7
379---------- Percy	VIw	---	---	---	---	3.2	3.7

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Irish potatoes	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Cwt	Tons	AUM*
387--Roliss	VIw	10	30	20	---	3.2	3.5
404--Chilgren	IIw	45	80	60	---	3.5	4.0
425--Donaldson	IIe	40	80	60	200	3.6	5.5
432--Strandquist	IIIw	35	60	45	---	3.5	4.0
458B--Menahga	IVs	20	45	30	---	2.3	3.6
481--Kratka	IIIw	35	70	50	---	3.5	4.0
482--Grygla	IVw	30	60	40	120	3.2	3.7
514--Tacoosh	VIw	---	---	---	---	---	---
532--Sago	VIw	---	---	---	---	---	---
540--Seelyeville	VIw	---	---	---	---	---	---
541--Rifle	VIw	---	---	---	---	---	---
543--Markey	VIw	---	---	---	---	---	---
544--Cathro	VIw	---	---	---	---	---	---
546--Lupton	VIIw	---	---	---	---	---	---
549--Greenwood	VIIw	---	---	---	---	---	---
560--Greenwood-Lobo	VIIw	---	---	---	---	---	---
563--Northwood	VIw	10	20	15	---	---	3.0
565--Eckvoll	IIIs	35	65	45	---	3.0	4.5
568--Zippel	IIw	40	75	50	240	3.5	4.7
569--Wabanica	IIw	40	80	50	---	4.5	6.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Irish potatoes	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Cwt	Tons	AUM*
570---------- Faunce	IVs	20	40	30	---	2.0	2.7
581---------- Percy	IIw	40	70	50	---	3.5	4.0
582---------- Roliss	IIw	40	75	50	---	4.0	4.2
616---------- Effie	IIw	40	75	60	---	4.0	4.7
626---------- Suomi	IIe	30	70	50	---	4.2	5.9
627---------- Tawas	VIw	---	---	---	---	---	---
630---------- Wildwood	VIw	10	20	15	---	---	3.0
641---------- Clearwater	IIw	45	80	55	---	3.5	5.0
644---------- Boash	IIw	41	75	55	---	3.5	5.0
655---------- Bearville	IIIw	30	65	40	---	3.0	3.7
702---------- Bullwinkle-Cathro	VIw	---	---	---	---	---	---
755---------- Woodslake	IIIw	30	65	45	---	3.5	5.0
792---------- Fordum	VIw	---	---	---	---	---	2.7
794---------- Faunce Variant	IVs	20	40	30	---	2.2	3.0
828D---------- Insula-Mesaba	VIe	---	---	---	---	---	2.0
952E: Quetico--------	VIIs	---	---	---	---	---	1.5
Rock outcrop.							
1030. Udorthents-Pits							
1033: Beaches.							
Menahga--------	IVs	---	---	---	---	---	---
1059---------- Wega	IIw	35	70	50	---	4.0	5.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Spring wheat	Oats	Barley	Irish potatoes	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Cwt	Tons	AUM*
1066: Rock outcrop.							
Garnes	VIs	---	---	---	---	---	2.0
1067: Waupaca	VIw	---	---	---	---	3.0	3.5
Eutroboralfs.							
1807 Cathro	VIIIw	---	---	---	---	---	---
1808 Markey	VIIIw	---	---	---	---	---	---
1923 Garnes	VIs	15	30	20	---	3.2	3.7
1924 Grygla	VIw	10	20	15	---	3.0	3.2
1925 Eckvoll	VIs	10	20	15	---	2.5	3.5
1984 Leafriver	VIw	10	20	15	---	---	3.0

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Productivity class*	
48B---------- Hiwood	8S	Slight	Moderate	Moderate	Moderate	Red pine----------	64	8	Red pine, jack pine, white spruce.
						Eastern white pine--	46	5	
						Jack pine----------	63	6	
						White spruce--------	50	8	
						Balsam fir----------	59	8	
						Black spruce--------	52	3	
						Quaking aspen-------	71	6	
77B---------- Garnes	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	84	7	Red pine, eastern white pine, white spruce.
						Red pine----------	60	7	
						Eastern white pine--	55	7	
						Jack pine----------	65	7	
						White spruce--------	60	8	
						Sugar maple---------	55	2	
						Paper birch---------	70	6	
						Balsam fir----------	60	8	
						Bur oak----------	40	2	
116---------- Redby	7S	Slight	Moderate	Moderate	Moderate	Jack pine----------	67	7	Red pine, jack pine, white spruce.
						Quaking aspen-------	76	6	
						Red pine----------	49	5	
						White spruce--------	60	8	
						Black spruce--------	50	3	
117---------- Cormant	6W	Slight	Moderate	Moderate	Moderate	Quaking aspen-------	75	6	Black spruce, eastern white pine, white spruce.
						Black ash----------	50	2	
						Balsam fir----------	50	7	
122B---------- Taylor	6D	Slight	Moderate	Slight	Severe	Quaking aspen-------	79	6	White spruce, balsam fir, eastern white pine.
						Paper birch---------	65	5	
						Balsam fir----------	64	9	
						White spruce--------	58	8	
						Eastern white pine--	51	6	
						American basswood---	65	4	
						Jack pine----------	63	6	
						Red pine----------	54	6	
145---------- Enstrom	7S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	80	7	Red pine, eastern white pine, jack pine.
						Red pine----------	58	7	
						Eastern white pine--	54	7	
						Jack pine----------	60	6	
						White spruce--------	59	8	
147---------- Spooner	8W	Slight	Severe	Slight	Moderate	Quaking aspen-------	91	8	White spruce, black spruce.
						Paper birch---------	65	5	
						Balsam fir----------	60	8	
						Black ash----------	65	3	
						American elm--------	---	---	
						White spruce--------	60	8	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Productivity class*	
167B---------- Baudette	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	85	7	Balsam fir, white spruce, eastern white pine, red pine.
						Paper birch---------	65	5	
						Balsam fir----------	60	8	
						Black ash-----------	65	3	
						American elm--------	---	---	
						White spruce--------	60	8	
						Bur oak-------------	63	3	
						American basswood---	67	4	
172---------- Indus	7W	Slight	Moderate	Severe	Moderate	Quaking aspen-------	80	7	White spruce, eastern white pine, black spruce, balsam fir, tamarack, northern whitecedar.
						Paper birch---------	65	5	
						Balsam fir----------	55	8	
						Black ash-----------	65	3	
						White spruce--------	55	7	
191---------- Epoufette	5W	Slight	Severe	Moderate	Severe	Quaking aspen-------	64	5	Black spruce.
						Black ash-----------	---	---	
						Balsam fir----------	---	---	
						American elm--------	---	---	
195B---------- Taylor	6D	Slight	Moderate	Slight	Severe	Quaking aspen-------	79	6	White spruce, balsam fir, eastern white pine.
						Paper birch---------	65	5	
						Balsam fir----------	64	9	
						White spruce--------	58	8	
						Eastern white pine--	51	6	
						American basswood---	65	4	
						Jack pine-----------	63	6	
						Red pine------------	54	6	
202---------- Meehan	6W	Slight	Moderate	Slight	Moderate	Jack pine-----------	60	6	Eastern white pine, jack pine, white spruce, balsam fir, red pine, red maple.
						Red pine------------	60	7	
						Quaking aspen-------	70	6	
						Paper birch---------	60	4	
						Balsam fir----------	59	8	
						Eastern white pine--	55	7	
205---------- Karlstad	6L	Slight	Moderate	Slight	Slight	Jack pine-----------	60	6	Red pine, white spruce.
						Quaking aspen-------	65	5	
						Red pine------------	55	6	
						Eastern white pine--	55	7	
						Bur oak-------------	36	2	
242B---------- Marquette	6F	Slight	Slight	Moderate	Slight	Red pine------------	55	6	Red pine, white spruce, jack pine.
						Quaking aspen-------	63	5	
						Eastern white pine--	55	7	
						Jack pine-----------	65	7	
						Paper birch---------	---	---	
						White spruce--------	50	7	
						Bur oak-------------	---	---	
242D---------- Marquette	6R	Moderate	Moderate	Moderate	Slight	Red pine------------	55	6	Red pine, white spruce, jack pine.
						Quaking aspen-------	63	5	
						Eastern white pine--	55	7	
						Jack pine-----------	65	7	
						Paper birch---------	---	---	
						White spruce--------	50	7	
						Bur oak-------------	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Productivity class*	
280---------- Pelan	6L	Slight	Moderate	Slight	Slight	Jack pine----------	60	6	Red pine, white spruce.
						Red pine----------	55	6	
						White spruce--------	60	8	
						Eastern white pine--	55	7	
404---------- Chilgren	6W	Slight	Severe	Slight	Moderate	Quaking aspen-------	75	6	White spruce, black spruce.
						White spruce--------	55	7	
						Black ash----------	45	2	
						Balsam fir----------	50	7	
						Bur oak------------	38	2	
458B---------- Menahga	8S	Slight	Moderate	Moderate	Slight	Red pine----------	63	8	Red pine, white spruce, eastern white pine, jack pine.
						Jack pine----------	65	7	
						Eastern white pine--	57	8	
						Quaking aspen-------	66	5	
						Bigtooth aspen------	76	6	
						Paper birch---------	70	6	
						Balsam fir----------	68	9	
						Northern red oak----	55	3	
482---------- Grygla	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	76	6	White spruce, black spruce, eastern white pine.
						Jack pine----------	50	5	
546---------- Lupton	3W	Slight	Severe	Severe	Severe	Black spruce--------	40	3	Black spruce, balsam fir, northern whitecedar.
						Black ash----------	55	2	
						Northern whitecedar-	31	3	
						Balsam fir----------	50	7	
						Tamarack-----------	50	3	
						Paper birch---------	---	---	
549---------- Greenwood	4W	Slight	Severe	Severe	Severe	Black spruce--------	39	4	Black spruce, tamarack.
						Tamarack-----------	46	2	
560:									
Greenwood------	4W	Slight	Severe	Severe	Severe	Black spruce--------	39	4	Black spruce, tamarack.
						Tamarack-----------	46	2	
Lobo----------	2W	Slight	Severe	Severe	Severe	Black spruce--------	25	2	Black spruce, tamarack.
						Tamarack-----------	30	1	
565---------- Eckvoll	6L	Slight	Severe	Slight	Moderate	Quaking aspen-------	70	6	Red pine, northern red oak, white spruce.
						Bur oak------------	45	2	
						American basswood---	60	4	
570---------- Faunce	7S	Slight	Moderate	Moderate	Slight	Red pine----------	60	7	Red pine, jack pine, white spruce.
						Jack pine----------	50	5	
						Quaking aspen-------	75	6	
						Sugar maple---------	---	---	
						Paper birch---------	---	---	
						Bur oak------------	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Productivity class*	
616---------- Effie	7W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	80	7	White spruce, black spruce, balsam fir, tamarack, northern whitecedar.
						Balsam fir----------	60	8	
						Paper birch---------	65	5	
						Eastern white pine--	55	7	
						White spruce--------	60	8	
						Black ash-----------	65	3	
						Balsam poplar-------	90	---	
626---------- Suomi	7W	Slight	Moderate	Slight	Moderate	Quaking aspen-------	85	7	White spruce, eastern white pine, northern red oak, balsam fir, jack pine.
						Paper birch---------	70	6	
						American basswood---	70	5	
						Sugar maple---------	55	2	
						Northern red oak----	65	4	
						Balsam fir----------	65	9	
						Eastern white pine--	55	7	
						White spruce--------	60	8	
						Red pine------------	54	6	
627---------- Tawas	3W	Slight	Severe	Severe	Severe	Black spruce--------	40	3	---
						Northern whitecedar-	24	3	
						Balsam fir----------	50	7	
						Black ash-----------	55	2	
						Tamarack------------	47	3	
630---------- Wildwood	3W	Slight	Severe	Severe	Severe	Black ash-----------	60	3	Balsam fir, black spruce, northern whitecedar.
						Balsam fir----------	50	7	
						American elm--------	---	---	
						Black spruce--------	40	3	
						Tamarack------------	50	3	
						Northern whitecedar-	35	4	
655---------- Bearville	7W	Slight	Moderate	Moderate	Moderate	Quaking aspen-------	85	7	White spruce, black spruce, eastern white pine.
						Balsam fir----------	59	8	
						Paper birch---------	65	5	
						Black ash-----------	65	3	
						White spruce--------	60	8	
702:									
Bullwinkle-----	3W	Slight	Severe	Moderate	Severe	Black spruce--------	40	3	Black spruce, tamarack.
						Tamarack------------	37	2	
						Northern whitecedar-	35	4	
						Balsam fir----------	30	4	
Cathro.									
792---------- Fordum	6W	Slight	Severe	Severe	Severe	Quaking aspen-------	78	6	Black spruce, northern whitecedar, balsam fir, black ash, white oak, northern red oak.
						Balsam fir----------	---	---	
						Silver maple--------	---	---	
						Black ash-----------	---	---	
						American elm--------	---	---	
						White oak-----------	---	---	
						American basswood---	57	2	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Productivity class*	
794---------- Faunce Variant	5S	Slight	Moderate	Moderate	Slight	Jack pine----------	53	5	Red pine, white spruce.
						Red pine----------	54	6	
						Eastern white pine--	46	5	
						White spruce--------	50	7	
						Quaking aspen-------	75	6	
828D:									
Insula---------	6R	Moderate	Moderate	Moderate	Severe	Red pine----------	55	6	Red pine, jack pine.
						Eastern white pine--	50	6	
						Jack pine----------	60	6	
						Quaking aspen-------	65	5	
						Paper birch---------	60	4	
Mesaba---------	6R	Moderate	Moderate	Slight	Moderate	Red pine----------	55	6	Red pine, jack pine.
						Eastern white pine--	50	6	
						Jack pine----------	60	6	
						Quaking aspen-------	65	5	
						Paper birch---------	60	4	
952E:									
Quetico--------	2R	Moderate	Severe	Severe	Severe	Jack pine----------	35	2	Jack pine.
						Eastern white pine--	35	5	
						Red pine----------	35	4	
						Quaking aspen-------	35	2	
						Paper birch---------	40	3	
Rock outcrop.									
1059---------- Wega	5W	Slight	Severe	Slight	Moderate	Quaking aspen-------	65	5	White spruce, eastern white pine.
						Black ash----------	90	4	
						American elm--------	---	---	
						Bur oak------------	65	3	
						Paper birch---------	62	5	
						Silver maple--------	---	---	
1066:									
Rock outcrop.									
Garnes---------	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	80	7	Red pine, eastern white pine, white spruce.
						Red pine----------	60	7	
						Eastern white pine--	55	7	
						Jack pine----------	65	7	
						White spruce--------	60	8	
						Sugar maple---------	55	2	
						Paper birch---------	70	6	
						Balsam fir----------	60	8	
						Bur oak------------	40	2	
1067:									
Waupaca--------	3W	Slight	Severe	Moderate	Severe	Black ash----------	65	3	Black spruce, tamarack, balsam fir, green ash.
						American elm--------	---	---	
						Quaking aspen-------	60	4	
						Balsam fir----------	40	5	
Eutroboralfs.									

