United States
Department of
Agriculture

Natural
Resources
Conservation
Service and
Forest
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Beltrami County Area, Minnesota

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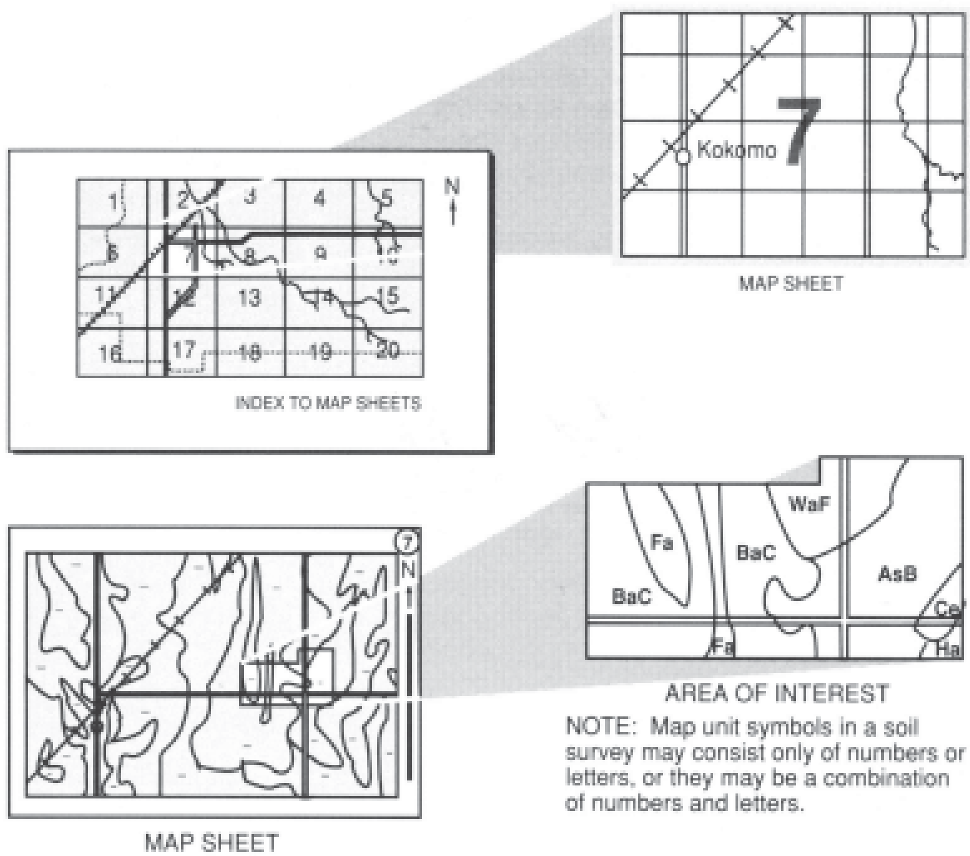
How To Use This Soil Survey

Detailed Soil Maps

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

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



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

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

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

Major fieldwork for this soil survey was completed in 1986. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. 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 for Minnesota Resources and Beltrami County. It is part of the technical assistance furnished to the Beltrami 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.

Cover: A farmstead near a small lake in Beltrami County. Lakes in the county offer recreational opportunities and provide habitat for wetland wildlife.

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Issued July 1997

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Foreword

This soil survey contains information that can be used in land-planning programs in Beltrami County. 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.

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

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.

This publication contains no interpretations for the map units in the Chippewa National Forest. Information about these units is available at the Forest Service headquarters of the Chippewa National Forest.

William Hunt
State Conservationist
Natural Resources Conservation Service

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Soil Survey of
Beltrami County Area, Minnesota

By David A. Larson, Minnesota Agricultural Experiment Station, and Richard E. Rolling, Natural Resources Conservation Service

Fieldwork by Ward J. Aas, Rodney B. Heschke, and Richard E. Rolling, Natural Resources Conservation Service; Grant L. Goltz, Forest Service; and Peter C. Bates, Jeffrey N. Bilkert, David A. Larson, and Michael D. Oja, Minnesota Agricultural Experiment Station

Data on soil productivity for woodland collected by Peter C. Bates, Minnesota Agricultural Experiment Station

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

General Nature of the Survey Area

This survey area is in north-central Minnesota (fig. 1). Bemidji is the county seat. The total area of Beltrami County is 1,955,600 acres. Of this total, 351,000 acres is made up of individual areas of water that are more than 40 acres in size. Also included in the total acreage are Upper Red Lake and Lower Red Lake, which cover about 280,000 acres.

This survey does not include interpretations for areas in Beltrami County that are part of the Red Lake Indian Reservation.

The mercantile trade is the principal business enterprise in Beltrami County, but tourism, the timber industry, and farming also are important to the local economy. The main crops are corn, small grain, and hay. Dairy and beef cattle operations are the main livestock enterprises. Timber is harvested for chipboard plants or for pulp, paper, and lumber mills, or it is used for fuelwood.

Physiography, Relief, and Drainage

Beltrami County is in two physiographic regions. One of these is the lake plain of glacial Lake Agassiz, which covers most of the northern part of the county. The other is a moraine-outwash complex, which is in the southern part of the county.

The landscape on the lake plain is broad and flat, but it is interrupted in places by relict sandbars and beach ridges. Lacustrine sand, silt, and clay have been deposited in the basins between the ridges. In many areas a thick layer of organic material has accumulated on top of the lacustrine deposits.

The moraine-outwash area is characterized by level to hilly topography. Glacial till, which ranges in texture from fine sandy loam to loam, was deposited in a series of ground and terminal moraines throughout the southern part of the county. Erosion and redeposition of the till by meltwater, wind, and rain left some areas covered by a variety of sorted deposits. Medium and coarse sand and scattered pockets of gravel were deposited on the broad outwash plain in the southern part of the county. Stratified deposits of fine sand, silt, and clay are scattered throughout the moraines.

The highest elevation in the county, 1,486 feet above sea level, is located in section 10 of Buzzle Township. The lowest elevation, 1,152 feet, is on the lake plain where the Moose River flows out of the county (sec. 6, T. 157 N., R. 38 W.). Generally, the lake plain is

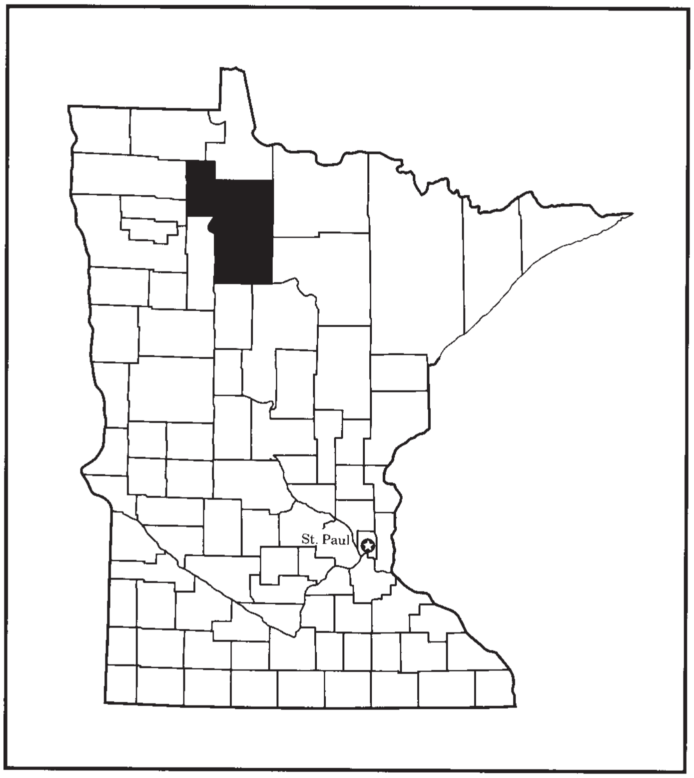

Figure 1.—Location of the survey area in Minnesota.

confined to elevations below 1,325 feet and the moraine-outwash complex is at higher elevations.

Surface water from Beltrami County drains into three watersheds. The northern part of the lake plain drains north through the Rapid River into the Rainy River, which drains into Lake Superior. The rest of the lake plain, including the Upper and Lower Red Lakes and the northern part of the morainic complex, drains west through the Roseau, Moose, Red Lake, and Clearwater Rivers into the Red River, which drains into Hudson Bay. The moraine-outwash area drains into the Mississippi River, which flows into the Gulf of Mexico.

History and Development

The area around Beltrami County was originally inhabited by Indians known as the mound builders, who were later replaced by the Dakota Indians. The first Europeans in the area, French fur traders, arrived in the early 18th century. At about the same time, the Chippewa Indians entered the area and fought a series of battles with the Dakota Indians. By about 1750, the Chippewa had forced the Dakota out of the area.

Permanent trading posts were established on Red Lake and Lake Bemidji in the late 1700's. The logging industry flourished during the 19th century until the 1880's, when most of the virgin coniferous forest had been harvested. Settlement and farming increased rapidly after the forest had been logged.

Beltrami County was established by an act of the State legislature on February 28, 1866. It was named after the Italian explorer Giacomo Constantino Beltrami, who had visited the area in 1823. Originally, Beltrami County included the southern two-thirds of the present county and the area that is now Clearwater County. In 1879, all territory north of the original county, to the Canadian border, was added. In 1896, a large area was transferred from Beltrami County to Roseau County. In 1902, 30 townships were taken from Beltrami County to form Clearwater County. The county was again divided in 1921, when the northern part was taken to establish Lake of the Woods County.

Transportation Facilities and Markets

Two railroad lines run across the southwestern part of the county. Air service is provided between Bemidji and the Minneapolis-St. Paul area.

Beltrami County is served by a network of all-weather roads. U.S. Highway 2 crosses the southern part of the county and connects Bemidji with Grand Forks, North Dakota, to the west and with Duluth to the east. U.S. Highway 71 runs from southwest to northeast through the southern part of the county and connects Bemidji with International Falls to the north. Trunk Highway 89 runs from north to south through the county, and Trunk Highway 1 runs from east to west through the northern part of the county. These highways and a number of paved county and State roads connect many gravel-surfaced roads and provide access to most parts of the county.

Grain is usually trucked to Duluth or Minneapolis. Typically, livestock is trucked to Fargo, St. Cloud, or St. Paul. Local milk is trucked in bulk to a processing plant about 50 miles west of Bemidji. Most of the timber harvested in the county is trucked to local chipboard plants or sawmills, but some is shipped by rail to paper and lumber mills in Cloquet.

Farming

According to 1982 agricultural census data, there are 775 farms in Beltrami County. These farms range from a few acres to several thousand acres in size, but most range from 50 to 1,000 acres in size. The major crops are oats, wheat, barley, rye, and corn. Other crops in the county include sunflowers, flax, wild rice, and potatoes. Many areas are used for alfalfa and hay. The major livestock in the county are beef cattle and dairy cattle, but hogs, sheep, and egg-laying hens also are raised.