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Productivity class*	
1923---------- Garnes	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	80	7	Red pine, eastern white pine, white spruce.
						Red pine----------	60	7	
						Eastern white pine--	55	7	
						Jack pine----------	65	7	
						White spruce--------	60	8	
						Sugar maple---------	55	2	
						Paper birch---------	70	6	
						Balsam fir----------	60	8	
						Bur oak------------	40	2	
1924---------- Grygla	6X	Slight	Severe	Moderate	Moderate	Quaking aspen-------	75	6	White spruce, black spruce, eastern white pine.
						Jack pine----------	50	5	
1925---------- Eckvoll	6L	Slight	Severe	Slight	Moderate	Quaking aspen-------	70	6	Red pine, northern red oak, white spruce.
						Bur oak------------	45	2	
						American basswood---	60	4	

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(Only the soils suitable for windbreaks and environmental plantings are listed. The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
48B---------- Hiwood	---	Silver buffaloberry, lilac, Siberian peashrub, Manchurian crabapple, sargent crabapple, Siberian crabapple.	Red pine, Russian-olive, green ash.	Jack pine, eastern white pine, Siberian elm.	---
52---------- Augsburg	---	Common chokecherry, lilac, Siberian peashrub, eastern redcedar.	Russian-olive, bur oak, white spruce, blue spruce.	Golden willow, Siberian elm.	Eastern cottonwood.
77B---------- Garnes	---	Lilac, redosier dogwood, Siberian peashrub, American cranberrybush.	Blue spruce, white spruce, eastern redcedar, northern whitecedar.	Eastern white pine, jack pine, green ash, red pine.	---
116---------- Redby	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	White spruce, blue spruce, Russian-olive.	Hackberry, Norway spruce, red pine, jack pine, green ash.	---
117---------- Cormant	---	Siberian peashrub, redosier dogwood, American plum, lilac, common chokecherry.	White spruce, blue spruce, Manchurian crabapple.	Golden willow-----	Carolina poplar, eastern cottonwood.
122B---------- Taylor	---	Amur maple, cotoneaster, lilac, American cranberrybush, Siberian peashrub, northern whitecedar.	White spruce, eastern redcedar, Manchurian crabapple.	Eastern white pine, green ash, jack pine.	---
145---------- Enstrom	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, blue spruce, white spruce.	Norway spruce, jack pine, red pine, eastern white pine, green ash.	---
147---------- Spooner	---	Lilac, Siberian peashrub, American cranberrybush, redosier dogwood.	White spruce, northern whitecedar, blue spruce, Norway spruce.	Golden willow, eastern white pine, green ash.	Silver maple.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
167B---------- Baudette	---	Siberian peashrub, Amur maple, redosier dogwood, lilac.	White spruce, eastern redcedar, blue spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, green ash, red pine.	---
172---------- Indus	---	Redosier dogwood, lilac, Siberian peashrub, American cranberrybush.	Northern whitecedar, white spruce, Norway spruce, blue spruce.	Eastern white pine, green ash, golden willow.	Silver maple.
187---------- Haug	Common ninebark---	---	---	White willow, golden willow.	Imperial Carolina poplar.
191---------- Epoufette	---	Lilac, Siberian peashrub, common chokecherry, American cranberrybush, silver buffaloberry, arrowwood, common ninebark, American plum, redosier dogwood.	Blue spruce, Scotch pine, northern whitecedar, white spruce, hackberry, Amur maple, radiant crabapple, Manchurian crabapple.	Eastern white pine, green ash, golden willow.	Silver maple, eastern cottonwood, cottonwood, white willow.
195B---------- Taylor	---	Amur maple, cotoneaster, lilac, American cranberrybush, Siberian peashrub, northern whitecedar.	White spruce, eastern redcedar, Manchurian crabapple.	Eastern white pine, green ash, jack pine.	---
202---------- Meehan	---	Lilac, American plum, Siberian peashrub, redosier dogwood.	Eastern redcedar, blue spruce, white spruce.	Eastern white pine, red pine, jack pine, Norway spruce, green ash.	---
205---------- Karlstad	---	Northern whitecedar, Siberian peashrub, lilac.	Bur oak, blue spruce, white spruce, Russian-olive, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
242B, 242D-------- Marquette	Silver buffaloberry, Siberian peashrub, lilac.	Blue spruce, eastern redcedar, sargent crabapple, common chokecherry, Russian-olive, late lilac, Rocky Mountain juniper.	Red pine, green ash, Black Hills spruce, ponderosa pine, Scotch pine, silver maple, white spruce, white willow.	Eastern cottonwood, Siberian elm, golden willow.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
280--- Pelan	---	Lilac, Siberian peashrub, American cranberrybush, Amur maple.	Red pine, eastern redcedar, blue spruce, white spruce.	Norway spruce, eastern white pine, jack pine, green ash.	---
387--- Roliss	---	Redosier dogwood, black spruce.	Tamarack, black ash.	White willow, golden willow.	---
404--- Chilgren	---	Redosier dogwood, common ninebark, American cranberrybush, lilac, Siberian peashrub.	Norway spruce, white spruce, blue spruce, northern whitecedar.	Eastern white pine, green ash.	Silver maple.
425--- Donaldson	Lilac---	Siberian peashrub, eastern redcedar, common chokecherry.	Blue spruce, Russian-olive, white spruce, bur oak.	Siberian elm, golden willow.	Eastern cottonwood.
432--- Strandquist	---	Northern whitecedar, Siberian peashrub, lilac.	Bur oak, Russian-olive, white spruce, blue spruce, eastern redcedar, Manchurian crabapple.	Golden willow, green ash.	Eastern cottonwood.
458B--- Menahga	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
481--- Kratka	---	Lilac, Siberian peashrub, northern whitecedar.	Eastern redcedar, white spruce, hackberry, bur oak.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
482--- Grygla	---	Common ninebark, lilac, Siberian peashrub, American cranberrybush, redosier dogwood.	White spruce, northern whitecedar, blue spruce, Norway spruce.	Eastern white pine, green ash.	Silver maple.
540--- Seelyeville	Common ninebark---	---	---	Golden willow, white willow.	Imperial Carolina poplar.
565--- Eckvoll	---	Lilac, redosier dogwood, American cranberrybush, Siberian peashrub.	Blue spruce, white spruce, northern whitecedar, eastern redcedar.	Eastern white pine, jack pine, red pine, green ash.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
568---------- Zippel	---	Common chokecherry, American plum, northern whitecedar, Siberian peashrub, lilac.	Black Hills spruce, white spruce, hackberry.	Golden willow, green ash.	Eastern cottonwood.
569---------- Wabanica	---	Common chokecherry, lilac, nannyberry viburnum, northern whitecedar, Siberian peashrub, whitebelle honeysuckle, American plum.	Black Hills spruce, bur oak, Russian-olive, blue spruce, eastern redcedar, Manchurian crabapple, white spruce, hackberry.	Siberian elm, golden willow, green ash.	Eastern cottonwood.
570---------- Faunce	---	Silver buffaloberry, lilac, Siberian peashrub, Manchurian crabapple, sargent crabapple, northern whitecedar.	Red pine, green ash, Russian-olive, ponderosa pine, Scotch pine, silver maple, white spruce.	Jack pine, eastern white pine, eastern cottonwood.	Siberian elm.
581---------- Percy	Redosier dogwood	Siberian peashrub, common chokecherry, lilac.	Bur oak, blue spruce, Russian-olive, white spruce, eastern redcedar.	Golden willow, Siberian elm.	Eastern cottonwood.
582---------- Roliss	---	Siberian peashrub, lilac, northern whitecedar.	Eastern redcedar, Manchurian crabapple, blue spruce, Russian-olive, white spruce, bur oak.	Green ash, golden willow.	Eastern cottonwood.
616---------- Effie	---	Redosier dogwood, Siberian peashrub, lilac, American cranberrybush.	White spruce, blue spruce, Norway spruce.	Northern whitecedar, green ash, eastern white pine, golden willow.	Silver maple.
626---------- Suomi	---	Amur maple, American cranberrybush, Siberian peashrub, lilac, northern whitecedar.	White spruce, Manchurian crabapple, eastern redcedar.	Jack pine, green ash, eastern white pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
641---------- Clearwater	---	Northern whitecedar, Siberian peashrub, lilac.	Bur oak, white spruce, blue spruce, Russian-olive, eastern redcedar, Manchurian crabapple.	Golden willow, green ash.	Eastern cottonwood.
644---------- Boash	---	Siberian peashrub, American plum, lilac, common chokecherry, redosier dogwood.	Blue spruce, white spruce, Manchurian crabapple.	Golden willow-----	Carolina poplar, eastern cottonwood.
655---------- Bearville	---	Lilac, Siberian peashrub, American cranberrybush, redosier dogwood.	White spruce, northern whitecedar, blue spruce, Norway spruce.	Golden willow, eastern white pine, green ash.	Silver maple.
755---------- Woodslake	Peking cotoneaster	American cranberrybush, redosier dogwood, American plum, Siberian peashrub, silver buffaloberry, common chokecherry, lilac, whitebelle honeysuckle.	Blue spruce, eastern redcedar, Amur maple, northern whitecedar, Siberian larch, white spruce, bur oak.	Eastern white pine, golden willow, green ash.	Carolina poplar, eastern cottonwood, silver maple, balsam poplar.
794---------- Faunce Variant	---	Lilac, eastern redcedar, silver buffaloberry, late lilac, Manchurian crabapple, honeysuckle, sargent crabapple, Siberian peashrub, blue spruce, northern whitecedar, common chokecherry.	Ponderosa pine, Russian-olive, Scotch pine, silver maple, green ash, white spruce, red pine.	Eastern cottonwood, jack pine, eastern white pine.	Siberian elm.
1033: Beaches.					
Menahga----------	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1059---------- Wega	---	Blue spruce, lilac, redosier dogwood, Siberian peashrub, American cranberrybush.	White spruce, eastern redcedar, northern whitecedar.	Eastern white pine, jack pine, green ash, red pine.	---
1066: Rock outcrop.					
Garnes----------	---	Lilac, redosier dogwood, Siberian peashrub, American cranberrybush.	Blue spruce, white spruce, eastern redcedar, northern whitecedar.	Eastern white pine, jack pine, green ash, red pine.	---
1067: Waupaca----------	---	Redosier dogwood, Siberian peashrub, silver buffaloberry.	Northern whitecedar, white spruce, Amur maple.	Golden willow, green ash, Norway spruce.	Eastern cottonwood, silver maple.
Eutroboralfs.					
1923---------- Garnes	---	Lilac, redosier dogwood, Siberian peashrub, American cranberrybush.	Blue spruce, white spruce, eastern redcedar, northern whitecedar.	Eastern white pine, jack pine, green ash, red pine.	---

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
48B Hiwood	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
52 Augsburg	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
77B Garnes	Slight	Slight	Moderate: small stones.	Slight	Slight.
116 Redby	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: too sandy, wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
117 Cormant	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
122B Taylor	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
145 Enstrom	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Moderate: droughty.
147 Spooner	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
167B Baudette	Slight	Slight	Moderate: slope.	Slight	Slight.
172 Indus	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
187 Haug	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
191 Epoufette	Severe: wetness.	Severe: wetness.	Severe: small stones, wetness.	Severe: wetness.	Severe: wetness, droughty.
195B Taylor	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
202 Meehan	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
205 Karlstad	Slight	Slight	Slight	Slight	Moderate: droughty.
242B Marquette	Slight	Slight	Moderate: slope, small stones.	Slight	Severe: droughty.
242D Marquette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: droughty, slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
280---------- Pelan	Slight----------	Slight----------	Moderate: small stones.	Slight----------	Moderate: droughty.
379---------- Percy	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
387---------- Roliss	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
404---------- Chilgren	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
425---------- Donaldson	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
432---------- Strandquist	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
458B---------- Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
481---------- Kratka	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
482---------- Grygla	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
514---------- Tacoosh	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
532---------- Sago	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
540---------- Seelyeville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
541---------- Rifle	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
543---------- Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
544---------- Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
546---------- Lupton	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
549---------- Greenwood	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
560: Greenwood	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
Lobo	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
563--- Northwood	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
565--- Eckvoll	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: small stones.	Moderate: too sandy.	Slight.
568--- Zippel	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
569--- Wabanica	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
570--- Faunce	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
581--- Percy	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
582--- Roliss	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
616--- Effie	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
626--- Suomi	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
627--- Tawas	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
630--- Wildwood	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
641--- Clearwater	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
644--- Boash	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
655--- Bearville	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
702:					
Bullwinkle	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
755 Woodslake	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
792 Fordum	Severe: flooding, wetness.	Severe: wetness.	Severe	Severe: wetness.	Severe.
794 Faunce Variant	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: small stones, too sandy.	Moderate: too sandy.	Severe: droughty.
828D:					
Insula	Severe: slope, small stones, thin layer.	Severe: slope, small stones, thin layer.	Severe: slope, small stones, thin layer.	Moderate: large stones, slope.	Severe: small stones, slope, thin layer.
Mesaba	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Moderate: large stones, slope.	Severe: small stones, slope.
952E:					
Quetico	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, small stones, thin layer.	Moderate: slope.	Severe: slope, thin layer, area reclaim.
Rock outcrop.					
1030:					
Udorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pits.					
1033:					
Beaches.					
Menahga	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: slope, droughty.
1059 Wega	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1066:					
Rock outcrop.					

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1066: Garnes	Slight	Slight	Moderate: large stones.	Slight	Moderate: large stones.
1067: Waupaca Eutroboralfs.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1807 Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1808 Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1923 Garnes	Slight	Slight	Moderate: large stones.	Slight	Moderate: large stones.
1924 Grygla	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
1925 Eckvoll	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: large stones, small stones.	Moderate: too sandy.	Moderate: large stones.
1984 Leafriver	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
48B---------- Hiwood	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor.
52---------- Augsburg	Good	Good	Fair	Fair	Poor	Fair	Fair	Good	Fair	Fair.
77B---------- Garnes	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
116---------- Redby	Poor	Fair	Good	Fair	Good	Fair	Fair	Fair	Good	Fair.
117---------- Cormant	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
122B---------- Taylor	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
145---------- Enstrom	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Good	Poor.
147---------- Spooner	Good	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
167B---------- Baudette	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
172---------- Indus	Fair	Fair	Fair	Good	Good	Fair	Good	Fair	Good	Good.
187---------- Haug	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
191---------- Epoufette	Fair	Fair	Poor	Poor	Poor	Fair	Good	Fair	Poor	Fair.
195B---------- Taylor	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
202---------- Meehan	Poor	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
205---------- Karlstad	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
242B, 242D--------- Marquette	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
280---------- Pelan	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor.
379---------- Percy	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
387---------- Roliss	Very poor.	Poor	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
404---------- Chilgren	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Fair.
425---------- Donaldson	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
432---------- Strandquist	Fair	Fair	Fair	Fair	Poor	Good	Good	Good	Fair	Good.
458B---------- Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
481---------- Kratka	Fair	Good	Good	Fair	Poor	Good	Fair	Fair	Fair	Fair.
482---------- Grygla	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
514---------- Tacoosh	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
532---------- Sago	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
540---------- Seelyeville	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
541---------- Rifle	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
543---------- Markey	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
544---------- Cathro	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
546---------- Lupton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
549---------- Greenwood	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
560:										
Greenwood---------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Lobo----------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Fair.
563---------- Northwood	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
565---------- Eckvoll	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
568---------- Zippel	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
569---------- Wabanica	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
570--Faunce	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
581--Percy	Good	Good	Fair	Fair	Poor	Good	Good	Good	Fair	Fair.
582--Roliss	Good	Good	Good	Fair	---	Good	Fair	Good	Fair	Fair.
616--Effie	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
626--Suomi	Fair	Good	Fair	Good	Good	Poor	Very poor.	Fair	Good	Poor.
627--Tawas	Poor	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
630--Wildwood	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
641--Clearwater	Good	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair.
644--Boash	Good	Good	Fair	---	---	Poor	Fair	Fair	---	Fair.
655--Bearville	Poor	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
702:										
Bullwinkle	Very poor.	Poor	Poor	Poor	Fair	Good	Good	Poor	Fair	Good.
Cathro	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
755--Woodslake	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Poor.
792--Fordum	Very poor.	Very poor.	Poor	Fair	Poor	Good	Good	Very poor.	Fair	Good.
794--Faunce Variant	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor.
828D:										
Insula	Poor	Poor	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.
Mesaba	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
952E:										
Quetico	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1030: Udorthents	Poor	Poor	Fair	Good	Good	Poor	Very poor.	Poor	Fair	Very poor.
Pits.										
1033: Beaches.										
Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
1059--- Wega	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Very poor.
1066: Rock outcrop.										
Garnes	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
1067: Waupaca	Very poor.	Fair	Good	Good	Good	Good	Good	Fair	Good	Good.
Eutroboralfs.										
1807--- Cathro	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
1808--- Markey	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
1923--- Garnes	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
1924--- Grygla	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
1925--- Eckvoll	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
1984--- Leafriver	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
48B---------- Hiwood	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: droughty.
52---------- Augsburg	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
77B---------- Garnes	Moderate: wetness.	Slight---------	Moderate: wetness.	Slight---------	Severe: frost action.	Slight.
116---------- Redby	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
117---------- Cormant	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
122B---------- Taylor	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
145---------- Enstrom	Severe: cutbanks cave.	Slight---------	Moderate: wetness, shrink-swell.	Slight---------	Moderate: frost action.	Moderate: droughty.
147---------- Spooner	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
167B---------- Baudette	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
172---------- Indus	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
187---------- Haug	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
191---------- Epoufette	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness, droughty.
195B---------- Taylor	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
202---------- Meehan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
205---------- Karlstad	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Moderate: droughty.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
242B---------- Marquette	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
242D---------- Marquette	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
280---------- Pelan	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Moderate: droughty.
379---------- Percy	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
387---------- Roliss	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
404---------- Chilgren	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
425---------- Donaldson	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
432---------- Strandquist	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
458B---------- Menahga	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
481---------- Kratka	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
482---------- Grygla	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
514---------- Tacoosh	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
532---------- Sago	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
540---------- Seelyeville	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, excess humus.
541---------- Rifle	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
543---------- Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
544---------- Cathro	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
546---------- Lupton	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
549---------- Greenwood	Severe: excess humus, wetness.	Severe: wetness, low strength, subsides.	Severe: wetness, low strength, subsides.	Severe: wetness, low strength, subsides.	Severe: wetness, frost action, subsides.	Severe: wetness, excess humus.
560: Greenwood--------	Severe: excess humus, wetness.	Severe: wetness, low strength, subsides.	Severe: wetness, low strength, subsides.	Severe: wetness, low strength, subsides.	Severe: wetness, frost action, subsides.	Severe: wetness, excess humus.
Lobo----------	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
563---------- Northwood	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
565---------- Eckvoll	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
568---------- Zippel	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
569---------- Wabanica	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
570---------- Faunce	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
581---------- Percy	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
582---------- Roliss	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
616---------- Effie	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
626---------- Suomi	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
627---------- Tawas	Severe: cutbanks cave, excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
630---------- Wildwood	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, excess humus.
641---------- Clearwater	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
644---------- Boash	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness.
655---------- Bearville	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
702:						
Bullwinkle-------	Severe: excess humus, wetness.	Severe: wetness, low strength, subsides.	Severe: wetness, subsides.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
Cathro----------	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
755---------- Woodslake	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
792---------- Fordum	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe.
794---------- Faunce Variant	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Severe: droughty.
828D:						
Insula----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, slope, thin layer.
Mesaba----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
952E:						
Quetico	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer, area reclaim.
Rock outcrop.						
1030:						
Udorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pits.						
1033:						
Beaches.						
Menahga	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
1059 Wega	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
1066:						
Rock outcrop.						
Garnes	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Moderate: large stones.
1067:						
Waupaca	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
Eutroboralfs.						
1807 Cathro	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
1808 Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
1923 Garnes	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Moderate: large stones.
1924 Grygla	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
1925 Eckvoll	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: large stones.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1984---------- Leafriver	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
48B Hiwood	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
52 Augsburg	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
77B Garnes	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: small stones, wetness.
116 Redby	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
117 Cormant	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
122B Taylor	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
145 Enstrom	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
147 Spooner	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
167B Baudette	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
172 Indus	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
187 Haug	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
191 Epoufette	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
195B---------- Taylor	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
202---------- Meehan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
205---------- Karlstad	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
242B---------- Marquette	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
242D---------- Marquette	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
280---------- Pelan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
379---------- Percy	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
387---------- Roliss	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
404---------- Chilgren	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
425---------- Donaldson	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack.
432---------- Strandquist	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
458B---------- Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
481---------- Kratka	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
482---------- Grygla	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
514---------- Tacoosh	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
532---------- Sago	Severe: ponding.	Severe: excess humus, ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
540---------- Seelyeville	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding, excess humus.
541---------- Rifle	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
543---------- Markey	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
544---------- Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
546---------- Lupton	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
549---------- Greenwood	Severe: wetness, subsides.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
560: Greenwood----------	Severe: wetness, subsides.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
Lobo----------	Severe: subsides, wetness, poor filter.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
563---------- Northwood	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
565---------- Eckvoll	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.
568---------- Zippel	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: wetness.
569---------- Wabanica	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
570---------- Faunce	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
581---------- Percy	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
582---------- Roliss	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
616---------- Effie	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
626---------- Suomi	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
627---------- Tawas	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
630---------- Wildwood	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
641---------- Clearwater	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
644---------- Boash	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
655---------- Bearville	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
702:					
Bullwinkle---------	Severe: wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
Cathro----------	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
755---------- Woodslake	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
792---------- Fordum	Severe: flooding, wetness.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
794---------- Faunce Variant	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
828D: Insula----------	Severe: thin layer, seepage, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, small stones, slope.
Mesaba----------	Severe: thin layer, seepage.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, small stones, slope.
952E: Quetico----------	Severe: thin layer, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, slope, thin layer.
Rock outcrop.					
1030: Udorthents---------	Moderate: percs slowly.	Severe: seepage.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope, thin layer.
Pits.					
1033: Beaches.					
Menahga----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1059---------- Wega	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1066: Rock outcrop.					
Garnes----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: small stones, wetness.
1067: Waupaca----------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too sandy.	Severe: flooding, wetness.	Poor: wetness.
Eutroboralfs.					