Forestry

Forestry is a major land use in Beltrami County. In 1977, the county had 1,044,000 total acres of forest land, of which 794,600 acres was classified as commercial forest land. Of this commercial forest land, 77 percent is publicly owned. The State administers 227,400 acres, the county administers 133,200 acres, Indian lands make up 195,900 acres, and 54,700 acres is in the Chippewa National Forest. Of the privately owned forest land, 137,400 acres is owned by farmers, 2,500 acres is owned by forest industries, and 43,500 acres is owned by other groups and by individuals.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Bemidji in the period 1951 to 1981. 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 -4 degrees. The lowest temperature on record, which occurred at Bemidji on January 21, 1954, is -48 degrees. In summer, the average temperature is 65 degrees and the average daily maximum temperature is 77 degrees. The highest recorded temperature, which occurred at Bemidji on July 29, 1975, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 23 inches. Of this, 18 inches, or about 78 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 14 inches. The heaviest 1-day rainfall during the period of record was 3.90 inches at Bemidji on June 22, 1957. Thunderstorms occur on about 33 days each year.

The average seasonal snowfall is about 39 inches. The greatest snow depth at any one time during the period of record was 41 inches. On the average, 140 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The 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 50 percent in winter. The prevailing wind is from the north. Average windspeed is highest, 14 miles per hour, in spring.

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.

This survey was made at two levels of investigation. Lands outside the Chippewa National Forest were mapped and correlated using guidelines established by the National Cooperative Soil Survey. Lands inside the Chippewa National Forest were mapped using the Ecological Classification System (ECS).

The Chippewa National Forest consists of approximately 1.2 million acres. About 160,000 acres of the Chippewa National Forest is in Beltrami County. Scattered throughout the forest are privately owned areas and areas that are owned by the county or the State. The areas are of various sizes, and many are small, somewhat inaccessible tracts. These areas also were mapped using the ECS.

Soil map units that are based on the Ecological Land Type (ELT) component of the ECS differ from the soil map units that are outside the forest. Ecological land types are based on geology, landform, hydrology, vegetation, and soils. The composition and variability of the soil component of each ELT are broader than in map units defined and correlated outside the Chippewa National Forest.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of changes and refinements in series concepts, differences in slope groupings, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

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.

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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, Nebish sandy loam, 1 to 6 percent slopes, is a phase of the Nebish series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

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. Graycalm-Menahga complex, 1 to 6 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Hiwood-Zimmerman association, nearly level to hilly, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. The map unit Seelyeville and Bowstring soils is an undifferentiated group in this survey area.

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. Pits, gravel, 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.

Descriptions of Soils Outside the Chippewa National Forest

32B—Nebish sandy loam, 1 to 6 percent slopes

Composition

Nebish soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—very dark gray sandy loam
3 to 9 inches—grayish brown fine sandy loam
9 to 24 inches—dark yellowish brown clay loam
24 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are in the less sloping areas
• The poorly drained Shooker soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have more clay throughout
• Soils that are underlain by stratified material
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a surface layer of loam or fine sandy loam

Use and Management

Cropland

Major management factors: Water erosion, soil blowing, and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Tilling and planting across the slope reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses and legumes, rotating crops, and returning crop residue to the soil maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, white spruce, northern red oak, and red pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Site preparation is needed to control competing vegetation.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed

for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

32C—Nebish fine sandy loam, 6 to 12 percent slopes

Composition

Nebish soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—very dark gray fine sandy loam
3 to 8 inches—brown fine sandy loam
8 to 16 inches—yellowish brown clay loam
16 to 26 inches—dark yellowish brown clay loam
26 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are in the less sloping areas
• The poorly drained Shooker soils, which are in swales and concave basins
• Very poorly drained organic soils in small closed depressions

Similar soils:
• Soils that have a thicker surface layer
• Soils that have more clay throughout
• Soils that are underlain by stratified material
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a surface layer of loam or sandy loam

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Tilling and planting across the slope, farming on the contour, establishing grassed waterways, and using tillage practices that leave crop residue on the surface reduce the hazard of water erosion and increase the rate of water infiltration.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, white spruce, northern red oak, and red pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer

according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

32D—Nebish fine sandy loam, 12 to 25 percent slopes

Composition

Nebish soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

0 to 3 inches—very dark grayish brown fine sandy loam
3 to 8 inches—grayish brown fine sandy loam
8 to 18 inches—brown clay loam
18 to 25 inches—dark yellowish brown loam
25 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are in the less sloping areas
• The poorly drained Shooker soils, which are in swales and concave basins
• Very poorly drained organic soils in small closed depressions

Similar soils:
• Soils that have a thicker surface layer
• Soils that have more clay throughout
• Soils that are underlain by stratified material
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a surface layer of loam or sandy loam
• Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Water erosion, slope, equipment limitations, and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, white spruce, northern red oak, and red pine are tree species of limited extent.
• Operating equipment on the steeper slopes may cause the formation of gullies and can result in serious erosion problems.
• Establishing skid roads and trails along the contour and sloping road surfaces reduce the hazard of water erosion.
• Water bars, culverts, and drop structures are needed to remove water.
• Special care is needed when logging roads, skid trails, and landings are laid out or when equipment is operated.
• Roads should be designed so that they conform to the topography, and the grade should be less than 10 percent and should be kept as low as possible.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Converting a site from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality and the slope
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 6R
Windbreak suitability group: 3

48—Hiwood loamy fine sand

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex rises on till-floored glacial lake plains and outwash plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 2 inches—very dark gray loamy fine sand
2 to 6 inches—dark grayish brown fine sand
6 to 12 inches—dark yellowish brown fine sand
12 to 26 inches—yellowish brown, mottled fine sand
26 to 42 inches—pale brown, mottled fine sand
42 to 60 inches—yellowish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cormant soils, which are in swales and in concave basins
• The somewhat poorly drained Redby soils, which are in plane or slightly concave basins
• The excessively drained Sartell soils, which are on side slopes and hilltops

Similar soils:
• Soils that contain thin bands of gravel or loamy material
• Soils that formed entirely in medium sand
• Soils that are underlain by glacial till at a depth of more than 60 inches
• Soils that have free carbonates at a depth of 40 to 60 inches
• Soils that have a surface layer of loamy sand

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, and organic matter content
• Forage plants are the main crops.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface and by leaving crop stubble in the field to trap snow.
• Using minimum tillage, maintaining crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, plant competition, windthrow, and seedling mortality
• The principal tree species is red pine.
• Jack pine, eastern white pine, and black spruce are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts may form if skidders are used when the soil is saturated.
• Deep ruts can damage tree roots and thus hinder natural regeneration.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or

containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• Windthrow is a hazard during periods of high winds and excessive wetness.
• The loose, sandy surface layer may limit the use of equipment.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 8W
Windbreak suitability group: 7

72—Shooker loam

Composition

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

Setting

Landform and position on the landform: Swales and broad flats on moraines and till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 300 acres

Typical Profile

0 to 6 inches—very dark gray loam
6 to 9 inches—light brownish gray, mottled fine sandy loam
9 to 28 inches—grayish brown, mottled clay loam
28 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are on low convex rises
• The very poorly drained Hamre and Talmoon soils, which are in closed depressions and have a thin organic surface layer

Similar soils:
• Soils that have a thicker surface layer
• Soils that have more clay throughout
• Soils that are underlain by stratified material
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a surface layer of clay loam or fine sandy loam

Use and Management

Cropland

Major management factors: Wetness
• The major crops are small grain, corn, and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is quaking aspen.

• Black ash, American elm, balsam fir, and paper birch are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas can prevent the establishment of desired species.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw, drained, and IVw, undrained
Woodland ordination symbol: 6W
Windbreak suitability group: 2

77—Garnes loam

Composition

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

Setting

Landform and position on the landform: Slightly convex rises on till-floored glacial lake plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 60 acres

Typical Profile

0 to 3 inches—black loam
3 to 7 inches—grayish brown fine sandy loam
7 to 16 inches—dark brown, mottled clay loam
16 to 20 inches—dark brown, mottled clay loam
20 to 60 inches—grayish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low or low
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The poorly drained Chilgren and Smiley soils, which are in swales and concave basins
• The poorly drained Kratka soils, which are in plane or slightly concave basins and have a sandy mantle overlying glacial till
Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam or sandy loam
• Soils that have a gravelly lens at the boundary of the glacial till
• Soils that have less clay throughout
• Soils that are more than 20 inches deep over free carbonates

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the

surface helps to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Deferring field traffic when the soil is wet and returning crop residue to the soil can minimize compaction of the surface layer.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Bur oak, red pine, sugar maple, white spruce, and eastern white pine are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can cause excessive rut formation and soil compaction and can permanently damage the site.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L
Windbreak suitability group: 1

116—Redby loamy fine sand

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex rises and broad flats on till-floored glacial lake plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 3 inches—very dark gray loamy fine sand
3 to 8 inches—grayish brown, mottled fine sand
8 to 30 inches—yellowish brown, mottled fine sand
30 to 60 inches—light brownish gray, mottled fine sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: 1.5 to 3.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cormant soils, which are in swales and concave basins
• The moderately well drained Hiwood soils, which are on slightly convex rises
• The moderately well drained Eckvoll soils, which are in adjacent areas and are underlain by loamy glacial till at a depth of more than 40 inches

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have thin bands of loamy material at a depth of more than 30 inches
• Soils that formed entirely in medium sand
• Soils that have free carbonates at a depth of more than 40 inches

Use and Management

Cropland

Major management factors: Wetness, available water capacity, soil blowing, ground-water contamination, and organic matter content
• The major crops are forage plants.