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1807---------- Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
1808---------- Markey	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
1923---------- Garnes	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: small stones, wetness.
1924---------- Grygla	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
1925---------- Eckvoll	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.
1984---------- Leafriver	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
48B Hiwood	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
52 Augsburg	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, thin layer.
77B Garnes	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
116 Redby	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
117 Cormant	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
122B Taylor	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
145 Enstrom	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
147 Spooner	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
167B Baudette	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
172 Indus	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
187 Haug	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
191 Epoufette	Poor: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
195B Taylor	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
202 Meehan	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
205 Karlstad	Fair: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
242B---------- Marquette	Good----------	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
242D---------- Marquette	Fair: slope.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
280---------- Pelan	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
379---------- Percy	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
387---------- Roliss	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
404---------- Chilgren	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
425---------- Donaldson	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
432---------- Strandquist	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
458B---------- Menahga	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
481---------- Kratka	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
482---------- Grygla	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
514---------- Tacoosh	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
532---------- Sago	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
540---------- Seelyeville	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
541---------- Rifle	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
543---------- Markey	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: excess humus, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
544---------- Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
546---------- Lupton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
549---------- Greenwood	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
560: Greenwood----------	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Lobo----------	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
563---------- Northwood	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
565---------- Eckvoll	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
568---------- Zippel	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
569---------- Wabanica	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
570---------- Faunce	Good----------	Probable----------	Improbable: too sandy.	Poor: small stones, too sandy.
581---------- Percy	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
582---------- Roliss	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
616---------- Effie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
626---------- Suomi	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
627---------- Tawas	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: excess humus, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
630--Wildwood	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
641--Clearwater	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
644--Boash	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
655--Bearville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
702:				
Bullwinkle	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
755--Woodslake	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
792--Fordum	Poor: wetness.	Probable	Improbable: too sandy.	Poor: small stones, wetness.
794--Faunce Variant	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, small stones.
828D:				
Insula	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Mesaba	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
952E:				
Quetico	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Rock outcrop.				
1030:				
Udorthents	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, thin layer.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1030: Pits.				
1033: Beaches.				
Menahga	Good	Probable	Improbable: too sandy.	Poor: too sandy.
1059 Wega	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1066: Rock outcrop.				
Garnes	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1067: Waupaca	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
Eutroboralfs.				
1807 Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1808 Markey	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
1923 Garnes	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1924 Grygla	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1925 Eckvoll	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1984 Leafriver	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
48B---------- Hiwood	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Wetness, too sandy.	Droughty.
52---------- Augsburg	Severe: seepage.	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
77B---------- Garnes	Moderate: seepage.	Severe: piping.	Frost action-----	Wetness, soil blowing.	Rooting depth.
116---------- Redby	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave----	Wetness, too sandy, soil blowing.	Droughty.
117---------- Cormant	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave----	Wetness, too sandy, soil blowing.	Wetness, droughty.
122B---------- Taylor	Moderate: slope.	Severe: hard to pack.	Deep to water----	Erodes easily, percs slowly.	Erodes easily, percs slowly.
145---------- Enstrom	Severe: seepage.	Severe: piping.	Favorable--------	Erodes easily, wetness.	Erodes easily, droughty.
147---------- Spooner	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.
167B---------- Baudette	Moderate: seepage.	Severe: piping.	Deep to water----	Erodes easily, soil blowing.	Erodes easily.
172---------- Indus	Slight----------	Severe: hard to pack, wetness.	Percs slowly-----	Wetness, percs slowly.	Wetness, percs slowly.
187---------- Haug	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding, soil blowing.	Wetness.
191---------- Epoufette	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Wetness, droughty.
195B---------- Taylor	Slight----------	Severe: hard to pack.	Deep to water----	Percs slowly-----	Percs slowly.
202---------- Meehan	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave----	Wetness, too sandy, soil blowing.	Wetness, droughty.
205---------- Karlstad	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave----	Large stones, wetness, too sandy.	Large stones, droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
242B---------- Marquette	Severe: seepage.	Severe: seepage.	Deep to water----	Too sandy, soil blowing.	Droughty.
242D---------- Marquette	Severe: seepage, slope.	Severe: seepage.	Deep to water----	Slope, too sandy, soil blowing.	Slope, droughty.
280---------- Pelan	Severe: seepage.	Severe: piping.	Favorable--------	Wetness, soil blowing.	Droughty, rooting depth.
379---------- Percy	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Wetness----------	Wetness.
387---------- Roliss	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding----------	Wetness.
404---------- Chilgren	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Wetness, soil blowing.	Wetness, rooting depth.
425---------- Donaldson	Severe: seepage.	Severe: hard to pack.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Percs slowly.
432---------- Strandquist	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Wetness, soil blowing, erodes easily.	Wetness, erodes easily.
458B---------- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water----	Too sandy, soil blowing.	Droughty.
481---------- Kratka	Severe: seepage.	Severe: piping, wetness.	Favorable--------	Wetness, soil blowing.	Wetness, droughty.
482---------- Grygla	Severe: seepage.	Severe: piping, wetness.	Frost action-----	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.
514---------- Tacoosh	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
532---------- Sago	Moderate: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, too sandy.	Wetness.
540---------- Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding----------	Wetness.
541---------- Rifle	Severe: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding----------	Wetness.
543---------- Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, too sandy, soil blowing.	Wetness.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
544---------- Cathro	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
546---------- Lupton	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness----------	Wetness.
549---------- Greenwood	Severe: seepage.	Severe: excess humus, wetness.	Frost action-----	Wetness----------	Wetness.
560: Greenwood--------	Severe: seepage.	Severe: excess humus, wetness.	Frost action-----	Wetness----------	Wetness.
Lobo----------	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness----------	Wetness.
563---------- Northwood	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.
565---------- Eckvoll	Severe: seepage.	Moderate: piping, wetness.	Frost action-----	Wetness, soil blowing, erodes easily.	Erodes easily.
568---------- Zippel	Severe: seepage.	Severe: piping, wetness.	Frost action, cutbanks cave.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.
569---------- Wabanica	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Wetness----------	Wetness.
570---------- Faunce	Severe: seepage.	Severe: seepage.	Deep to water----	Soil blowing, too sandy.	Droughty.
581---------- Percy	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Wetness, soil blowing.	Wetness.
582---------- Roliss	Moderate: seepage.	Severe: piping, wetness.	Frost action-----	Wetness----------	Wetness.
616---------- Effie	Slight----------	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
626---------- Suomi	Slight----------	Severe: hard to pack.	Percs slowly-----	Erodes easily, wetness.	Wetness, erodes easily.
627---------- Tawas	Severe: seepage.	Severe: seepage, piping, wetness.	Subsides, frost action, cutbanks cave.	Wetness, too sandy, soil blowing.	Wetness.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
630---------- Wildwood	Slight----------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Wetness, percs slowly.
641---------- Clearwater	Slight----------	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
644---------- Boash	Moderate: seepage.	Severe: piping, wetness.	Percs slowly, frost action.	Wetness----------	Wetness, percs slowly.
655---------- Bearville	Slight----------	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Wetness, rooting depth, percs slowly.
702:					
Bullwinkle-------	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness, soil blowing.	Wetness.
Cathro----------	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
755---------- Woodslake	Slight----------	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, droughty, percs slowly.
792---------- Fordum	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, too sandy.	Wetness, droughty.
794---------- Faunce Variant	Severe: seepage.	Severe: seepage.	Cutbanks cave----	Wetness, too sandy, soil blowing.	Droughty.
828D:					
Insula----------	Severe: depth to rock, seepage, slope.	Severe: seepage.	Deep to water----	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Mesaba----------	Severe: seepage, slope.	Severe: seepage.	Thin layer, large stones, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
952E:					
Quetico----------	Severe: depth to rock, seepage, slope.	Severe: thin layer.	Deep to water----	Slope, depth to rock, area reclaim.	Slope, depth to rock, area reclaim.
Rock outcrop.					
1030:					
Udorthents-------	Severe: seepage.	Severe: piping.	Deep to water----	Slope, soil blowing.	Slope, droughty.
Pits.					

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions	Grassed waterways
1033: Beaches.					
Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
1059 Wega	Moderate: seepage.	Severe: piping, wetness.	Frost action	Erodes easily, wetness.	Wetness, erodes easily.
1066: Rock outcrop.					
Garnes	Moderate: seepage, slope.	Severe: piping.	Frost action, slope.	Wetness	Rooting depth.
1067: Waupaca	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.
Eutroboralfs.					
1807 Cathro	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
1808 Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, too sandy, soil blowing.	Wetness.
1923 Garnes	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Rooting depth.
1924 Grygla	Severe: seepage.	Severe: piping, wetness.	Frost action	Erodes easily, wetness.	Wetness, erodes easily.
1925 Eckvoll	Severe: seepage.	Moderate: piping, wetness.	Frost action	Wetness, erodes easily.	Erodes easily.
1984 Leafriver	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, too sandy, soil blowing.	Wetness.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
48B---------- Hiwood	0-6	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	95-100	80-95	5-25	---	NP
	6-46	Sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	95-100	80-95	5-20	---	NP
	46-60	Sand, fine sand	SP-SM, SP	A-3, A-2	0	100	95-100	80-95	1-12	---	NP
52---------- Augsburg	0-8	Loam----------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	50-90	15-40	NP-15
	8-15	Loam, very fine sandy loam, silt loam.	ML	A-4	0	100	100	85-100	60-90	20-40	NP-10
	15-22	Loamy very fine sand, very fine sandy loam, loam.	ML	A-4	0	100	100	85-100	60-90	20-40	NP-10
	22-60	Silty clay, clay, silty clay loam.	CH	A-7	0	95-100	95-100	95-100	95-100	35-85	35-55
77B---------- Garnes	0-7	Fine sandy loam	SM	A-4	0-3	95-100	85-100	55-75	35-50	20-30	NP-5
	7-15	Clay loam, sandy clay loam, loam.	CL, SC	A-6, A-4	2-5	95-100	80-100	70-100	45-80	20-40	7-20
	15-60	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-4, A-6	1-5	95-100	75-95	60-90	35-65	15-40	1-15
116---------- Redby	0-3	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	85-95	5-25	---	NP
	3-19	Fine sand, sand	SM, SP-SM	A-3, A-2	0	100	95-100	80-95	5-20	---	NP
	19-60	Fine sand, sand	SP, SP-SM	A-3, A-2	0	100	95-100	80-95	2-12	---	NP
117---------- Cormant	0-6	Loamy fine sand	SM, SP-SM	A-2, A-4, A-3	0	100	100	80-100	5-40	---	NP
	6-60	Fine sand, sand, loamy fine sand.	SP, SP-SM, SM	A-2, A-3	0	100	100	75-100	1-20	---	NP
122B---------- Taylor	0-12	Loam----------	CL	A-6	0	100	100	90-100	70-90	30-40	10-15
	12-29	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	60-80	35-50
	29-60	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-80	30-50
145---------- Enstrom	0-4	Loamy sand-------	SM, SP-SM	A-2	0	100	95-100	80-95	10-25	---	NP
	4-25	Fine sand, sand, loamy sand.	SP-SM, SM	A-2, A-3	0-3	95-100	80-100	60-95	5-15	---	NP
	25-60	Fine sandy loam, loam, silty clay loam.	CL-ML, CL, SC, SC-SM	A-4, A-6	0-2	90-100	80-95	65-90	35-80	20-40	5-15
147---------- Spooner	0-6	Very fine sandy loam.	SM, ML	A-4	0	100	100	90-100	35-55	20-40	1-10
	6-15	Loamy very fine sand, very fine sandy loam, loam.	SM, ML, SC, CL	A-4, A-6	0	100	100	90-100	35-60	10-40	1-15
	15-22	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	60-85	20-40	5-15
	22-60	Very fine sandy loam, silt loam, sandy loam.	ML, CL, SM, SC	A-4, A-6	0	100	100	90-100	35-95	16-40	NP-15

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
167B---------- Baudette	0-6	Fine sandy loam	SM, ML	A-4	0	100	100	75-95	40-60	<25	NP-4
	6-12	Very fine sandy loam, fine sandy loam, silt loam.	SM, ML	A-4	0	100	100	75-100	40-90	<40	NP-10
	12-19	Clay loam, silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	80-100	20-50	5-20
	19-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML	A-4	0	100	100	95-100	70-100	20-40	1-10
172---------- Indus	0-4	Clay loam--------	CL, CH	A-7	0	100	95-100	85-100	70-95	40-55	15-30
	4-31	Clay----------	CH	A-7	0	100	95-100	90-100	85-100	60-80	35-50
	31-60	Clay, silty clay	CH	A-7	0	98-100	95-100	90-100	85-100	60-80	35-50
187---------- Haug	0-15	Muck----------	PT	A-8	---	---	---	---	---	---	---
	15-18	Mucky sandy loam, fine sandy loam, loam.	OL, ML, CL, SM	A-4, A-6	0-3	95-100	90-100	70-85	35-65	15-40	1-15
	18-60	Loam, sandy loam, fine sandy loam.	ML, CL, SM, SC	A-4, A-6	0-3	95-100	70-100	60-95	35-65	15-40	1-15
191---------- Epoufette	0-10	Loamy fine sand	SM	A-2, A-1	0-5	95-100	65-95	45-70	15-30	---	NP
	10-20	Gravelly sandy loam, sandy loam, gravelly loamy sand.	SM, SC-SM, SC	A-2, A-4	0-5	95-100	70-95	60-80	25-40	<25	2-10
	20-60	Gravelly sand, coarse sand, sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	50-90	45-85	30-60	0-10	---	NP
195B---------- Taylor	0-12	Loamy fine sand	SM	A-2, A-4	0	100	100	50-75	25-50	---	NP
	12-18	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	60-80	35-50
	18-60	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-80	30-50
202---------- Meehan	0-15	Loamy sand-------	SM	A-2, A-1	0	90-100	75-100	40-90	15-30	---	NP
	15-40	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-1, A-2, A-3	0	90-100	75-100	40-90	3-30	---	NP
	40-60	Sand, coarse sand	SP, SP-SM	A-1, A-3, A-2	0	90-100	75-100	40-90	0-5	---	NP
205---------- Karlstad	0-10	Loamy sand-------	SM, SP-SM	A-2, A-3	0-5	95-100	95-100	75-95	5-35	15-25	NP-4
	10-15	Coarse sandy loam, sandy loam, fine sandy loam.	SM, SC-SM, SC	A-2, A-4	0-5	95-100	95-100	75-95	12-50	15-25	NP-10
	15-60	Stratified gravelly coarse sand to loamy fine sand.	SP, SP-SM	A-1, A-2, A-3	0-25	60-100	35-100	20-80	10-55	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
242B---------- Marquette	0-16	Loamy sand-------	SP-SM, SM, SC-SM	A-2	0-5	90-100	85-100	50-75	10-35	<20	NP-5
	16-21	Very gravelly fine sandy loam, very gravelly loam, very gravelly sandy loam.	SM, SC, GM, GC	A-2, A-1	0-15	45-85	20-55	10-45	5-35	<30	NP-10
	21-60	Very gravelly sand, coarse sand, very gravelly loamy coarse sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-10	45-95	20-80	10-70	0-20	---	NP
242D---------- Marquette	0-4	Loamy fine sand	SP-SM, SM, SC-SM	A-2	0-5	90-100	85-100	50-75	10-35	<20	NP-5
	4-8	Very gravelly fine sandy loam, very gravelly loam, very gravelly sandy loam.	SM, SC, GM, GC	A-2, A-1	0-15	45-85	20-55	10-45	5-35	<30	NP-10
	8-60	Very gravelly sand, coarse sand, very gravelly loamy coarse sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-10	45-95	20-80	10-70	0-20	---	NP
280---------- Pelan	0-4	Sandy loam-------	SM, SC-SM	A-2, A-4	2-4	95-100	75-100	55-90	30-50	<20	NP-5
	4-6	Sand, coarse sand, loamy fine sand.	SP-SM, SM	A-2-4	2-4	95-100	75-100	55-90	10-30	<20	NP
	6-15	Very gravelly sandy loam, very gravelly sandy clay loam.	SM, GM, SC, GC	A-2, A-1	2-4	45-85	25-50	5-45	12-35	20-30	NP-10
	15-38	Very gravelly coarse sand, very gravelly fine sandy loam.	SP-SM, SP, GP, GP-GM	A-1, A-3, A-2	2-4	40-85	25-50	5-50	1-10	---	NP
	38-60	Fine sandy loam, sandy loam, loam.	SM, ML, CL, SC	A-4, A-6	1-5	90-100	85-95	60-90	40-65	10-30	1-15
379---------- Percy	0-6	Loam----------	CL-ML, CL, SC, SC-SM	A-4, A-6	1-3	90-100	80-100	55-95	35-60	20-40	5-15
	6-30	Loam, fine sandy loam, sandy loam.	CL, CL-ML	A-4	1-5	85-100	80-95	60-90	50-70	20-30	5-10
	30-60	Loam, fine sandy loam, sandy loam.	SC-SM, SC, CL-ML, CL	A-4	1-5	85-100	65-85	55-80	40-60	<30	3-10
387---------- Roliss	0-7	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	80-100	80-100	60-90	20-40	5-20
	7-10	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	80-100	80-90	60-80	20-50	10-30
	10-24	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	95-100	80-98	80-95	60-80	20-50	5-30
	24-60	Loam, clay loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	95-100	80-100	80-95	60-80	20-50	5-30

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
404---------- Chilgren	0-3	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2	0-3	90-100	85-100	60-85	25-55	15-35	NP-10
	3-8	Loamy sand, loamy fine sand, fine sandy loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0-3	75-100	70-100	50-85	15-55	15-35	NP-10
	8-14	Clay loam, loam, sandy clay loam.	CL, ML, SM, SC	A-6, A-7, A-4	1-5	75-100	70-100	60-95	35-85	25-50	7-20
	14-60	Loam, sandy loam, fine sandy loam.	CL, SM, ML, SC	A-4	2-5	75-100	70-100	50-90	35-70	20-30	3-10
425---------- Donaldson	0-10	Loamy very fine sand.	SM	A-4	0	100	100	95-100	35-50	15-20	NP-4
	10-38	Loamy very fine sand, very fine sandy loam, very fine sand.	SM, SC, SC-SM	A-4, A-2	0	100	100	95-100	20-50	15-30	1-10
	38-60	Clay, silty clay, silty clay loam.	CH, MH	A-7	0	100	95-100	90-100	85-100	60-80	30-50
432---------- Strandquist	0-8	Sandy loam-------	SM	A-2, A-4	0	95-100	90-100	70-80	25-50	20-30	NP-5
	8-36	Gravelly sand, gravelly coarse sand, very gravelly sand.	SP, GP, GP-GM, SP-SM	A-1	2-5	40-75	25-65	15-50	0-5	---	NP
	36-60	Silty clay loam, loam, sandy loam.	CL-ML, CL, SC, SC-SM	A-4, A-6	1-2	95-100	80-100	65-90	35-80	20-40	5-20
458B---------- Menahga	0-3	Loamy sand-------	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	3-32	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	32-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
481---------- Kratka	0-9	Fine sandy loam	SM, SC-SM	A-4	0	95-100	90-100	50-80	36-50	<25	2-6
	9-25	Loamy sand, sand, loamy fine sand.	SP-SM	A-3, A-2	0	95-100	90-100	50-80	5-10	---	NP
	25-60	Loam, clay loam, sandy loam.	SC-SM, SC, CL-ML, CL	A-4, A-6	0	95-100	90-100	70-90	40-60	15-40	5-25
482---------- Grygla	0-6	Loamy fine sand	SM, SC-SM	A-2	0	100	100	85-95	15-35	<25	NP-7
	6-21	Sand, fine sand, loamy fine sand.	SP-SM, SM, SC-SM	A-2, A-3	0	95-100	90-100	70-95	5-35	<20	NP-5
	21-60	Loam, fine sandy loam, silt loam.	CL-ML, CL	A-4, A-6	0-3	95-100	80-100	70-85	50-70	20-40	5-20
514---------- Tacoosh	0-6	Muck----------	PT	A-8	0-10	---	---	---	---	---	---
	6-36	Mucky-peat-------	PT	A-8	0-10	---	---	---	---	---	---
	36-60	Sandy loam, loam, clay loam.	SM, ML, SC, CL	A-2, A-4, A-6	0-10	85-100	85-95	65-95	25-75	15-35	NP-20
532---------- Sago	0-13	Muck----------	PT	A-8	0	---	---	---	---	---	---
	13-60	Stratified fine sand to silt loam.	SM, ML, CL, SC	A-4, A-2	0	98-100	95-100	70-95	15-85	15-30	2-9
540---------- Seelyeville	0-3	Mucky-peat-------	PT	A-8	0	---	---	---	---	---	---
	3-60	Muck, mucky-peat	PT	A-8	0	---	---	---	---	---	---
541---------- Rifle	0-3	Mucky-peat-------	PT	A-8	0	---	---	---	---	---	---
	3-60	Mucky-peat-------	PT	A-8	0	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
543----------	0-28	Muck----------	PT	A-8	---	---	---	---	---	---	---
Markey	28-60	Fine sand, loamy sand, coarse sand.	SP, SM, SP-SM	A-2, A-3	0	100	75-100	60-75	0-20	---	NP
544----------	0-12	Muck----------	PT	A-8	0	---	---	---	---	---	---
Cathro	12-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Sandy loam, loam, clay loam.	CL-ML, SC-SM, SC, CL	A-4, A-6	0-5	85-100	75-100	60-100	35-90	20-40	5-20
546----------	0-8	Mucky-peat-------	PT	A-8	0	---	---	---	---	---	---
Lupton	8-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
549----------	0-18	Fibric material	PT	A-8	0	---	---	---	---	---	---
Greenwood	18-60	Hemic material, mucky-peat.	PT	A-8	0	---	---	---	---	---	---
560:											
Greenwood-------	0-15	Fibric material	PT	A-8	0	---	---	---	---	---	---
	15-60	Hemic material, mucky-peat.	PT	A-8	0	---	---	---	---	---	---
Lobo----------	0-38	Fibric material	PT	A-8	0	---	---	---	---	---	---
	38-60	Hemic material---	PT	A-8	0	---	---	---	---	---	---
563----------	0-9	Muck----------	PT	A-8	0	---	---	---	---	---	---
Northwood	9-12	Fine sandy loam, loamy fine sand, loamy sand.	SM, SC-SM	A-2, A-4	0-3	95-100	90-100	51-85	15-50	<35	NP-10
	12-27	Coarse sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0-3	95-100	80-100	70-95	5-35	---	NP
	27-60	Loam, clay loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0-3	95-100	90-100	75-100	50-80	20-40	3-20
565----------	0-4	Loamy fine sand	SM, SC-SM	A-4, A-2	0-2	90-100	85-100	45-80	25-40	15-20	NP-7
Eckvoll	4-24	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-1, A-2, A-3	0-2	90-100	85-100	45-75	5-30	15-20	NP-4
	24-28	Clay loam, sandy clay loam, loam.	SC, CL	A-4, A-6, A-7	0-5	90-100	85-98	65-95	45-75	25-50	7-25
	28-60	Loam, clay loam, fine sandy loam.	CL	A-4, A-6, A-7	0-5	90-100	85-98	70-95	50-80	25-45	7-20
568----------	0-7	Very fine sandy loam.	ML, CL-ML	A-4	0	100	95-100	85-100	50-75	<25	NP-5
Zippel	7-12	Very fine sand, very fine sandy loam, loamy very fine sand.	ML, CL-ML	A-4	0	100	95-100	85-100	50-95	<25	NP-5
	12-60	Stratified silt loam to very fine sand.	ML, CL-ML	A-4	0	100	95-100	85-100	50-95	<25	NP-5
569----------	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	60-90	25-35	5-15
Wabanica	8-11	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	60-95	25-40	5-15
	11-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	60-95	25-40	5-15

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
570---------- Faunce	0-3	Fine sand--------	SP-SM, SM	A-2, A-3	0-2	95-100	80-100	55-80	5-20	---	NP
	3-14	Sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	95-100	80-100	55-80	5-20	---	NP
	14-20	Gravelly loamy coarse sand, sand, gravelly sandy loam.	SP-SM, SM	A-2, A-3	0-2	95-100	65-100	55-80	5-20	---	NP
	20-60	Stratified gravelly sand to coarse sand.	SP-SM, SP	A-2, A-3, A-1	0-2	75-90	50-85	40-65	0-10	---	NP
581---------- Percy	0-8	Fine sandy loam	SC, SC-SM	A-4	0-1	90-100	75-100	60-90	35-50	15-25	5-10
	8-15	Loam, fine sandy loam, sandy loam.	CL, CL-ML	A-4	1-5	85-100	80-95	60-90	50-70	20-30	5-10
	15-60	Loam, fine sandy loam, sandy loam.	SC-SM, SC, CL-ML, CL	A-4	1-5	85-100	65-85	55-80	40-60	<30	3-10
582---------- Roliss	0-9	Clay loam--------	CL	A-6, A-7	0	95-100	80-100	80-100	60-80	35-50	15-25
	9-15	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	80-100	80-90	60-80	20-50	10-30
	15-24	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	95-100	80-100	80-95	60-80	20-50	5-30
	24-60	Loam, clay loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	95-100	80-100	80-95	60-80	20-50	5-30
616---------- Effie	0-6	Loam----------	CL, ML, CL-ML	A-4, A-6	0-2	95-100	90-100	85-100	60-90	20-40	3-15
	6-14	Clay loam, clay, silty clay loam.	CH, CL	A-7	0-2	95-100	95-100	85-100	70-90	45-70	25-45
	14-60	Clay loam, clay, silty clay loam.	CH, CL	A-7, A-6	0-2	95-100	95-100	85-100	65-90	35-60	20-40
626---------- Suomi	0-8	Loam----------	CL, ML, CL-ML	A-6, A-4	0-3	95-100	90-100	85-100	60-90	20-40	3-15
	8-20	Silty clay, clay, silty clay loam.	CH, CL	A-7	0-3	95-100	90-100	85-100	70-95	45-70	25-45
	20-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0-3	95-100	90-100	80-100	65-95	35-60	15-30
627---------- Tawas	0-8	Muck----------	PT	A-8	0	---	---	---	---	---	---
	8-36	Sapric material, hemic material.	PT	A-8	0	---	---	---	---	---	---
	36-60	Fine sand, sand, loamy sand.	SP, SP-SM, SM	A-2-4, A-3	0	80-100	60-100	50-75	0-20	---	NP
630---------- Wildwood	0-10	Mucky-peat-------	PT	A-8	0	---	---	---	---	---	---
	10-18	Clay, silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-98	50-80	35-60
	18-60	Clay, silty clay	CH	A-7	0	100	85-100	85-100	80-98	50-80	35-60
641---------- Clearwater	0-9	Clay----------	CL, CH	A-7	0-1	95-100	90-97	80-95	70-95	45-80	20-50
	9-18	Clay, silty clay, silty clay loam.	CL, CH	A-7	0-1	95-100	90-97	80-95	70-95	40-80	20-50
	18-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0-1	95-100	90-100	80-97	75-95	40-80	20-50