• The seasonal high water table provides supplemental moisture for plants.
• Using minimum tillage, leaving crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface and by leaving crop stubble in the field to trap snow.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, plant competition, windthrow, and seedling mortality
• The principal tree species is quaking aspen.
• Jack pine and white spruce are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts may form if skidders are used when the soil is saturated.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Windthrow is a hazard during periods of high winds and excessive wetness.
• The loose, sandy surface layer may limit the use of equipment.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 7W
Windbreak suitability group: 1

117—Cormant loamy fine sand

Composition

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

Setting

Landform and position on the landform: Concave basins and broad flats on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 8 inches—black loamy fine sand
8 to 60 inches—light olive gray and grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderate to very high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Deerwood soils, which are in closed depressions and have a thin organic surface layer
• The somewhat poorly drained Redby soils on slightly convex rises
• The poorly drained Grygla soils, which are in adjacent areas and are underlain by loamy glacial till at a depth of more than 40 inches

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have thin bands of loamy material at a depth of more than 30 inches
• Soils that formed entirely in medium and coarse sand

Use and Management

Cropland

Major management factors: Wetness, available water

capacity, soil blowing, and ground-water contamination
• The major crops are small grain and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Using minimum tillage, leaving crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface, by establishing vegetative barriers, and by leaving crop stubble in the field to trap snow.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Balsam fir and black ash are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas can prevent the establishment of desired species.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IVw
Woodland ordination symbol: 6W
Windbreak suitability group: 2

121—Wykeham fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex rises on moraines and till plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 8 inches—very dark grayish brown fine sandy loam
8 to 16 inches—brown, mottled fine sandy loam
16 to 23 inches—dark yellowish brown, mottled loam that has interfingerings of grayish brown fine sandy loam
23 to 32 inches—dark brown, mottled loam
32 to 60 inches—light olive brown, mottled, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 4.0 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are

in adjacent areas and have a sandy mantle that is more than 20 inches thick
• The poorly drained Shooker soils, which are in swales and concave basins
• The well drained Snellman soils, which are in the more sloping areas

Similar soils:
• Soils in which material from the subsurface layer does not interfinger into the subsoil
• Soils that have more clay throughout
• Soils that have a lower content of sand throughout
• Soils that have a surface layer of sandy loam or loam

Use and Management

Cropland

Major management factors: Soil blowing and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize compaction of the surface layer.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, and northern red oak are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6L
Windbreak suitability group: 1

125—Beltrami fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly convex rises on moraines and till plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 5 inches—very dark grayish brown fine sandy loam
5 to 10 inches—grayish brown, mottled fine sandy loam
10 to 17 inches—dark brown, mottled clay loam
17 to 26 inches—olive brown, mottled clay loam
26 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow

Depth to the water table: 2 to 4 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
- The well drained Nebish soils, which are in the more sloping areas
- The poorly drained Shooker soils, which are in swales and concave basins

Similar soils:
- Soils that have a thicker surface layer
- Soils that have a surface layer of loam or sandy loam
- Soils that have more clay throughout
- Soils that are underlain by stratified material

Use and Management

Cropland

Major management factors: Soil blowing and organic matter content
- The major crops are small grain, corn, and forage plants.
- Using tillage practices that leave crop residue on the surface helps to control soil blowing.
- Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
- Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize compaction of the surface layer.
- Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
- The principal tree species is quaking aspen.
- Sugar maple, American basswood, white spruce, northern red oak, and eastern white pine are tree species of limited extent.
- The use of equipment is restricted during spring thaw and other excessively wet periods.
- Ruts form easily if skidders are used when the soil is wet.
- Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
- Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
- Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
- Converting sites from northern hardwoods to conifers requires intensive management.
- If conifer species are planted, suckering and competition from hardwood seedlings are severe.
- Mechanical or chemical site preparation is needed to control competing vegetation.
- Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
- Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

- A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

- Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
- Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L
Windbreak suitability group: 1

147—Spooner silt loam

Composition

Spooner soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Swales and broad flats on water-modified till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 4 inches—very dark gray silt loam
4 to 7 inches—grayish brown very fine sandy loam
7 to 25 inches—olive gray, mottled silty clay loam
25 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High

Organic matter content: 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 slightly convex rises
• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer
Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or very fine sandy loam
• Soils that have very fine sand and coarse silt in the underlying material
• Soils that have more clay throughout
• Soils that formed in glacial till

Use and Management

Cropland

Major management factors: Wetness
• The major crops are small grain, corn, and forage plants.
• Most of the commonly grown crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is quaking aspen.
• Black ash, American elm, balsam fir, and white spruce are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw, drained, and IVw, undrained
Woodland ordination symbol: 8W
Windbreak suitability group: 2

158B—Zimmerman loamy fine sand, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and beach ridges
Shape of areas: Irregular
Size of areas: 15 to 200 acres

Typical Profile

0 to 3 inches—very dark gray loamy fine sand
3 to 16 inches—brown fine sand
16 to 35 inches—yellowish brown fine sand

35 to 40 inches—pale brown fine sand
40 to 60 inches—very pale brown fine sand that has thin bands of dark yellowish brown loamy fine sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Balmlake soils, which are in adjacent areas and are stratified with loamy material
• The poorly drained Cormant soils, which are in swales and do not have thin textural bands
• The moderately well drained Hiwood soils, which are in plane or slightly concave basins and do not have thin textural bands

Similar soils:
• Soils that do not have thin bands of loamy material within a depth of 60 inches
• Soils that contain more gravel throughout
• Soils that have lenses of medium and coarse sand or that formed entirely in medium and coarse sand
• Soils that have free carbonates at a depth of 40 to 60 inches

Use and Management

Cropland

Major management factors: Soil blowing, available water capacity, and ground-water contamination
• The major crops are forage plants.
• Maintaining crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Crops that can tolerate drought should be selected.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Seedling mortality and plant competition
• The principal tree species is red pine.
• Jack pine, eastern white pine, and paper birch are tree species of limited extent.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can tolerate drought, mulching, and shading the seedlings reduce the seedling mortality rate.
• The loose, sandy surface layer may limit the use of equipment.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate drought should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 8S
Windbreak suitability group: 7

158C—Zimmerman loamy fine sand, 6 to 12 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and beach ridges
Shape of areas: Irregular
Size of areas: 15 to 100 acres

Typical Profile

0 to 2 inches—very dark grayish brown loamy fine sand
2 to 12 inches—brown fine sand
12 to 30 inches—yellowish brown fine sand
30 to 37 inches—very pale brown fine sand
37 to 60 inches—very pale brown fine sand that has thin bands of dark yellowish brown loamy fine sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Balmlake soils, which are in adjacent areas and are stratified with loamy material
• The poorly drained Cormant soils, which are in swales and do not have thin textural bands
• The moderately well drained Hiwood soils, which are in plane or slightly concave basins and do not have thin textural bands

Similar soils:
• Soils that do not have thin bands of loamy material within a depth of 60 inches
• Soils that contain more gravel throughout
• Soils that have lenses of medium and coarse sand or that formed entirely in medium and coarse sand
• Soils that have free carbonates at a depth of 40 to 60 inches
• Soils that have slopes of more than 12 percent

Use and Management

Woodland

Major management factors: Seedling mortality and plant competition
• The principal tree species is red pine.
• Jack pine, eastern white pine, and paper birch are tree species of limited extent.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can tolerate drought, mulching, and shading the seedlings reduce the seedling mortality rate.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• The loose, sandy surface layer may limit the use of equipment.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate drought should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 8S
Windbreak suitability group: 7

167—Baudette silt loam

Composition

Baudette soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on water-modified till plains

Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 4 inches—very dark gray silt loam
4 to 8 inches—grayish brown very fine sandy loam
8 to 16 inches—dark brown silty clay loam
16 to 35 inches—olive brown, mottled silt loam
35 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
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 3 to 6 feet

Inclusions

Contrasting inclusions:
• The well drained Debs soils, which are in the more sloping areas
• The poorly drained Spooner soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam, fine sandy loam, or very fine sandy loam
• Soils that have very fine sand and coarse silt in the underlying material
• Soils that have more clay throughout
• Soils that formed in glacial till

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize compaction of the surface layer.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Paper birch, American basswood, white spruce, bur oak, and eastern white pine are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L
Windbreak suitability group: 3

191—Epoufette sandy loam

Composition

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

Setting

Landform and position on the landform: Swales and concave basins on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—black sandy loam
4 to 13 inches—grayish brown, mottled loamy sand
13 to 18 inches—grayish brown, mottled sandy loam
18 to 60 inches—light brownish gray, 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: Low
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 0.5 foot to 2.0 feet

Inclusions

Contrasting inclusions:
• The very poorly drained Deerwood and Epoufette soils, which are in closed depressions and have a thin organic surface layer
• The moderately well drained Karlstad soils, which are on slightly convex rises

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam, loam, or loamy sand
• Soils that do not have a clay-enriched layer underlying the surface layer
• Soils that have more clay in the clay-enriched layer
• Soils that have less gravel throughout

Use and Management

Cropland

Major management factors: Wetness, available water capacity, and ground-water contamination
• The major crops are forage plants.
• The seasonal high water table provides supplemental moisture for plants.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface and by leaving crop stubble in the field to trap snow.
• Using a cropping system that includes grasses and legumes or including grass-legume mixtures in rotations improves fertility and tilth.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Black ash, balsam fir, and American elm are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas can prevent the establishment of desired species.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIw, drained, and IVw, undrained
Woodland ordination symbol: 5W
Windbreak suitability group: 2

199B—Sol cobbly sandy loam, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—very dark gray cobbly sandy loam
4 to 13 inches—brown cobbly loamy sand
13 to 20 inches—dark yellowish brown loam that is penetrated by tongues and interfingerings of grayish brown fine sand
20 to 28 inches—dark yellowish brown sandy clay loam
28 to 52 inches—olive brown loam
52 to 60 inches—olive brown, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: Stones and cobbles on the surface in most areas

Inclusions

Contrasting inclusions:
• The moderately well drained Bemidji and Nary soils, which are in the less sloping areas
• The somewhat poorly drained Stuntz soils, which are in swales and concave basins

Similar soils:
• Soils that have a surface layer of cobbly fine sandy loam
• Soils that have free carbonates at a depth of less than 40 inches
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that have a sandy mantle as much as 20 inches thick
• Soils that do not have cobbles on the surface or that have fewer cobbles on the surface
• Soils that have more clay throughout

Use and Management

Cropland

Major management factors: Rock fragments, water erosion, and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• The cobbles and stones on or near the surface cause rapid wear of equipment and may limit tillage.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• American elm, sugar maple, northern red oak, white spruce, eastern white pine, and paper birch are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Stones on the surface can interfere with felling and yarding and other logging activities that involve the use of equipment.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality

• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 6L
Windbreak suitability group: 3

199C—Sol cobbly sandy loam, 6 to 12 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 3 inches—very dark gray cobbly sandy loam
3 to 10 inches—brown cobbly loamy sand
10 to 18 inches—dark brown sandy clay loam that is penetrated by tongues and interfingerings of grayish brown fine sand
18 to 30 inches—dark yellowish brown sandy clay loam
30 to 46 inches—dark yellowish brown loam
46 to 60 inches—light olive brown, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: Stones and cobbles on the surface in most areas

Inclusions

Contrasting inclusions:
• The moderately well drained Nary soils, which are in the less sloping areas
• The somewhat poorly drained Stuntz soils, which are in swales and concave basins

Similar soils:
• Soils that have a surface layer of cobbly fine sandy loam
• Soils that have free carbonates at a depth of less than 40 inches
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that have a sandy mantle as much as 20 inches thick
• Soils that have fewer cobbles on the surface or that do not have cobbles on the surface
• Soils that have more clay throughout
• Soils that have slopes of more than 12 percent

Use and Management

Woodland

Major management factors: Equipment limitations, plant competition, and stoniness
• The principal tree species is quaking aspen.
• American elm, sugar maple, northern red oak, white spruce, eastern white pine, and paper birch are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control water erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Stones on the surface can interfere with felling and yarding and other logging activities that involve the use of equipment.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water

contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 6L
Windbreak suitability group: 3