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
644----------	0-7	Clay loam--------	CL	A-7	0-2	95-100	90-100	80-100	70-95	40-50	20-25
Boash	7-35	Clay, silty clay loam, silty clay.	CH, CL	A-7	0-2	95-100	90-100	80-100	70-95	45-80	25-50
	35-60	Loam, clay loam, sandy loam.	CL, CL-ML	A-4, A-6	1-3	95-100	85-98	70-95	50-80	24-35	6-15
655----------	0-4	Loamy fine sand	SM	A-2	0-2	95-100	95-100	50-80	15-35	---	NP
Bearville	4-13	Loamy sand, loamy coarse sand, fine sand.	SM, SP-SM	A-2	0-2	95-100	95-100	50-70	10-30	---	NP
	13-16	Sandy clay loam, loam, sandy loam.	SC, CL	A-6	0-2	95-100	95-100	55-85	35-60	20-40	10-20
	16-24	Clay, silty clay	CH, MH	A-7	0	100	95-100	80-100	75-100	50-75	25-45
	24-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	95-100	80-95	60-95	45-70	20-40
702:											
Bullwinkle------	0-28	Muck----------	PT	A-8	0	---	---	---	---	---	---
	28-42	Sapric material	PT	A-8	0	---	---	---	---	---	---
	42-44	Loam, sandy loam, clay loam.	SM, SC, ML, CL	A-4, A-6	0	100	95-100	55-90	35-65	15-40	3-19
	44-60	Loam, sandy loam, clay loam.	SC-SM, SC, CL-ML, CL	A-4, A-6	0	100	95-100	55-90	35-75	20-40	5-25
Cathro----------	0-12	Muck----------	PT	A-8	0	---	---	---	---	---	---
	12-25	Sapric material	PT	A-8	0	---	---	---	---	---	---
	25-60	Sandy loam, loam, clay loam.	CL-ML, SC-SM, SC, CL	A-4, A-6	0-5	85-100	75-100	60-100	35-90	20-40	5-20
755----------	0-7	Clay----------	CH, MH	A-7	0	100	98-100	90-100	85-98	50-65	20-35
Woodslake	7-19	Clay----------	CH	A-7	0	95-100	95-100	90-100	85-100	60-85	35-50
	19-60	Clay----------	CH	A-7	0	95-100	95-100	90-100	85-100	60-85	35-50
792----------	0-8	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2, A-1	0-15	80-100	75-100	45-95	20-65	<25	3-7
Fordum	8-39	Silt loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-15	80-100	75-100	45-100	20-90	<30	3-10
	39-60	Stratified sand to silt loam.	SM, SP-SM	A-2, A-1, A-4	0-15	80-100	75-100	35-100	10-50	---	NP
794----------	0-3	Loamy fine sand	SM, SP-SM	A-2	0	95-100	85-100	75-90	10-35	---	NP
Faunce Variant	3-15	Sand, loamy sand	SP-SM, SM	A-2, A-3	0	95-100	85-100	55-80	5-20	---	NP
	15-60	Stratified fine sand to gravelly coarse sand.	SP-SM, SP	A-2, A-3, A-1	0-2	75-100	65-85	40-65	0-10	---	NP
828D:											
Insula----------	0-3	Gravelly loam----	SM, GM, SC, GC	A-2, A-4, A-1-b	5-15	60-80	55-80	30-70	15-50	<25	NP-9
	3-11	Gravelly sandy loam, gravelly fine sandy loam, gravelly loam.	SM, GM, SC, GC	A-2, A-4, A-1-b	5-15	60-80	55-80	30-70	15-50	<25	NP-9
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
828D:											
Mesaba----------	0-4	Gravelly loam----	SM, GM	A-1, A-2	2-10	60-85	45-75	30-55	15-35	12-20	NP-4
	4-22	Gravelly coarse sandy loam, gravelly loam.	SM, GM	A-1, A-2	2-10	60-85	45-75	30-55	15-35	12-20	NP-4
	22	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
952E:											
Quetico---------	0-8	Loam----------	CL, ML, CL-ML	A-4, A-6	2-10	85-100	80-95	60-90	50-85	20-35	3-15
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
1030:											
Udorthents------	0-60	Fine sandy loam, loam, very fine sandy loam.	ML, SM, SC-SM, CL-ML	A-4, A-6	0-10	95-100	90-100	65-95	35-75	<30	NP-15
	60-80	Variable---------	---	---	---	---	---	---	---	---	---
Pits.											
1033:											
Beaches.											
Menahga---------	0-8	Loamy sand-------	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	8-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
1059----------	0-8	Silt loam--------	ML, CL-ML	A-4	0	100	100	100	95-100	<25	NP-7
Wega	8-60	Stratified silt to fine sand.	ML, CL-ML, SM, SC-SM	A-4	0	100	100	85-100	40-100	<25	NP-7
1066:											
Rock outcrop.											
Garnes----------	0-5	Loam----------	ML, CL-ML, SM, SC-SM	A-4	1-5	85-100	80-100	55-90	35-65	20-35	1-10
	5-9	Clay loam, sandy clay loam, loam.	CL, SC	A-6, A-4	2-5	95-100	80-100	70-100	45-80	20-40	7-20
	9-60	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-4, A-6	1-5	95-100	75-95	60-90	35-65	15-40	1-15
1067:											
Waupaca---------	0-8	Very fine sandy loam.	ML	A-4	0	100	100	85-95	50-65	<20	NP-4
	8-60	Stratified silt to very fine sand.	ML, CL-ML, CL	A-4	0	100	100	95-100	90-100	<28	NP-9
Eutroboralfs.											
1807----------	0-21	Muck----------	PT	A-8	0	---	---	---	---	---	---
Cathro	21-60	Sandy loam, loam, clay loam.	CL-ML, SC-SM, SC, CL	A-4, A-6	0-5	85-100	75-100	60-100	35-90	20-40	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
1808----------	0-28	Muck----------	PT	A-8	---	---	---	---	---	---	---
Markey	28-60	Fine sand, loamy sand, coarse sand.	SP, SM, SP-SM	A-2, A-3	0	100	75-100	60-75	0-20	---	NP
1923----------	0-5	Loam----------	ML, CL-ML, SM, SC-SM	A-4	1-5	85-100	80-100	55-90	35-65	20-35	1-10
Garnes	5-9	Clay loam, sandy clay loam, loam.	CL, SC	A-6, A-4	2-5	95-100	80-100	70-100	45-80	20-40	7-20
	9-60	Sandy loam, loam, fine sandy loam.	SM, ML, CL, SC	A-4, A-6	1-5	95-100	75-95	60-90	35-65	15-40	1-15
1924----------	0-6	Fine sandy loam	SM, SC-SM, SC	A-4, A-2	1-5	85-100	80-100	50-85	25-50	15-30	NP-10
Grygla	6-31	Sand, fine sand, loamy fine sand.	SP-SM, SM, SC-SM	A-2, A-3	0-3	95-100	90-100	70-95	5-35	15-20	NP-5
	31-60	Loam, fine sandy loam, silt loam.	CL-ML, CL	A-4, A-6	0-3	95-100	80-98	70-95	50-70	20-40	5-20
1925----------	0-5	Loamy fine sand	SM, SC-SM	A-2-4, A-1-b	1-5	90-100	80-100	45-80	20-35	15-20	NP-7
Eckvoll	5-26	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-1, A-2, A-3	0-2	90-100	85-100	45-75	5-30	15-20	NP-4
	26-34	Clay loam, sandy clay loam, loam.	SC, CL	A-4, A-6, A-7	0-5	90-100	85-98	65-95	45-75	25-50	7-25
	34-60	Loam, clay loam, fine sandy loam.	CL	A-4, A-6, A-7	0-5	90-100	85-98	70-95	50-80	25-45	7-20
1984----------	0-11	Muck----------	PT	A-8	0	---	---	---	---	---	---
Leafriver	11-16	Loamy sand, sandy loam, fine sand.	SM	A-4, A-2-4	0	100	95-100	55-80	15-40	15-20	NP-4
	16-60	Loamy sand, fine sand, sand.	SM, SP-SM, SP	A-3, A-2, A-2-4, A-1-b	0	95-100	80-100	45-70	3-35	---	NP