202—Meehan loamy sand

Composition

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

Setting

Landform and position on the landform: Concave basins and broad flats on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 5 inches—very dark grayish brown loamy sand
5 to 14 inches—yellowish brown, mottled sand
14 to 30 inches—light yellowish brown, mottled sand
30 to 60 inches—light gray, mottled sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The poorly drained Cormant soils, which are in swales
• The moderately well drained Hiwood soils, which are on slightly convex rises
• The excessively drained Menahga soils, which are in the more sloping areas

Similar soils:
• Soils that have a surface layer of sandy loam or sand
• Soils that have more gravel throughout
• Soils that formed entirely in fine sand
• Soils that have free carbonates at a depth of 40 to 60 inches

Use and Management

Cropland

Major management factors: Wetness, available water capacity, soil blowing, ground-water contamination, and organic matter content
• The major crops are forage plants.
• The seasonal high water table provides supplemental moisture for plants.
• Using minimum tillage, leaving crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface and by leaving crop stubble in the field to trap snow.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, windthrow, and seedling mortality
• The principal tree species is quaking aspen.
• Red pine, paper birch, and eastern white pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts may form if skidders are used when the soil is saturated.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• The seedling mortality rate may be high in the summer because of inadequate soil moisture.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

• Windthrow is a hazard during periods of high winds and excessive wetness.
• The loose, sandy surface layer may limit the use of equipment.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVw
Woodland ordination symbol: 6W
Windbreak suitability group: 1

205—Karlstad loamy sand

Composition

Karlstad soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on outwash plains and beach ridges
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—black loamy sand
3 to 7 inches—brown loamy sand
7 to 12 inches—dark yellowish brown, mottled coarse sandy loam
12 to 18 inches—dark brown, mottled gravelly coarse sandy loam
18 to 60 inches—brown, mottled, calcareous very 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
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
• The well drained Andrusia soils, which are in the more sloping areas
• The poorly drained Epoufette soils, which are in swales and concave basins
• The excessively drained Marquette soils, which are in the more sloping areas

Similar soils:
• Soils that have less gravel throughout
• Soils that have more clay in the clay-enriched layer
• Soils that are more than 30 inches deep over sand, gravel, and free carbonates
• Soils that have a surface layer of sandy loam

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, and organic matter content
• The major crops are forage plants.
• Using minimum tillage, leaving crop residue on the surface, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface and by leaving crop stubble in the field to trap snow.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, plant competition, and seedling mortality
• The principal tree species is red pine.
• Quaking aspen, eastern white pine, jack pine, and bur oak are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts may form if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.

• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 5L
Windbreak suitability group: 1

240B—Warba fine sandy loam, 1 to 6 percent slopes

Composition

Warba soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 15 to 200 acres

Typical Profile

0 to 2 inches—very dark brown fine sandy loam
2 to 12 inches—brown fine sandy loam
12 to 16 inches—brown fine sandy loam that tongues into dark yellowish brown loam
16 to 22 inches—dark yellowish brown clay loam that has interfingerings of brown fine sandy loam
22 to 35 inches—dark yellowish brown clay loam
35 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are in the less sloping areas
• The somewhat poorly drained Stuntz soils, which are in swales and concave basins
• The very poorly drained Talmoon soils, which are in closed depressions and have a thin organic surface layer

Similar soils:
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that have a surface layer of loam or very fine sandy loam
• Soils that have a thicker surface layer
• Soils that have free carbonates at a depth of less than 30 inches

Use and Management

Cropland

Major management factors: Water erosion, soil blowing, and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Tilling and planting across the slope reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.

• Sugar maple, American basswood, white spruce, paper birch, northern red oak, and red pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

240C—Warba fine sandy loam, 6 to 12 percent slopes

Composition

Warba soil and similar soils: 85 to 98 percent
Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 15 to 100 acres

Typical Profile

0 to 2 inches—very dark brown fine sandy loam
2 to 8 inches—light brownish gray fine sandy loam
8 to 16 inches—dark yellowish brown clay loam
16 to 44 inches—yellowish brown clay loam that has interfingerings of brown fine sandy loam
44 to 60 inches—light olive brown, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium or rapid
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are in the less sloping areas
• The somewhat poorly drained Stuntz soils, which are in swales and concave basins
• The very poorly drained Talmoon soils, which are in closed depressions and have a thin organic surface layer

Similar soils:
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that have a surface layer of loam or very fine sandy loam
• Soils that have a thicker surface layer
• Soils that have free carbonates at a depth of less than 30 inches
• Soils that have slopes of more than 12 percent

Use and Management

Cropland

Major management factors: Water erosion, soil blowing, and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface, tilling and planting across the slope, farming on the contour, and using grassed waterways reduce the

runoff rate, increase the rate of water infiltration, and help to control erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, paper birch, northern red oak, and red pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

242B—Marquette loamy sand, 1 to 6 percent slopes

Composition

Marquette soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and glacial beach ridges
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand
3 to 13 inches—dark yellowish brown sand
13 to 18 inches—dark yellowish brown very gravelly sandy loam
18 to 60 inches—pale brown, calcareous 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
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Epoufette soils, which are in swales and concave basins
• The moderately well drained Karlstad soils, which are in plane or slightly concave basins
• The well drained Andrusia soils, which are in adjacent areas

Similar soils:
• Soils that have less gravel throughout
• Soils that have more clay in the clay-enriched layer
• Soils that do not have a clay-enriched layer
• Soils that are more than 24 inches deep over free carbonates
• Soils that have a surface layer of loamy fine sand or sandy loam

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, and organic matter content

• The major crops are small grain and forage plants.
• Crops that can tolerate drought should be selected.
• Leaving crop residue on the surface, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Plant competition and seedling mortality

• The principal tree species is red pine.
• Jack pine, paper birch, eastern white pine, and bur oak are tree species of limited extent.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Plant competition should be controlled around new seedlings.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality

• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 6F
Windbreak suitability group: 7

242C—Marquette loamy sand, 6 to 12 percent slopes

Composition

Marquette soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and glacial beach ridges
Shape of areas: Irregular
Size of areas: 10 to 60 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand
4 to 12 inches—brown sand
12 to 17 inches—dark yellowish brown very gravelly coarse sandy loam
17 to 60 inches—light yellowish brown, calcareous very gravelly coarse 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
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

• The poorly drained Epoufette soils, which are in swales and concave basins
• The moderately well drained Karlstad soils, which are in plane or slightly concave basins

• The well drained Andrusia soils, which are in adjacent areas

Similar soils:
• Soils that have less gravel throughout
• Soils that have more clay in the clay-enriched layer
• Soils that do not have a clay-enriched layer
• Soils that are more than 24 inches deep over free carbonates
• Soils that have a surface layer of loamy fine sand or sandy loam

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and ground-water contamination
• The major crops are small grain and forage plants.
• Crops that can tolerate drought should be selected.
• Leaving crop residue on the surface, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Plant competition and seedling mortality
• The principal tree species is red pine.
• Jack pine, paper birch, eastern white pine, and bur oak are tree species of limited extent.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Plant competition should be controlled around new seedlings.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 6F
Windbreak suitability group: 7

243—Stuntz fine sandy loam

Composition

Stuntz soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Swales and concave basins on moraines and till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 2 inches—very dark gray fine sandy loam
2 to 10 inches—grayish brown fine sandy loam
10 to 16 inches—grayish brown fine sandy loam and olive brown, mottled sandy clay loam
16 to 23 inches—olive brown, mottled clay loam and grayish brown fine sandy loam
23 to 28 inches—olive brown, mottled clay loam

28 to 35 inches—light olive brown, mottled loam
35 to 60 inches—light yellowish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 1.5 to 3.0 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The moderately well drained Beltrami soils, which are on slightly convex rises
• The very poorly drained Talmoon soils, which are in closed depressions and have a thin organic surface layer
• The well drained Warba soils, which are in the more sloping areas

Similar soils:
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or very fine sandy loam
• Soils that have free carbonates at a depth of less than 30 inches

Use and Management

Cropland

Major management factors: Wetness and organic matter content
• The major crops are small grain and forage plants.
• The seasonal high water table provides supplemental moisture for plants.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize compaction of the surface layer.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, American elm, white spruce, and balsam fir are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 7W
Windbreak suitability group: 1

267B—Snellman fine sandy loam, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 3 inches—very dark grayish brown fine sandy loam
3 to 12 inches—brown fine sandy loam
12 to 19 inches—dark yellowish brown sandy clay loam that has interfingerings of brown fine sandy loam
19 to 29 inches—dark yellowish brown sandy clay loam
29 to 60 inches—light olive brown, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are in adjacent areas and have a sandy mantle that is more than 20 inches thick
• The poorly drained Shooker soils, which are in swales and concave basins
• The moderately well drained Wykeham soils, which are in the less sloping areas

Similar soils:
• Soils in which material from the subsurface layer does not interfinger into the subsoil
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or sandy loam
• Soils that have more clay throughout
• Soils that are underlain by stratified sediments

Use and Management

Cropland

Major management factors: Water erosion, soil blowing, and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Tilling and planting across the slope reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, white spruce, northern red oak, and red pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can

provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

267C—Snellman fine sandy loam, 6 to 12 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 3 inches—very dark gray fine sandy loam
3 to 14 inches—brown fine sandy loam
14 to 21 inches—dark yellowish brown sandy clay loam that has interfingerings of brown fine sandy loam
21 to 30 inches—dark yellowish brown sandy clay loam
30 to 60 inches—light olive brown, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Medium or rapid
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are in adjacent areas and have a sandy mantle that is more than 20 inches thick
• The poorly drained Shooker soils, which are in swales and concave basins
• The moderately well drained Wykeham soils, which are in the less sloping areas

Similar soils:
• Soils in which material from the subsurface layer does not interfinger into the subsoil
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or sandy loam
• Soils that have more clay throughout
• Soils that are underlain by stratified sediments

Use and Management

Cropland

Major management factors: Water erosion and organic matter
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface, tilling and planting across the slope, farming on the contour, and using grassed waterways reduce the runoff rate, increase the rate of water infiltration, and help to control erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, white spruce, northern red oak, and red pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control water erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

267D—Snellman fine sandy loam, 12 to 25 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

0 to 3 inches—very dark gray fine sandy loam
3 to 10 inches—brown fine sandy loam
10 to 18 inches—dark yellowish brown sandy clay loam that has interfingerings of brown fine sandy loam
18 to 29 inches—dark yellowish brown sandy clay loam
29 to 60 inches—light olive brown, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are in adjacent areas and have a sandy mantle that is more than 20 inches thick
• The poorly drained Shooker soils, which are in swales and concave basins
• The moderately well drained Wykeham soils, which are in the less sloping areas

Similar soils:
• Soils in which material from the subsurface layer does not interfinger into the subsoil
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or sandy loam
• Soils that have more clay throughout
• Soils that are underlain by stratified sediments
• Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Erosion, slope, equipment limitations, and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, white spruce, northern red oak, and red pine are tree species of limited extent.
• Operating equipment on the steeper slopes may cause the formation of gullies and can result in serious erosion problems.
• Establishing skid roads and trails along the contour and sloping road surfaces reduce the hazard of water erosion.
• Water bars, culverts, and drop structures are needed to remove water.
• Special care is needed when logging roads, skid trails, and landings are laid out or when equipment is operated.
• Roads should be designed so that they conform to the topography, and the grade should be less than 10 percent and should be kept as low as possible.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.

• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality and the slope
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 6R
Windbreak suitability group: 3

272—Bemidji loamy sand

Composition

Bemidji soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on till plains and outwash plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand
4 to 12 inches—dark brown cobbly loamy sand
12 to 26 inches—dark yellowish brown cobbly sand
26 to 34 inches—light olive brown, mottled fine sandy loam that has interfingerings of grayish brown loamy sand
34 to 44 inches—light olive brown, mottled fine sandy loam
44 to 60 inches—light olive brown, mottled, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 2 to 6 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are in the more sloping areas
• The somewhat poorly drained Stuntz soils, which are in swales and concave basins

Similar soils:
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that do not have cobbles
• Soils in which material from the subsurface layer does not interfinger into the subsoil
• Soils that have more clay in the clay-enriched layer
• Soils that have a surface layer of sandy loam or loamy fine sand

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and organic matter content
• The major crops are small grain and forage plants.
• Leaving crop residue on the surface, using minimum tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Establishing field windbreaks, using tillage practices that leave crop residue on the surface, and returning crop residue to the soil conserve moisture.

Woodland

Major management factors: Seedling mortality, equipment limitations, windthrow, and plant competition
• The principal tree species is red pine.
• Quaking aspen, eastern white pine, white spruce, and paper birch are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees

may not be adequately restocked by natural regeneration.
• Windthrow is a hazard during periods of high winds and excessive wetness.
• The seedling mortality rate may be high in summer because of inadequate soil moisture.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 8W
Windbreak suitability group: 5

280—Pelan sandy loam

Composition

Pelan soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises and gravel bars on till-floored glacial lake plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 5 to 40 acres

Typical Profile

0 to 3 inches—very dark grayish brown sandy loam
3 to 12 inches—brown gravelly sand
12 to 17 inches—dark brown very gravelly sandy loam
17 to 24 inches—light olive brown, calcareous very gravelly sand
24 to 60 inches—light olive brown, mottled, calcareous sandy 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
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are in adjacent areas and have a sandy mantle that does not contain gravel
• The moderately well drained Garnes soils, which are in adjacent areas and formed entirely in glacial till
• The poorly drained Strandquist soils, which are in swales and concave basins

Similar soils:
• Soils that have less gravel throughout
• Soils that have a sandy and gravelly mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a thicker surface layer
• Soils that have a surface layer of loamy sand or fine sandy loam

Use and Management

Cropland

Major management factors: Soil blowing, available water capacity, and organic matter content
• The major crops are small grain and forage plants.
• Leaving crop residue on the surface, using minimum tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Establishing field windbreaks, using tillage practices that leave crop residue on the surface, and returning crop residue to the soil conserve moisture.

Woodland

Major management factors: Seedling mortality, equipment limitations, windthrow, and plant competition
• The principal tree species is red pine.
• Jack pine, eastern white pine, and white spruce are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Windthrow is a hazard during periods of high winds and excessive wetness.
• The seedling mortality rate may be high in summer

because of inadequate soil moisture.

Pasture

Major management factors: Forage quality

• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 6L
Windbreak suitability group: 5

328B—Sartell loamy fine sand, 1 to 6 percent slopes

Composition

Sartell soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on till-floored glacial lake plains and outwash plains
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 6 inches—very dark grayish brown loamy fine sand
6 to 40 inches—yellowish brown fine sand
40 to 60 inches—yellow fine sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

• The moderately well drained Hiwood soils, which are in the less sloping areas

• The somewhat poorly drained Redby soils, which are in concave basins

• The poorly drained Cormant soils, which are in swales

Similar soils:

• Soils that have thin bands of loamy material at a depth of more than 40 inches

• Soils that formed entirely in medium sand

• Soils that have slopes of more than 6 percent

• Soils that have a surface layer of loamy sand

Use and Management

Cropland

Major management factors: Soil blowing, available water capacity, and ground-water contamination

• The major crops are forage plants.

• Leaving crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.

• Crops that can tolerate drought should be selected.

• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, and plant competition

• The principal tree species is red pine.

• Jack pine and eastern white pine are tree species of limited extent.

• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.

• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.

• Plant competition should be controlled around new seedlings.

• Planting seedlings that can withstand droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.

• The loose, sandy surface layer may limit the use of equipment.

• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality

• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.

• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.

• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 7S
Windbreak suitability group: 7

404—Chilgren loam

Composition

Chilgren soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Concave basins and broad flats on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 3 inches—black loam
3 to 11 inches—grayish brown fine sandy loam
11 to 18 inches—grayish brown, mottled loam
18 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:

• The moderately well drained Garnes soils, which are on plane or slightly convex rises

• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer

Similar soils:

• Soils that have a thicker surface layer

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

• Soils that have a thin sandy mantle

• Soils that are more than 24 inches deep over free carbonates

• Soils that have a thin gravelly layer

Use and Management

Cropland

Major management factors: Wetness

• The major crops are small grain, corn, and forage plants.

• Most suitable crops can be grown if adequate drainage is provided.

• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.

• Working the soil when it is too wet can result in severe compaction and the formation of clods.

• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow

• The principal tree species is quaking aspen.

• Black ash, white spruce, bur oak, and balsam fir are tree species of limited extent.

• The use of equipment is restricted during spring thaw and other excessively wet periods.

• Ruts form easily if skidders are used when the soil is wet.

• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.

• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.

• Because of the seasonal high water table, equipment

should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 6W
Windbreak suitability group: 2

432—Strandquist loam

Composition

Strandquist soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Swales and concave basins on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 60 acres

Typical Profile

0 to 9 inches—black, calcareous loam
9 to 32 inches—grayish brown, mottled, calcareous very gravelly sand
32 to 40 inches—light brownish gray, mottled, calcareous fine sandy loam
40 to 60 inches—grayish brown, 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
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 0.5 foot to 3.0 feet

Inclusions

Contrasting inclusions:
• The poorly drained Kratka soils, which are in adjacent areas and do not have gravel in the upper mantle
• The moderately well drained Pelan soils, which are on plane or slightly convex rises
• The poorly drained Roliss soils, which are on adjacent broad flats and formed entirely in loamy glacial till

Similar soils:
• Soils that have a surface layer of sandy loam or fine sandy loam
• Soils that contain less gravel
• Soils that have a sandy and gravelly mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a thinner surface layer
• Soils that are leached of carbonates in the upper 10 inches

Use and Management

Cropland

Major management factors: Wetness and a high pH level
• The major crops are small grain and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using tillage practices that maintain a plant cover or that leave crop residue on the surface helps to control soil blowing.
• Plants that can tolerate a high pH level should be selected for planting because the soil has a high content of lime.

Pasture

Major management factors: Forage quality

• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate a high content of lime should be selected for windbreaks and environmental plantings.
• Free carbonates in the soil limit the availability of plant nutrients.
• Because of wetness, the seedling mortality rate is moderate and spring planting may be delayed.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2K
Woodland ordination symbol: Not assigned

439—Rockwell fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave basins on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 160 acres

Typical Profile

0 to 9 inches—black, calcareous fine sandy loam
9 to 17 inches—dark gray and olive gray, calcareous fine sandy loam
17 to 26 inches—light olive gray, mottled, calcareous sand
26 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are on slightly convex rises
• The very poorly drained Northwood soils, which are in closed depressions and have a thin organic surface layer
• The moderately well drained Pelan soils, which are on slightly convex rises and have gravelly sediments in the upper part

Similar soils:
• Soils that have a surface layer of loam or sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that are leached of carbonates in the upper 10 inches
• Soils that have a thin, gravelly lag line at the contact of the sandy mantle and the underlying glacial till
• Soils in which the sandy sediment contains more gravel

Use and Management

Cropland

Major management factors: Wetness, soil blowing, and a high pH level
• The major crops are small grain and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Leaving crop residue on the surface, establishing field windbreaks, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Selecting plants that can tolerate a high pH level minimizes the effects of a high content of lime.

Pasture

Major management factors: Forage quality
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate a high content of lime should be selected for windbreaks and environmental plantings.
• Free carbonates in the soil limit the availability of plant nutrients.
• Because of wetness, the seedling mortality rate is moderate and spring planting may be delayed.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K

Woodland ordination symbol: Not assigned

458B—Menahga loamy sand, 1 to 6 percent slopes

Composition

Menahga soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes, hilltops, and broad flats on outwash plains
Shape of areas: Irregular
Size of areas: 30 to 300 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand
3 to 30 inches—yellowish brown sand
30 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Andrusia soils, which are in adjacent areas and have a deep, loamy subsoil
• The poorly drained Cormant soils, which are in swales and concave basins
• The somewhat poorly drained Meehan soils, which are in concave basins

Similar soils:
• Soils that have a surface layer of loamy coarse sand or sand
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches
• Soils that have more gravel throughout
• Soils that have thin bands of loamy material at a depth of more than 30 inches
• Soils that formed entirely in fine sand

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and ground-water contamination
• The major crops are forage plants.
• Crops that can tolerate drought should be selected (fig. 2).
• Leaving crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, and plant competition
• The principal tree species is jack pine.
• Red pine, eastern white pine, and paper birch are tree species of limited extent.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings can reduce the seedling mortality rate.
• The loose, sandy surface layer may limit the use of equipment.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Figure 2.—An area of Menahga loamy sand, 1 to 6 percent slopes. Crops that cannot tolerate droughty conditions grow poorly in areas of this soil.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: 7S
Windbreak suitability group: 7

458C—Menahga loamy sand, 6 to 12 percent slopes

Composition

Menahga soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains
Shape of areas: Irregular

Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand
3 to 24 inches—strong brown sand
24 to 60 inches—yellowish brown sand and coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The well drained Andrusia soils, which are in adjacent areas and have a deep, loamy subsoil
- The poorly drained Cormant soils, which are in swales and concave basins
- The somewhat poorly drained Meehan soils, which are in concave basins

Similar soils:
- Soils that have a surface layer of loamy coarse sand or sand
- Soils that are underlain by loamy glacial till at a depth of more than 60 inches
- Soils that have more gravel throughout
- Soils that have thin bands of loamy material at a depth of more than 30 inches
- Soils that formed entirely in fine sand
- Soils that have free carbonates at a depth of more than 40 inches

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and ground-water contamination
- The major crops are forage plants.
- Crops that can tolerate drought should be selected.
- Leaving crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
- Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
- Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, and plant competition
- The principal tree species is jack pine.
- Red pine, eastern white pine, and paper birch are tree species of limited extent.
- The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
- Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
- Plant competition should be controlled around new seedlings.
- Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
- Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
- The loose, sandy surface layer may limit the use of equipment.
- Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
- Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

- Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
- The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
- Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

- Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
- Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 7S
Windbreak suitability group: 7

458D—Menahga loamy sand, 12 to 25 percent slopes

Composition

Menahga soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and valley trains
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand
3 to 27 inches—yellowish brown sand
27 to 60 inches—brownish yellow sand and coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Andrusia soils, which are in adjacent areas and have a deep, loamy subsoil
• The poorly drained Cormant soils, which are in swales and concave basins
• The somewhat poorly drained Meehan soils, which are in concave basins

Similar soils:
• Soils that have a surface layer of loamy coarse sand or sand
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches
• Soils that have more gravel throughout
• Soils that have thin bands of loamy material at a depth of more than 30 inches
• Soils that formed entirely in fine sand
• Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Equipment limitations, water erosion, slope, seedling mortality, and plant competition
• The principal tree species is red pine.
• Jack pine, eastern white pine, and paper birch are tree species of limited extent.
• Operating equipment on the steeper slopes may result in the formation of gullies and can lead to serious erosion problems.
• Establishing skid roads and trails along the contour and sloping road surfaces reduce the hazard of erosion.
• Water should be removed with water bars, culverts, and drop structures.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can withstand droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can

provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 8R
Windbreak suitability group: 7

481—Kratka fine sandy loam

Composition

Kratka soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 10 inches—black fine sandy loam
10 to 22 inches—dark grayish brown, mottled fine sand
22 to 28 inches—grayish brown, mottled loamy fine sand
28 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 0.5 foot to 3.0 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are on slightly convex rises
• The very poorly drained Northwood soils, which are in closed depressions and have a thin organic surface layer
• The poorly drained Roliss and Smiley soils, which are in adjacent areas

Similar soils:
• Soils that have a surface layer of loamy fine sand or sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a sandy mantle that contains free carbonates
• Soils that have a sandy mantle that contains more gravel
• Soils that have a gravelly lag line at the contact of the sandy mantle and the glacial till

Use and Management

Cropland

Major management factors: Wetness and soil blowing
• The major crops are small grain and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Leaving crop residue on the surface, using stubble mulch tillage, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.

Pasture

Major management factors: Forage quality
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2
Woodland ordination symbol: Not assigned

482—Grygla loamy fine sand

Composition

Grygla soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 7 inches—black loamy fine sand
7 to 25 inches—grayish brown, mottled fine sand

25 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
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 0.5 foot to 2.0 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are on slightly convex rises
• The very poorly drained Northwood soils, which are in closed depressions and have a thin organic surface layer
• The somewhat poorly drained Sandwick soils, which are on plane or slightly convex rises

Similar soils:
• Soils that have a surface layer of fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a thicker surface layer
• Soils that have more medium and coarse sand in the upper part of the mantle
• Soils that have a gravelly lag line at the contact of the sandy mantle and glacial till

Use and Management

Cropland

Major management factors: Wetness and soil blowing
• The major crops are small grain and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Leaving crop residue on the surface, using stubble mulch tillage, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Jack pine is a tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.

Pasture

Major management factors: Forage quality
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IVw
Woodland ordination symbol: 6W
Windbreak suitability group: 2

496B—Andrusia loamy sand, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes,

hilltops, and broad flats on outwash plains and beach ridges
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand
3 to 19 inches—dark brown sand
19 to 29 inches—yellowish brown loamy sand
29 to 39 inches—dark yellowish brown sandy loam
39 to 50 inches—yellowish brown, calcareous gravelly sand
50 to 60 inches—light yellowish brown, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Epoufette soils, which are in swales and concave basins
• The somewhat excessively drained Graycalm soils, which have a thinner subsoil consisting of thin bands of loamy material; in adjacent areas
• The moderately well drained Karlstad soils, which are on plane or slightly convex rises

Similar soils:
• Soils that have a surface layer of loamy coarse sand or sandy loam
• Soils that have fewer coarse fragments throughout
• Soils that have a higher content of clay in the clay-enriched layer
• Soils that have free carbonates at a depth of less than 25 inches
• Soils that do not have a thin clay-enriched horizon

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, ground-water contamination, and organic matter content
• The major crops are forage plants and small grain.
• Crops that can tolerate drought should be selected.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface, by returning crop residue to the soil, and by leaving crop stubble in the field to trap snow.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Leaving crop residue on the surface, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, and plant competition
• The principal tree species is red pine (fig. 3).
• Jack pine, paper birch, and white spruce are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Planting seedlings that can withstand droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• Plant competition should be controlled around new seedlings.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

Major management factors:
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can

Figure 3.—A stand of red pine in an area of Andrusia loamy sand, 1 to 6 percent slopes.

provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 7S
Windbreak suitability group: 5

496C—Andrusia loamy sand, 6 to 12 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and beach ridges
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand
3 to 31 inches—yellowish brown loamy sand
31 to 43 inches—yellowish brown gravelly sandy loam
43 to 60 inches—yellowish brown, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Epoufette soils, which are in swales and concave basins
• The somewhat excessively drained Graycalm soils, which have a thinner subsoil consisting of thin bands of loamy material; in adjacent areas
• The moderately well drained Karlstad soils, which are on plane or slightly convex rises

Similar soils:
• Soils that have a surface layer of loamy coarse sand or sandy loam
• Soils that contain fewer coarse fragments
• Soils that have a higher content of clay in the clay-enriched layer
• Soils that have free carbonates at a depth of less than 25 inches
• Soils that do not have a thin clay-enriched horizon

Use and Management

Cropland

Major management factors: Soil blowing, available water capacity, and ground-water contamination
• The major crops are small grain and forage plants.
• Crops that can tolerate drought should be selected.
• Leaving crop residue on the surface, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, plant competition, and seedling mortality
• The principal tree species is red pine.
• Jack pine, paper birch, and white spruce are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• Plant competition should be controlled around new seedlings.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 7S
Windbreak suitability group: 5

496D—Andrusia loamy sand, 12 to 25 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains and stream terraces
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand
3 to 24 inches—yellowish brown sand
24 to 32 inches—dark yellowish brown gravelly sandy loam
32 to 60 inches—light yellowish brown, calcareous sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Available water capacity: Low
Organic matter content: Moderate
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The poorly drained Epoufette soils, which are in swales and concave basins
• The somewhat excessively drained Graycalm soils, which have a thinner subsoil consisting of thin bands of loamy material; in adjacent areas
• The moderately well drained Karlstad soils, which are on plane or slightly convex rises

Similar soils:
• Soils that have a surface layer of loamy coarse sand or sandy loam
• Soils that have fewer coarse fragments
• Soils that have a higher content of clay in the clay-enriched layer
• Soils that have free carbonates at a depth of less than 25 inches
• Soils that do not have a thin clay-enriched horizon
• Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Equipment limitations, water erosion, slope, seedling mortality, and plant competition
• The principal tree species is red pine.
• Jack pine, paper birch, and white spruce are tree species of limited extent.
• Operating equipment on the steeper slopes may cause the formation of gullies and can result in serious erosion problems.
• Establishing skid roads and trails along the contour and sloping road surfaces reduce the hazard of water erosion.
• Water should be removed with water bars, culverts, and drop structures.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can tolerate droughty conditions, mulching, and shading the seedlings can reduce the seedling mortality rate.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 7R
Windbreak suitability group: 5

503B—Balmlake fine sandy loam, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 3 inches—very dark brown fine sandy loam
3 to 24 inches—yellowish brown fine sandy loam
24 to 60 inches—pale brown, stratified, calcareous fine sand, very fine sand, and silt

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
- The well drained Lengby soils, which are in adjacent areas
- The poorly drained Morph soils, which are in swales and concave basins
- The moderately well drained Rosy soils, which are in the less sloping areas
- The excessively drained Zimmerman soils, which are in adjacent areas and formed entirely in fine sand and a few thin bands of loamy material

Similar soils:
- Soils that have more clay throughout
- Soils having a mantle of lacustrine fine sand, as much as 30 inches thick, that is underlain by stratified material
- Soils that have a clay-enriched subsoil more than 20 inches thick
- Soils that have more gravel
- Soils that are underlain entirely by fine sand or silt

Use and Management

Cropland

Major management factors: Water erosion, soil blowing, and organic matter content
- The major crops are small grain, corn, and forage plants.
- Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
- Tilling and planting across the slope reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
- Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
- Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
- The principal tree species is red pine.
- Northern red oak, paper birch, white oak, sugar maple, American basswood, and jack pine are tree species of limited extent.
- The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
- Ruts form easily if skidders are used when the soil is wet.
- Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
- Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
- Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
- Converting sites from northern hardwoods to conifers requires intensive management.
- If conifer species are planted, suckering and competition from hardwood seedlings are severe.
- Mechanical or chemical site preparation is needed to control competing vegetation.
- Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
- Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

- A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

- Commercial aspen management practices are needed

for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L
Windbreak suitability group: 5

503C—Balmlake fine sandy loam, 6 to 12 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 3 inches—dark grayish brown fine sandy loam
3 to 14 inches—pale brown loamy fine sand
14 to 22 inches—dark yellowish brown fine sandy loam
22 to 60 inches—light yellowish brown, stratified, calcareous fine sand, loamy fine sand, and silt

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Lengby soils, which are in adjacent areas
• The poorly drained Morph soils, which are in swales and concave basins
• The moderately well drained Rosy soils, which are in the less sloping areas
• The excessively drained Zimmerman soils, which are in adjacent areas and formed entirely in fine sand and a few thin bands of loamy material

Similar soils:
• Soils that have more clay
• Soils having a mantle of lacustrine fine sand, as much as 30 inches thick, that is underlain by stratified material
• Soils that have a clay-enriched subsoil more than 20 inches thick
• Soils that have more gravel
• Soils that are underlain entirely by fine sand or silt
• Soils that formed primarily in lacustrine silt

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Tilling and planting across the slope, farming on the contour, using tillage practices that leave crop residue on the surface, and using grassed waterways reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is red pine.
• Northern red oak, paper birch, white oak, sugar maple, American basswood, and jack pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water

contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality

• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 7L
Windbreak suitability group: 5

503D—Balmlake fine sandy loam, 12 to 25 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 3 inches—very dark brown fine sandy loam
3 to 11 inches—yellowish brown loamy fine sand
11 to 21 inches—dark yellowish brown fine sandy loam
21 to 60 inches—light yellowish brown, stratified, calcareous fine sand, loamy fine sand, and silt

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

• The well drained Lengby soils in adjacent areas
• The poorly drained Morph soils, which are in swales and concave basins
• The moderately well drained Rosy soils, which are in the less sloping areas
• The excessively drained Zimmerman soils, which are in adjacent areas and formed entirely in fine sand and a few thin bands of loamy material

Similar soils:

• Soils that have more clay
• Soils having a mantle of lacustrine fine sand, as much as 30 inches thick, that is underlain by stratified material
• Soils that have a clay-enriched subsoil more than 20 inches thick
• Soils that have more gravel
• Soils that are underlain entirely by fine sand or silt
• Soils that formed primarily in lacustrine silt
• Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Water erosion, slope, equipment limitations, and plant competition

• The principal tree species is red pine.
• Northern red oak, paper birch, white spruce, sugar maple, American basswood, and jack pine are tree species of limited extent.
• Operating equipment on the steeper slopes may cause the formation of gullies and can lead to serious erosion problems.
• Establishing skid roads and trails along the contour and sloping road surfaces reduce the hazard of water erosion.
• Water should be removed with water bars, culverts, and drop structures.
• Special care is needed when logging roads, skid trails, and landings are laid out or when equipment is operated.
• Roads should be designed so that they conform to the topography, and the grade should be less than 10 percent and should be kept as low as possible.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and

competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 7R
Windbreak suitability group: 5

505B—Debs silt loam, 1 to 6 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—very dark gray silt loam
4 to 12 inches—brown very fine sandy loam
12 to 24 inches—dark yellowish brown silty clay loam
24 to 60 inches—light olive brown, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Baudette soils, which are in the less sloping areas
• The poorly drained Spooner soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or fine sandy loam
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a thin mantle of fine sand
• Soils that are underlain by glacial till or that are stratified with fine sand and very fine sand

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion.
• Tilling and planting across the slope reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, and paper birch are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.