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
48B----------	0-6	1-5	1.40-1.60	6.0-20	0.08-0.12	4.5-6.0	Low----------	0.15	5	1	.5-2
Hiwood	6-46	1-10	1.55-1.70	6.0-20	0.07-0.10	5.1-6.0	Low----------	0.15			
	46-60	1-10	1.55-1.70	6.0-20	0.05-0.08	5.6-7.8	Low----------	0.15			
52----------	0-8	10-27	1.20-1.40	0.6-2.0	0.20-0.23	7.4-8.4	Low----------	0.28	4	4L	4-6
Augsburg	8-15	5-18	1.30-1.50	2.0-6.0	0.20-0.23	7.4-8.4	Low----------	0.28			
	15-22	5-18	1.40-1.60	2.0-6.0	0.17-0.22	7.4-8.4	Low----------	0.28			
	22-60	35-85	1.10-1.40	<0.2	0.10-0.14	7.4-8.4	High---------	0.28			
77B----------	0-7	5-20	1.40-1.60	2.0-6.0	0.14-0.18	6.1-7.8	Low----------	0.32	5	3	.5-2
Garnes	7-15	18-30	1.50-1.65	0.6-2.0	0.17-0.20	6.6-7.8	Moderate-----	0.32			
	15-60	10-27	1.60-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
116----------	0-3	2-10	1.40-1.60	6.0-20	0.08-0.12	5.1-6.5	Low----------	0.17	5	2	.5-2
Redby	3-19	1-8	1.55-1.70	6.0-20	0.07-0.10	5.1-6.5	Low----------	0.17			
	19-60	0-6	1.55-1.70	6.0-20	0.06-0.08	6.1-7.8	Low----------	0.17			
117----------	0-6	3-10	1.30-1.50	6.0-20	0.08-0.12	6.1-7.3	Low----------	0.17	5	2	2-10
Cormant	6-60	0-5	1.50-1.70	6.0-20	0.06-0.10	6.1-7.8	Low----------	0.17			
122B----------	0-12	20-27	1.50-1.60	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.43	3	6	1-2
Taylor	12-29	60-85	1.40-1.45	0.06-0.2	0.10-0.14	5.1-7.8	High---------	0.28			
	29-60	50-80	1.35-1.60	0.00-0.06	0.09-0.13	7.4-8.4	High---------	0.28			
145----------	0-4	4-15	1.30-1.50	6.0-20	0.10-0.12	6.6-7.8	Low----------	0.17	5	2	.5-4
Enstrom	4-25	1-12	1.40-1.65	6.0-20	0.06-0.08	6.6-8.4	Low----------	0.15			
	25-60	10-35	1.50-1.75	0.2-2.0	0.17-0.20	7.4-8.4	Moderate-----	0.37			
147----------	0-6	5-18	1.30-1.45	2.0-6.0	0.20-0.22	5.6-7.8	Low----------	0.37	5	3	1-4
Spooner	6-15	3-18	1.35-1.55	0.6-6.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	15-22	18-35	1.30-1.50	0.6-2.0	0.17-0.22	6.1-7.8	Low----------	0.37			
	22-60	5-27	1.40-1.60	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.37			
167B----------	0-6	5-18	1.30-1.45	2.0-6.0	0.15-0.19	5.6-7.3	Low----------	0.28	5	3	1-4
Baudette	6-12	5-27	1.30-1.50	0.6-2.0	0.14-0.20	5.6-7.3	Low----------	0.37			
	12-19	18-35	1.25-1.45	0.6-2.0	0.17-0.24	5.6-7.8	Moderate-----	0.37			
	19-60	5-27	1.30-1.60	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.37			
172----------	0-4	28-40	1.20-1.40	0.2-0.6	0.17-0.22	5.1-7.3	High---------	0.28	5	4	1-2
Indus	4-31	60-85	1.30-1.40	0.06-0.2	0.12-0.16	5.6-8.4	High---------	0.28			
	31-60	50-85	1.30-1.50	0.06-0.2	0.10-0.14	7.4-8.4	High---------	0.28			
187----------	0-15	---	0.13-0.42	0.6-6.0	0.35-0.48	6.6-7.8	----------	----	5	2	50-90
Haug	15-18	10-18	1.20-1.60	0.6-6.0	0.12-0.24	6.6-8.4	Low----------	0.20			
	18-60	10-18	1.40-1.60	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.20			
191----------	0-10	2-10	1.35-1.50	6.0-20	0.06-0.11	6.1-7.3	Low----------	0.17	4	2	4-6
Epoufette	10-20	8-18	1.40-1.60	2.0-6.0	0.08-0.14	6.6-7.8	Low----------	0.17			
	20-60	0-8	1.40-1.65	>20	0.01-0.03	7.4-8.4	Low----------	0.10			
195B----------	0-12	5-12	1.55-1.65	2.0-6.0	0.10-0.12	5.6-7.3	Low----------	0.17	3	2	1-2
Taylor	12-18	60-85	1.40-1.45	0.06-0.2	0.10-0.14	5.1-7.8	High---------	0.28			
	18-60	50-80	1.35-1.60	0.00-0.06	0.09-0.13	7.4-8.4	High---------	0.28			
202----------	0-15	4-10	1.35-1.65	6.0-20	0.10-0.12	3.6-7.3	Low----------	0.17	5	2	.5-3
Meehan	15-40	4-9	1.60-1.70	6.0-20	0.06-0.11	3.6-6.5	Low----------	0.15			
	40-60	1-4	1.60-1.70	6.0-20	0.02-0.07	5.1-7.3	Low----------	0.15			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
205	0-10	1-10	1.40-1.60	6.0-20	0.10-0.12	4.5-7.3	Low	0.17	3	2	1-4
Karlstad	10-15	5-18	1.35-1.60	2.0-6.0	0.13-0.18	6.1-7.3	Low	0.24			
	15-60	1-5	1.50-1.70	6.0-20	0.02-0.04	7.4-8.4	Low	0.10			
242B	0-16	1-10	1.40-1.60	6.0-20	0.10-0.14	5.6-7.3	Low	0.17	2	2	1-3
Marquette	16-21	5-18	1.50-1.70	2.0-6.0	0.10-0.16	6.6-8.4	Low	0.20			
	21-60	1-5	1.50-1.70	>20	0.02-0.04	7.4-8.4	Low	0.10			
242D	0-4	1-10	1.40-1.60	6.0-20	0.10-0.14	5.6-7.3	Low	0.17	2	2	1-3
Marquette	4-8	5-18	1.50-1.70	2.0-6.0	0.10-0.16	6.6-8.4	Low	0.20			
	8-60	1-5	1.50-1.70	>20	0.02-0.04	7.4-8.4	Low	0.10			
280	0-4	5-20	1.35-1.55	2.0-6.0	0.10-0.13	6.1-7.3	Low	0.24	3	3	.5-3
Pelan	4-6	2-15	1.40-1.60	6.0-20	0.04-0.12	6.1-7.3	Low	0.17			
	6-15	15-25	1.50-1.65	6.0-20	0.05-0.11	6.1-7.8	Low	0.20			
	15-38	1-8	1.55-1.70	6.0-20	0.02-0.09	7.4-8.4	Low	0.20			
	38-60	8-18	1.40-1.75	0.6-2.0	0.14-0.18	7.4-8.4	Low	0.28			
379	0-6	10-30	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	Moderate	0.28	5	8	4-9
Percy	6-30	10-18	1.30-1.60	0.6-2.0	0.15-0.19	7.4-8.4	Low	0.28			
	30-60	7-18	1.40-1.60	0.6-2.0	0.12-0.19	7.4-8.4	Low	0.28			
387	0-7	18-27	1.10-1.50	0.2-2.0	0.17-0.24	6.6-8.4	Moderate	0.28	5	6	3-8
Roliss	7-10	18-35	1.30-1.70	0.2-0.6	0.15-0.19	7.4-8.4	Moderate	0.28			
	10-24	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate	0.28			
	24-60	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate	0.28			
404	0-3	5-18	1.30-1.60	2.0-6.0	0.16-0.18	6.1-7.3	Low	0.28	5	3	1-3
Chilgren	3-8	2-18	1.40-1.60	0.6-2.0	0.13-0.22	6.1-7.3	Low	0.28			
	8-14	18-35	1.30-1.70	0.6-2.0	0.18-0.22	6.1-7.8	Moderate	0.28			
	14-60	10-27	1.30-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.28			
425	0-10	5-10	1.30-1.50	2.0-6.0	0.16-0.19	6.6-7.8	Low	0.20	4	2	3-6
Donaldson	10-38	5-18	1.45-1.60	2.0-6.0	0.16-0.19	6.6-8.4	Low	0.28			
	38-60	35-70	1.15-1.50	0.06-0.2	0.09-0.13	7.4-8.4	High	0.28			
432	0-8	7-18	1.20-1.70	2.0-6.0	0.16-0.20	6.6-8.4	Low	0.20	3	3	2-6
Strandquist	8-36	1-8	1.50-1.70	6.0-20	0.03-0.05	7.4-8.4	Low	0.10			
	36-60	15-30	1.30-1.65	0.6-2.0	0.12-0.19	7.4-8.4	Moderate	0.37			
458B	0-3	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low	0.15	5	2	.5-2
Menahga	3-32	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low	0.15			
	32-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.8	Low	0.15			
481	0-9	5-15	1.20-1.50	2.0-6.0	0.13-0.18	5.6-7.8	Low	0.17	5	3	2-5
Kratka	9-25	2-10	1.30-1.60	6.0-20	0.06-0.11	5.6-7.8	Low	0.17			
	25-60	10-35	1.50-1.80	0.2-2.0	0.11-0.19	6.1-8.4	Moderate	0.32			
482	0-6	2-15	1.40-1.60	6.0-20	0.13-0.15	6.1-7.3	Low	0.15	5	2	1-4
Grygla	6-21	1-10	1.50-1.70	6.0-20	0.06-0.11	6.6-7.8	Low	0.15			
	21-60	8-27	1.30-1.75	0.2-2.0	0.17-0.19	7.4-8.4	Moderate	0.37			
514	0-6	---	0.10-0.30	0.2-6.0	0.35-0.45	5.6-7.8	---	---	5	2	>75
Tacoosh	6-36	---	0.10-0.20	0.6-6.0	0.45-0.55	5.6-7.8	---	---			
	36-60	5-35	1.40-2.00	0.2-2.0	0.12-0.20	5.6-8.4	Low	0.32			
532	0-13	---	0.15-0.25	0.2-6.0	0.35-0.45	4.5-6.5	Low	---	5	2	50-95
Sago	13-60	6-18	1.50-1.70	0.6-2.0	0.14-0.20	5.6-8.4	Low	0.28			
540	0-3	---	0.10-0.25	0.6-6.0	0.35-0.45	4.5-7.3	---	---	5	5	>25
Seelyeville	3-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	---	---			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
541----------	0-3	---	0.20-0.35	0.6-6.0	0.48-0.58	4.5-7.3	----------	----	5	5	>75
Rifle	3-60	---	0.08-0.20	0.6-6.0	0.48-0.58	4.5-7.3	----------	----			
543----------	0-28	---	0.15-0.45	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	4	2	55-85
Markey	28-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
544----------	0-12	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	----------	----	5	2	60-85
Cathro	12-25	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
	25-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.20			
546----------	0-8	---	0.20-0.35	0.6-6.0	0.45-0.55	4.5-7.8	----------	----	5	5	70-90
Lupton	8-60	---	0.10-0.35	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
549----------	0-18	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	----------	----	5	7	55-75
Greenwood	18-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	----------	----			
560:											
Greenwood-------	0-15	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	----------	----	5	7	55-75
	15-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	----------	----			
Lobo----------	0-38	---	0.02-0.10	6.0-20	0.55-0.65	3.0-4.4	----------	----	5	8	25-99
	38-60	---	0.07-0.20	0.6-6.0	0.45-0.55	3.0-4.4	----------	----			
563----------	0-9	---	0.18-0.25	2.0-6.0	0.35-0.45	5.1-7.8	----------	----	5	2	50-85
Northwood	9-12	3-18	1.45-1.65	2.0-20	0.09-0.17	5.6-7.8	Low----------	0.15			
	12-27	1-10	1.55-1.70	6.0-20	0.06-0.11	5.6-8.4	Low----------	0.15			
	27-60	7-30	1.40-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Moderate-----	0.37			
565----------	0-4	5-15	1.30-1.70	6.0-20	0.10-0.12	6.1-7.3	Low----------	0.17	5	2	1-3
Eckvoll	4-24	2-10	1.30-1.70	6.0-20	0.06-0.08	6.1-7.3	Low----------	0.15			
	24-28	18-35	1.40-1.70	0.2-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.37			
	28-60	16-32	1.30-1.70	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			
568----------	0-7	10-18	1.35-1.50	2.0-6.0	0.16-0.22	6.6-7.8	Low----------	0.28	5	3	2-6
Zippel	7-12	5-18	1.40-1.55	2.0-6.0	0.15-0.20	6.6-7.8	Low----------	0.37			
	12-60	5-18	1.40-1.55	2.0-6.0	0.15-0.20	7.4-8.4	Low----------	0.37			
569----------	0-8	15-27	1.35-1.55	0.6-2.0	0.17-0.22	6.6-7.8	Low----------	0.28	5	4L	2-4
Wabanica	8-11	18-35	1.35-1.60	0.6-2.0	0.17-0.22	6.6-7.8	Low----------	0.28			
	11-60	18-35	1.45-1.65	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.28			
570----------	0-3	3-10	1.40-1.60	6.0-20	0.06-0.09	5.1-6.5	Low----------	0.15	5	1	1-2
Faunce	3-14	3-10	1.45-1.70	6.0-20	0.06-0.08	5.1-6.5	Low----------	0.10			
	14-20	3-10	1.45-1.70	6.0-20	0.06-0.08	5.1-7.3	Low----------	0.10			
	20-60	0-5	1.45-1.75	6.0-20	0.03-0.06	6.6-7.8	Low----------	0.10			
581----------	0-8	10-20	1.30-1.60	2.0-6.0	0.13-0.18	6.6-8.4	Low----------	0.28	5	3	4-9
Percy	8-15	10-18	1.30-1.60	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.28			
	15-60	7-18	1.40-1.60	0.6-2.0	0.12-0.19	7.4-8.4	Low----------	0.28			
582----------	0-9	28-35	1.10-1.40	0.2-0.6	0.18-0.22	6.6-8.4	Moderate-----	0.24	5	4L	3-7
Roliss	9-15	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	15-24	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	24-60	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
616----------	0-6	8-27	1.35-1.55	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.37	3	5	1-3
Effie	6-14	35-60	1.50-1.70	0.06-0.2	0.12-0.19	5.1-8.4	High---------	0.37			
	14-60	25-55	1.50-1.70	0.06-0.2	0.12-0.19	7.9-8.4	Moderate-----	0.37			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
626----------	0-8	8-27	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.43	3	5	1-3
Suomi	8-20	35-60	1.50-1.70	0.06-0.2	0.10-0.19	5.1-7.3	High----------	0.32			
	20-60	27-45	1.50-1.70	0.06-0.2	0.11-0.17	7.4-8.4	Moderate-----	0.32			
627----------	0-8	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	4	2	40-60
Tawas	8-36	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
	36-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low----------	0.15			
630----------	0-10	---	0.10-0.25	0.6-6.0	0.45-0.55	5.1-6.5	----------	----	3	5	25-99
Wildwood	10-18	60-75	1.35-1.45	0.06-0.2	0.0-0.04	5.6-7.3	High----------	0.28			
	18-60	50-75	1.40-1.55	0.00-0.2	0.0-0.04	7.4-8.4	High----------	0.28			
641----------	0-9	40-60	1.20-1.50	0.06-0.2	0.13-0.17	6.6-7.8	High----------	0.28	5	4	3-6
Clearwater	9-18	35-60	1.20-1.50	0.06-0.2	0.15-0.18	7.4-8.4	High----------	0.32			
	18-60	35-60	1.20-1.60	0.06-0.2	0.15-0.18	7.4-8.4	High----------	0.32			
644----------	0-7	30-40	1.10-1.40	0.06-0.2	0.13-0.17	6.6-7.8	High----------	0.32	5	4	3-6
Boash	7-35	35-60	1.10-1.40	0.06-0.2	0.15-0.20	6.6-7.8	High----------	0.32			
	35-60	16-35	1.20-1.60	0.6-2.0	0.12-0.18	7.4-8.4	Low----------	0.32			
655----------	0-4	2-10	1.40-1.55	6.0-20	0.10-0.12	5.1-7.3	Low----------	0.15	4	2	1-3
Bearville	4-13	2-7	1.40-1.55	6.0-20	0.06-0.10	5.1-7.3	Low----------	0.15			
	13-16	18-27	1.50-1.75	0.2-0.6	0.13-0.18	5.6-7.3	Low----------	0.32			
	16-24	45-75	1.35-1.55	0.06-0.2	0.13-0.19	6.6-7.8	High----------	0.32			
	24-60	35-60	1.30-1.50	0.06-0.2	0.12-0.16	6.6-8.4	High----------	0.32			
702:											
Bullwinkle------	0-28	---	0.20-0.45	0.2-6.0	0.35-0.48	5.6-7.3	----------	----	5	2	60-85
	28-42	---	0.20-0.45	2.0-6.0	0.35-0.48	5.6-7.3	----------	----			
	42-44	8-27	1.20-1.50	0.6-2.0	0.14-0.18	6.6-7.8	Low----------	0.32			
	44-60	10-30	1.45-1.75	0.2-2.0	0.11-0.18	6.6-8.4	Moderate-----	0.32			
Cathro----------	0-12	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	----------	----	5	2	60-85
	12-25	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
	25-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.20			
755----------	0-7	41-65	1.45-1.65	0.06-0.6	0.10-0.14	6.6-7.8	High----------	0.28	5	4	3-5
Woodslake	7-19	60-85	1.35-1.45	<0.06	0.09-0.13	6.6-8.4	High----------	0.28			
	19-60	60-85	1.35-1.45	<0.06	0.09-0.13	7.4-8.4	High----------	0.28			
792----------	0-8	8-15	1.35-1.50	0.6-6.0	0.11-0.18	4.5-8.4	Low----------	0.20	4	8	3-12
Fordum	8-39	8-17	1.40-1.50	0.6-2.0	0.10-0.22	4.5-8.4	Low----------	0.37			
	39-60	2-5	1.55-1.70	>6.0	0.04-0.16	5.6-8.4	Low----------	0.15			
794----------	0-3	5-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low----------	0.17	5	2	1-2
Faunce Variant	3-15	3-10	1.55-1.70	6.0-20	0.06-0.11	5.1-7.3	Low----------	0.15			
	15-60	1-5	1.55-1.70	6.0-20	0.02-0.06	6.6-7.8	Low----------	0.10			
828D:											
Insula----------	0-3	4-18	1.40-1.60	2.0-6.0	0.09-0.14	4.5-6.5	Low----------	0.17	2	8	1-3
	3-11	4-18	1.40-1.60	2.0-6.0	0.08-0.13	4.5-6.5	Low----------	0.17			
	11	---	---	0.01-20	---	---	----------	----			
Mesaba----------	0-4	10-18	1.55-1.70	2.0-6.0	0.10-0.15	5.1-6.5	Low----------	0.17	4	8	---
	4-22	5-18	1.55-1.70	2.0-6.0	0.10-0.15	5.1-6.5	Low----------	0.17			
	22	---	---	0.01-20	---	---	----------	----			
952E:											
Quetico---------	0-8	10-25	1.40-1.60	0.6-2.0	0.20-0.22	4.5-5.5	Low----------	0.32	1	5	2-4
	8	---	---	0.01-20	---	---	----------	----			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
952E:											
Rock outcrop.											
1030:											
Udorthents------	0-60	2-18	1.50-1.70	0.6-6.0	0.08-0.14	6.6-9.0	Low----------	0.24	5	3	<1
	60-80	---	---	0.06-6.0	---	---	----------	----			
Pits.											
1033:											
Beaches.											
Menahga---------	0-8	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low----------	0.15	5	2	.5-2
	8-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.8	Low----------	0.15			
1059----------	0-8	5-15	1.20-1.65	0.6-2.0	0.22-0.24	5.6-7.8	Low----------	0.32	5	5	2-4
Wega	8-60	1-15	1.60-1.70	0.6-2.0	0.08-0.18	5.6-8.4	Low----------	0.43			
1066:											
Rock outcrop.											
Garnes----------	0-5	7-28	1.30-1.60	0.6-6.0	0.14-0.18	6.1-7.8	Low----------	0.32	5	8	.5-2
	5-9	18-30	1.50-1.65	0.6-2.0	0.17-0.20	6.6-7.8	Moderate-----	0.32			
	9-60	10-27	1.60-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
1067:											
Waupaca---------	0-8	2-10	1.20-1.65	0.6-2.0	0.20-0.22	6.6-7.8	Low----------	0.32	5	3	2-4
	8-60	2-18	1.60-1.70	0.6-2.0	0.08-0.13	6.6-8.4	Low----------	0.43			
Eutroboralfs.											
1807----------	0-21	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	----------	----	5	2	60-85
Cathro	21-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.20			
1808----------	0-28	---	0.15-0.45	0.2-6.0	0.35-0.45	4.5-7.8	----------	----	4	2	55-85
Markey	28-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
1923----------	0-5	7-28	1.30-1.60	0.6-6.0	0.14-0.18	6.1-7.8	Low----------	0.32	5	8	.5-2
Garnes	5-9	18-30	1.50-1.65	0.6-2.0	0.17-0.20	6.6-7.8	Moderate-----	0.32			
	9-60	10-27	1.60-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
1924----------	0-6	5-20	1.25-1.50	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	8	1-4
Grygla	6-31	1-10	1.30-1.75	6.0-20	0.06-0.11	6.6-7.8	Low----------	0.15			
	31-60	8-27	1.40-1.65	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			
1925----------	0-5	5-15	1.30-1.70	6.0-20	0.08-0.10	6.1-7.3	Low----------	0.10	5	8	1-3
Eckvoll	5-26	2-10	1.30-1.70	6.0-20	0.06-0.08	6.1-7.3	Low----------	0.15			
	26-34	18-35	1.40-1.70	0.2-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.37			
	34-60	16-32	1.30-1.70	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			
1984----------	0-11	---	0.10-0.25	0.6-6.0	0.35-0.50	4.5-7.3	----------	----	2	2	50-90
Leafriver	11-16	3-18	1.40-1.65	2.0-20	0.08-0.14	4.5-7.3	Low----------	0.17			
	16-60	0-10	1.50-1.65	6.0-20	0.03-0.08	4.5-7.3	Low----------	0.17			