• Mechanical or chemical site preparation is needed to control competing vegetation.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

505C—Debs silt loam, 6 to 12 percent slopes

Composition

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

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 2 inches—very dark grayish brown silt loam
2 to 10 inches—pale brown loamy fine sand
10 to 23 inches—yellowish brown silty clay loam
23 to 60 inches—light yellowish brown, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Medium or rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Baudette soils, which are in the less sloping areas
• The poorly drained Spooner soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or fine sandy loam
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a thin mantle of fine sand
• Soils that are underlain by glacial till or that are stratified with fine sand and very fine sand
• Soils that have slopes of more than 12 percent

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Tilling and planting across the slope, farming on the contour, using tillage practices that leave crop residue on the surface, and using grassed waterways reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, and paper birch are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring

thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control water erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 6L
Windbreak suitability group: 3

514—Tacoosh muck

Composition

Tacoosh soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 100 to 500 acres

Typical Profile

0 to 7 inches—black muck
7 to 41 inches—very dark brown mucky peat
41 to 60 inches—dark grayish brown, calcareous 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
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Bullwinkle soils, which are in forested bogs
• The very poorly drained Hamre soils, which are on the margins of bogs adjacent to mineral uplands
• The very poorly drained Rifle soils, which are in the deeper basins in the bogs and formed entirely in herbaceous organic material

Similar soils:
• Soils that have a sandy layer between the organic material and the loamy glacial till
• Soils that formed in more highly decomposed organic material
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss

Use and Management

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.

Interpretive Groups

Land capability classification: VIw
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

534—Mooselake mucky peat

Composition

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

Setting

Landform and position on the landform: Forested bogs on till plains and outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 50 to 300 acres

Typical Profile

0 to 40 inches—very dark grayish brown mucky peat
40 to 60 inches—dark brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Bullwinkle and Tawas soils, which are in adjacent forested bogs and are underlain by mineral material at a depth of less than 51 inches
• The very poorly drained Rifle soils, which are in sedge-covered bogs
• The very poorly drained Tacoosh soils, which are in adjacent sedge-covered bogs and are underlain by loamy glacial till at a depth of less than 51 inches

Similar soils:
• Soils that formed in more highly decomposed organic material
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that have few woody fragments or that do not have woody fragments
• Soils that are underlain by coprogenous earth and limnic material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is black spruce.
• Northern whitecedar, tamarack, balsam fir, and black ash are tree species of limited extent.
• Harvesting is limited to periods when the soil is adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees in areas of this soil are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from unwanted species may be severe if the overstory is removed.
• The seedling mortality rate is high because of seasonal wetness.

Wildlife habitat

• The natural vegetation is diverse and provides food and cover for many wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 2W

538—Waskish peat

Composition

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

Setting

Landform and position on the landform: Raised forested bogs on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 100 to 500 acres

Typical Profile

0 to 3 inches—very pale brown peat
3 to 16 inches—brown and dark reddish brown peat
16 to 60 inches—reddish brown and light yellowish brown peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow
Seasonal high water table: At the surface to 2 feet below the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Greenwood soils, which are in

broad flat areas that surround the raised bogs
• The very poorly drained Lobo soils, which are on the side slopes of the raised bogs

Similar soils:
• Soils that have more than 10 percent woody fragments
• Soils that contain layers of more highly decomposed organic material
• Soils that are less acid

Use and Management

Woodland

Major management factors: Equipment limitations, extreme acidity, seedling mortality, windthrow, and plant competition
• The principal tree species is black spruce.
• Tamarack is a tree species of limited extent.
• Harvesting is limited to periods when the soil is adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees in areas of this soil are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from undesirable species can be severe if the overstory is removed.
• The seedling mortality rate is high because of the seasonal wetness and the extreme acidity of the soil.

Wildlife habitat

• The natural vegetation is diverse and provides food and cover for many wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: 2W

540—Seelyeville muck

Composition

Seelyeville soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 20 to 500 acres

Typical Profile

0 to 60 inches—very dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 2 feet below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro and Markey soils, which are on the margins of bogs adjacent to mineral uplands and are underlain by mineral material at a depth of less than 51 inches
• The very poorly drained Lupton soils, which are in forested bogs

Similar soils:
• Soils that formed in less decomposed organic material
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that are underlain by coprogenous earth or limnic material

Use and Management

Cropland

Major management factors: Wetness
• The major crops are forage plants and wild rice.
• Wetness limits the choice of plants, the period of grazing, and the productivity of deep-rooted crops.
• Providing drainage is difficult because most areas have poor outlets and are seasonally ponded.
• Most crops can be grown in areas where adequate drainage can be provided.
• Wild rice can be grown if a sufficient quantity of suitable water is available for flooding paddies.

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• Generally, the level of fertility is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species (fig. 4).

Interpretive Groups

Land capability classification: IVw, drained, and VIw, undrained
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

541—Rifle mucky peat

Composition

Rifle soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 20 to 2,000 acres

Typical Profile

0 to 60 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Mooselake soils, which are in forested bogs
• The very poorly drained Tacoosh soils, which are on the margins of bogs adjacent to mineral uplands and are underlain by mineral material at a depth of less than 51 inches

Similar soils:
• Soils that formed entirely in more highly decomposed organic material
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that contain more than 15 percent woody fragments
• Soils that are underlain by coprogenous earth or limnic material

Use and Management

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• The level of fertility generally is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.

Interpretive Groups

Land capability classification: VIw
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

543—Markey muck

Composition

Markey soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 24 inches—black muck
24 to 60 inches—grayish brown, mottled loamy 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

Figure 4.—An area of Seelyeville muck. The vegetation in areas of this soil consists mostly of reedgrass, sedges, and rushes, which provide good habitat for wetland wildlife.

Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are in adjacent sedge-covered bogs and are underlain by loamy glacial till
• The very poorly drained Deerwood and Northwood soils, which are on the margins of bogs adjacent to mineral uplands and have an organic surface layer that is thinner than that of the Markey soil
• The very poorly drained Seelyeville soils, which are in the deeper bogs
• The very poorly drained Tawas soils, which are in forested bogs

Similar soils:
• Soils that have more gravel in the underlying sand
• Soils that formed in less decomposed organic material
• Soils that have free carbonates in the underlying sand
• Soils that are underlain by coprogenous earth or limnic material

Use and Management

Cropland

Major management factors: Wetness
• The major crops are forage plants and wild rice.
• Wetness limits the choice of plants, the period of grazing, and the productivity of deep-rooted crops.
• Providing drainage is difficult because most areas have poor outlets and are seasonally ponded.
• Most crops can be grown in areas where adequate drainage can be provided.
• Wild rice can be grown if a sufficient quantity of suitable water is available for flooding paddies.

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• The level of fertility generally is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.

Interpretive Groups

Land capability classification: IVw, drained, and VIw, undrained
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

544—Cathro muck

Composition

Cathro soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 20 to 300 acres

Typical Profile

0 to 8 inches—black muck
8 to 30 inches—very dark brown muck
30 to 34 inches—black silt loam
34 to 60 inches—light olive gray, mottled, calcareous 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
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Hamre soils, which are on the margins of bogs adjacent to mineral uplands and have an organic layer that is thinner than that of the Cathro soil
• The very poorly drained Markey soils, which are in adjacent sedge-covered bogs and are underlain by sand
• The very poorly drained Bullwinkle soils, which are in forested bogs
• The very poorly drained Seelyeville soils, which are in the deeper bogs

Similar soils:
• Soils that formed in less decomposed organic material
• Soils that have a gravelly layer at the contact of the organic material and the mineral material
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that have a sandy mantle between the organic material and the loamy glacial till
• Soils that are underlain by coprogenous earth or limnic material

Use and Management

Cropland

Major management factors: Wetness
• The major crops are forage plants and wild rice.
• Wetness limits the choice of plants, the period of grazing, and the productivity of deep-rooted crops.

• Providing drainage is difficult because most areas have poor outlets and are seasonally ponded.
• Most crops can be grown in areas where adequate drainage can be provided.
• Wild rice can be grown if a sufficient quantity of suitable water is available for flooding paddies.

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• Generally, the level of fertility is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.

Interpretive Groups

Land capability classification: IVw, drained, and VIw, undrained
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

545—Rondeau muck

Composition

Rondeau soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Forested and sedge-covered bogs in drainageways on postglacial lakes and moraines
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 40 to 200 acres

Typical Profile

0 to 18 inches—black, calcareous muck
18 to 24 inches—black, calcareous coprogenous earth
24 to 60 inches—light gray, mottled, calcareous marl

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid in the upper part; slow in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Bullwinkle and Cathro soils, which are on the margins of bogs adjacent to mineral uplands and are underlain by glacial till
• The very poorly drained Lupton and Seelyeville soils, which are in the deeper forested and sedge-covered bogs and formed entirely in organic material

Similar soils:
• Soils that have a thinner organic surface layer
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that are underlain entirely by coprogenous earth

Use and Management

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.
• Management for wildlife habitat should include wetland restoration.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

546—Lupton muck

Composition

Lupton soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Forested bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 40 to 300 acres

Typical Profile

0 to 25 inches—dark reddish brown muck

25 to 60 inches—dark reddish brown and dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Organic matter content: 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 on the margins of bogs adjacent to mineral uplands and are underlain by loamy glacial till at a depth of 16 to 51 inches
• The very poorly drained Seelyeville soils, which are in sedge-covered bogs
• The very poorly drained Tawas soils, which are on the margins of bogs adjacent to mineral uplands and are underlain by sand at a depth of 16 to 51 inches

Similar soils:
• Soils that are underlain by coprogenous earth and limnic material
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that formed in less decomposed organic material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is black spruce.
• Northern whitecedar, tamarack, balsam fir, and black ash are tree species of limited extent.
• Harvesting is limited to periods when the soil is adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from undesirable species may be severe if the overstory is removed.
• The seedling mortality rate is high because of the seasonal wetness.