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
48B---------- Hiwood	A	None--------	---	---	2.0-5.0	Apparent	Apr-Jul	>60	---	---	Moderate	Low------	Low.
52---------- Augsburg	B/D	None--------	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	---	High-----	High-----	Low.
77B---------- Garnes	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	---	High-----	Moderate	Low.
116---------- Redby	B	None--------	---	---	1.5-3.0	Apparent	Apr-Jul	>60	---	---	Moderate	Low------	Low.
117---------- Cormant	A/D	None--------	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	---	Moderate	High-----	Low.
122B---------- Taylor	C	None--------	---	---	3.0-6.0	Perched	Apr-Jul	>60	---	---	Moderate	High-----	Low.
145---------- Enstrom	B	None--------	---	---	2.5-5.0	Apparent	Apr-Jul	>60	---	---	Moderate	Moderate	Low.
147---------- Spooner	C/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	---	High-----	High-----	Low.
167B---------- Baudette	B	None--------	---	---	3.0-6.0	Apparent	May-Jul	>60	---	---	High-----	Moderate	Low.
172---------- Indus	D	None--------	---	---	0.5-3.0	Perched	Apr-Jul	>60	---	---	Moderate	High-----	Moderate.
187---------- Haug	B/D	None--------	---	---	+1-3.0	Apparent	Jan-Dec	>60	---	---	High-----	High-----	Low.
191---------- Epoufette	B/D	None--------	---	---	0.5-2.0	Apparent	Nov-Jun	>60	---	---	High-----	High-----	Moderate.
195B---------- Taylor	C	None--------	---	---	3.0-6.0	Perched	Apr-Jul	>60	---	---	Moderate	High-----	Low.
202---------- Meehan	B	None--------	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	Moderate	Low------	Moderate.
205---------- Karlstad	A	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	---	Moderate	Low------	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
242B, 242D---- Marquette	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Low.
280---- Pelan	B	None	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	---	Moderate	Moderate	Low.
379---- Percy	B/D	None	---	---	0.5-3.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.
387---- Roliss	B/D	None	---	---	+.5-3.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.
404---- Chilgren	C	None	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.
425---- Donaldson	C	None	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.
432---- Strandquist	B/D	None	---	---	0.5-3.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
458B---- Menahga	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.
481---- Kratka	B/D	None	---	---	0.5-3.0	Apparent	Apr-Jul	>60	---	---	Moderate	High	Low.
482---- Grygla	B/D	None	---	---	0.5-2.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
514---- Tacoosh	B/D	None	---	---	+1-1.0	Apparent	Sep-May	>60	---	9-29	High	High	Moderate.
532---- Sago	D	None	---	---	+1-1.0	Apparent	Oct-Jul	>60	---	5-10	High	High	Moderate.
540---- Seelyeville	A/D	None	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	50-55	High	High	Moderate.
541---- Rifle	A/D	None	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	---	High	High	Low.
543---- Markey	A/D	None	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	25-30	High	High	Low.
544---- Cathro	A/D	None	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	19-22	High	High	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
546--Lupton	A/D	None	---	---	0-1.0	Apparent	Sep-May	>60	---	50-55	High	High	Low.
549--Greenwood	A/D	None	---	---	0-1.0	Apparent	Sep-Jun	>60	---	---	High	High	High.
560:													
Greenwood	A/D	None	---	---	0-1.0	Apparent	Sep-Jun	>60	---	---	High	High	High.
Lobo	D	None	---	---	0-2.0	Apparent	Jan-Dec	>60	---	55-50	High	High	High.
563--Northwood	B/D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	8-10	High	High	Low.
565--Eckvoll	B	None	---	---	2.0-5.0	Apparent	Apr-Jun	>60	---	---	High	Moderate	Low.
568--Zippel	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
569--Wabanica	C	None	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	---	High	High	Low.
570--Faunce	A	None	---	---	>6.0	---	---	>60	---	---	Low	Low	Moderate.
581--Percy	B/D	None	---	---	0.5-3.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.
582--Roliss	B/D	None	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.
616--Effie	C	None	---	---	1.0-2.5	Perched	Mar-Jun	>60	---	---	High	High	Moderate.
626--Suomi	C	None	---	---	1.0-2.0	Perched	Apr-May	>60	---	---	Moderate	Moderate	Moderate.
627--Tawas	A/D	None	---	---	0-1.0	Apparent	Nov-May	>60	---	25-30	High	High	Moderate.
630--Wildwood	D	None	---	---	+1-1.0	Perched	Sep-Jun	>60	---	---	High	High	Low.
641--Clearwater	D	None	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	---	High	High	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
644---------- Boash	D	None--------	---	---	1.0-3.0	Apparent	Apr-Jun	>60	---	---	High-----	High-----	Low.
655---------- Bearville	C	None--------	---	---	1.0-3.0	Perched	Oct-Jun	>60	---	---	High-----	High-----	Moderate.
702:													
Bullwinkle-----	D	None--------	---	---	0-1.0	Apparent	Jan-Dec	>60	---	19-22	High-----	High-----	Moderate.
Cathro---------	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	19-22	High-----	High-----	Low.
755---------- Woodslake	D	None--------	---	---	+.5-2.0	Apparent	Apr-Oct	>60	---	---	Moderate	High-----	Low.
792---------- Fordum	D	Frequent----	Brief or long.	Mar-Jun	0-1.0	Apparent	Jan-Dec	>60	---	---	High-----	High-----	Moderate.
794---------- Faunce Variant	B	None--------	---	---	2.0-5.0	Apparent	Apr-Jun	>60	---	---	Low------	Low------	Moderate.
828D:													
Insula---------	D	None--------	---	---	>6.0	---	---	8-20	Hard	---	Moderate	Low------	Moderate.
Mesaba---------	C	None--------	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Low------	Moderate.
952E:													
Quetico--------	D	None--------	---	---	>6.0	---	---	4-10	Hard	---	Low------	Low------	Moderate.
Rock outcrop.													
1030:													
Udorthents-----	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate	High-----	Moderate.
Pits.													
1033:													
Beaches.													
Menahga--------	A	None--------	---	---	>6.0	---	---	>60	---	---	Low------	Low------	Moderate.
1059---------- Wega	B	Rare--------	---	---	1.0-3.0	Apparent	Apr-Oct	>60	---	---	High-----	Moderate	Low.
1066:													
Rock outcrop.													
Garnes---------	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	---	High-----	Moderate	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					Ft			In		In			
1067: Waupaca--------- Eutroboralfs.	B/D	Occasional	Brief-----	Apr-Oct	0-1.0	Apparent	Apr-Oct	>60	---	---	High-----	High-----	Low.
1807---------- Cathro	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	19-22	High-----	High-----	Low.
1808---------- Markey	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	25-30	High-----	High-----	Low.
1923---------- Garnes	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	---	High-----	Moderate	Low.
1924---------- Grygla	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	---	High-----	High-----	Low.
1925---------- Eckvoll	B	None--------	---	---	2.0-5.0	Apparent	Apr-Jun	>60	---	---	High-----	Moderate	Low.
1984---------- Leafriver	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	>60	---	5-10	High-----	High-----	High.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Augsburg	Coarse-silty over clayey, frigid Typic Calciaquolls
Baudette	Fine-silty, mixed Aquic Eutroboralfs
Bearville	Fine-loamy over clayey, mixed, frigid Typic Ochraqualfs
Boash	Clayey over loamy, montmorillonitic (calcareous), frigid Typic Haplaquolls
Bullwinkle	Loamy, mixed, euic Terric Borosaprists
Cathro	Loamy, mixed, euic Terric Borosaprists
Chilgren	Fine-loamy, mixed, frigid Typic Ochraqualfs
Clearwater	Fine, montmorillonitic (calcareous), frigid Typic Haplaquolls
Cormant	Mixed, frigid Mollic Psammaquents
Donaldson	Coarse-loamy over clayey, mixed Aquic Haploborolls
Eckvoll	Loamy, mixed Aquic Arenic Eutroboralfs
Effie	Fine, mixed, frigid Typic Ochraqualfs
Enstrom	Sandy over loamy, mixed, nonacid, frigid Aquic Udorthents
Epoufette	Coarse-loamy, mixed, frigid Mollic Ochraqualfs
Eutroboralfs	Silty and loamy, mixed Eutroboralfs
Faunce	Mixed, frigid Alfic Udipsamments
Faunce Variant	Mixed, frigid Aquic Udipsamments
Fordum	Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents
Garnes	Fine-loamy, mixed Aquic Eutroboralfs
Greenwood	Dysic Typic Borohemists
Grygla	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
Haug	Coarse-loamy, mixed (calcareous), frigid Histic Humaquepts
Hiwood	Mixed, frigid Aquic Udipsamments
Indus	Very fine, montmorillonitic, frigid Typic Ochraqualfs
*Insula	Loamy, mixed, frigid Lithic Dystrochrepts
Karlstad	Coarse-loamy, mixed Aquic Eutroboralfs
Kratka	Sandy over loamy, mixed, frigid Typic Haplaquolls
Leafriver	Sandy, mixed, frigid Histic Humaquepts
Lobo	Dysic, frigid Hemic Sphagnofibrists
Lupton	Euic Typic Borosaprists
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Marquette	Loamy-skeletal, mixed Psammentic Eutroboralfs
Meehan	Mixed, frigid Aquic Udipsamments
Menahga	Mixed, frigid Typic Udipsamments
*Mesaba	Coarse-loamy, mixed, frigid Typic Dystrochrepts
Northwood	Sandy over loamy, mixed, nonacid, frigid Histic Humaquepts
*Pelan	Loamy-skeletal, mixed Psammentic Eutroboralfs
Percy	Coarse-loamy, frigid Typic Calciaquolls
*Quetico	Loamy, mixed, acid, frigid Lithic Udorthents
Redby	Mixed, frigid Aquic Udipsamments
Rifle	Euic Typic Borohemists
Roliss	Fine-loamy, mixed (calcareous), frigid Typic Haplaquolls
*Sago	Coarse-loamy, mixed, nonacid, frigid Histic Humaquepts
Seelyeville	Euic Typic Borosaprists
Spooner	Fine-silty, mixed, frigid Typic Ochraqualfs
Strandquist	Sandy-skeletal over loamy, mixed (calcareous), frigid Typic Haplaquolls
Suomi	Fine, mixed Glossaquic Eutroboralfs
Tacoosh	Loamy, mixed, euic Terric Borohemists
Tawas	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Taylor	Very fine, montmorillonitic Aquic Eutroboralfs
Udorthents	Mixed, frigid Udorthents
Wabanica	Fine-silty, mixed (calcareous), frigid Typic Haplaquolls
Waupaca	Coarse-silty, mixed, nonacid, frigid Mollic Fluvaquents
Wega	Coarse-silty, mixed, nonacid, frigid Aquic Udifluvents
Wildwood	Very fine, montmorillonitic, nonacid, frigid Histic Humaquepts
Woodslake	Very fine, montmorillonitic, frigid Typic Haplaquolls
Zippel	Coarse-silty, mixed (calcareous), frigid Typic Haplaquolls

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