Wildlife habitat

• The natural vegetation is diverse and provides food and cover for many wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: 2W

547—Deerwood muck

Composition

Deerwood soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 12 inches—black muck
12 to 16 inches—black fine sandy loam
16 to 60 inches—light brownish gray, mottled, calcareous fine sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The poorly drained Cormant soils, which are on adjacent mineral uplands and do not have an organic surface layer
• The very poorly drained Markey soils, which are in the deeper bogs and have an organic layer that is thicker than that of the Deerwood soil
• The very poorly drained Northwood soils, which are in adjacent sedge-covered bogs and are underlain by loamy glacial till at a depth of more than 30 inches

Similar soils:
• Soils having sandy material that is leached of free carbonates
• Soils that have a thinner organic surface layer
• Soils that have a thicker loamy layer at the contact

between the organic material and the sand

Use and Management

Cropland

Major management factors: Wetness

• The major crops are forage plants and small grain.
• Wetness limits the choice of plants, the period of grazing, and the productivity of deep-rooted crops.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Only hay and pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.

Pasture

Major management factors: Wetness

• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• The level of fertility generally is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.
• Trees and shrubs that can tolerate extreme wetness should be selected for windbreaks and environmental plantings. Because of the wetness, seedling mortality is severe and spring planting may be delayed.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• Management for wildlife habitat should include grassland management practices and wetland restoration.

Interpretive Groups

Land capability classification: IVw, drained, and VIw, undrained
Windbreak suitability group: 2(O), drained, and 10, undrained
Woodland ordination symbol: Not assigned

549—Greenwood peat

Composition

Greenwood soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Forested bogs on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

0 to 4 inches—dark yellowish brown and dark brown peat
4 to 63 inches—dark brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
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 small raised bogs and have a layer of peat that is thicker than that of the Greenwood soil
• The very poorly drained Rifle soils, which are less acid than the Greenwood soil and do not have a fibric surface layer; in adjacent sedge-covered bogs
• The very poorly drained Waskish soils, which are in raised bogs and formed entirely in fibric peat

Similar soils:

• Soils that have layers of more highly decomposed organic material
• Soils that are less acid
• Soils that formed entirely in more decomposed organic material

Use and Management

Woodland

Major management factors: Equipment limitations, extreme acidity, seedling mortality, windthrow, and plant competition

• The principal tree species is black spruce.
• Tamarack is a tree species of limited extent.
• Harvesting is limited to periods when the soil is adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from undesirable species may be severe if the overstory is removed.
• The seedling mortality rate is high because of

seasonal wetness and the extreme acidity of the soil.

Wildlife habitat

- Many areas of this soil are suitable for the establishment or restoration of wetlands.
- Establishing open water areas attracts waterfowl and aquatic animals.
- The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.
- Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: 4W

560—Greenwood-Lobo complex

Composition

Greenwood soil and similar soils: 45 to 60 percent
Lobo soil and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Greenwood—forested and sedge-covered bogs; Lobo—raised forested bogs on till-floored glacial lake plains
Shape of areas: Irregular
Size of areas: 50 to 500 acres
Slope range: 0 to 1 percent

Typical Profile

Greenwood

0 to 8 inches—dark brown peat
8 to 60 inches—dark brown mucky peat

Lobo

0 to 37 inches—light yellowish brown peat
37 to 84 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Greenwood—moderate or moderately rapid; Lobo—rapid in the upper part, moderate or moderately rapid in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Greenwood—very slow or ponded; Lobo—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:

- The very poorly drained Rifle soils, which are less acid than the Greenwood and Lobo soils and do not have a fibric surface layer; in adjacent sedge-covered bogs
- The very poorly drained Waskish soils, which are on the more elevated parts of the raised bogs and formed entirely in fibric organic material

Similar soils:

- Soils that have layers of more highly decomposed organic material
- Soils that are less acid

Use and Management

Woodland

Major management factors: Equipment limitations, extreme acidity, seedling mortality, windthrow, and plant competition

- The principal tree species is black spruce.
- Tamarack is a tree species of limited extent.
- Harvesting is limited to periods when the soils are adequately frozen.
- Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on these soils.
- Equipment can be used during periods in winter when access roads are frozen.
- Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
- Plant competition from undesirable species may be severe if the overstory is removed.
- The seedling mortality rate is high because of seasonal wetness and the extreme acidity of the soils.

Wildlife habitat

- Many areas of these soils are suitable for the establishment or restoration of wetlands.
- Establishing open water areas attracts waterfowl and aquatic animals.
- The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.
- Management for wildlife habitat should include forestry practices.

Interpretive Groups

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

561—Bullwinkle muck

Composition

Bullwinkle soil and similar soils: 88 to 98 percent

Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Forested bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 50 to 3,000 acres

Typical Profile

0 to 17 inches—black muck
17 to 31 inches—very dark brown and dark reddish brown muck
31 to 41 inches—black and very dark brown muck
41 to 45 inches—black loam
45 to 60 inches—olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Very high
Organic matter content: 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 Cathro soils, which are in sedge-covered bogs
• The very poorly drained Tawas soils, which are in adjacent bogs and are underlain by sand
• The very poorly drained Lupton soils, which are in the deeper forested bogs

Similar soils:
• Soils that have a sandy or gravelly layer at the contact of the organic material and the mineral material
• Soils that formed in less decomposed organic material
• Soils that have fewer woody fragments
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that are underlain by coprogenous earth and limnic material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is black spruce.
• Northern whitecedar, tamarack, and balsam fir are tree species of limited extent.
• Harvesting is limited to periods when the soil is adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from undesirable species may be severe if the overstory is removed.
• The seedling mortality rate is high because of seasonal wetness.

Wildlife habitat

• The natural vegetation is diverse and provides food and cover for many wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 3W

563—Northwood muck

Composition

Northwood soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 9 inches—black muck
9 to 14 inches—very dark gray fine sandy loam
14 to 18 inches—olive gray, mottled loamy fine sand
18 to 24 inches—grayish brown, mottled loamy fine sand
24 to 60 inches—olive gray, mottled, calcareous 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
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are in adjacent sedge-covered bogs and formed in deeper organic material than the Northwood soil
• The very poorly drained Hamre soils, which are in adjacent bogs and do not have a sandy layer underlying the organic surface layer
• The poorly drained Kratka and Smiley soils, which are on the adjacent mineral uplands and do not have an organic surface layer

Similar soils:
• Soils that have sandy sediment less than 20 inches thick or more than 40 inches thick
• Soils that have a gravelly layer at the contact of the sandy sediment and the loamy glacial till
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have an organic surface layer less than 8 inches thick

Use and Management

Cropland

Major management factors: Wetness
• The major crops are forage plants and small grain.
• Wetness limits the choice of plants, the period of grazing, and the productivity of deep-rooted crops.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Only hay and pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• Generally, the level of fertility is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.
• Management for wildlife habitat should include grassland management practices and wetland restoration.

Interpretive Groups

Land capability classification: IVw, drained, and VIw, undrained
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

565—Eckvoll loamy fine sand

Composition

Eckvoll soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on till-floored glacial lake plains and water-modified till plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy fine sand
4 to 13 inches—dark grayish brown fine sand
13 to 25 inches—pale brown, mottled fine sand
25 to 32 inches—light olive brown, mottled clay loam
32 to 60 inches—light yellowish 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
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:
• The poorly drained Grygla and Kratka soils, which are in swales and concave basins
• The moderately well drained Pelan soils, which are on slightly convex rises and have a gravelly subsoil
• The somewhat poorly drained Sandwick soils, which are in concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loamy sand or fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a thin, gravelly lag line at the contact

of the sandy mantle and the glacial till
• Soils that do not have a clay-enriched layer at the contact of the sandy mantle and the glacial till
• Soils that have coarser sand in the sandy mantle

Use and Management

Cropland

Major management factors: Soil blowing, available water capacity, and organic matter content
• The major crops are small grain and forage plants.
• Leaving crop residue on the surface, using minimum tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Establishing field windbreaks, using tillage practices that leave crop residue on the surface, and returning crop residue to the soil conserve moisture.

Woodland

Major management factors: Equipment limitations, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Bur oak and American basswood are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Trees commonly are subject to windthrow during periods of excessive wetness and strong winds.
• The seedling mortality rate may be high in summer because of inadequate soil moisture.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 6L
Windbreak suitability group: 1

582—Roliss loam

Composition

Roliss soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

0 to 8 inches—black loam
8 to 12 inches—dark gray, mottled, calcareous loam
12 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate or moderately slow
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Garnes soils, which are on slightly convex rises
• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer
• The poorly drained Smiley soils, which are in adjacent areas and have an accumulation of clay below the surface layer

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of clay loam or silt loam
• Soils that have 1 to 5 percent gypsum crystals
• Soils that have an accumulation of carbonates below the surface layer
• Soils that are leached of carbonates to a depth of 10 inches

Use and Management

Cropland

Major management factors: Wetness
• The major crops are small grain, corn, and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Selecting plants that can tolerate a high pH level can minimize the effects of a high content of lime in the soil.
• Recommendations for plant nutrients should be based on soil analysis.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs grown as windbreaks and environmental plantings should be those that can tolerate a high content of lime.
• Free carbonates in the soil limit the availability of plant nutrients.
• Because of the wetness, the seedling mortality rate is moderate and spring planting may be delayed.

Interpretive Groups

Land capability classification: IIw
Windbreak suitability group: 2K
Woodland ordination symbol: Not assigned

607—Pengilly very fine sandy loam

Composition

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

Setting

Landform and position on the landform: Plane or slightly concave basins on flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 30 to 500 acres

Typical Profile

0 to 4 inches—very dark gray very fine sandy loam
4 to 12 inches—grayish brown, mottled loamy very fine sand
12 to 22 inches—dark grayish brown, mottled very fine sandy loam
22 to 30 inches—dark olive gray, mottled silt loam
30 to 60 inches—dark grayish brown, mottled, stratified very fine sandy loam, silt loam, loam, and fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Seasonal high water table: At the surface to 2 feet below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• Very poorly drained soils, in adjacent areas on the flood plain, that formed in 10 to 25 inches of organic material overlying stratified sand, silt, and loamy material
• Poorly drained to moderately well drained soils, on levees, bars, and deltas adjacent to streams, that formed in sand and gravel
• Moderately well drained and well drained, gently sloping to steep soils that are on short side slopes between the flood plain and the adjacent mineral uplands

Similar soils:
• Soils that have a surface layer of fine sandy loam or loam
• Soils that have more clay
• Soils that have thin subhorizons of organic material
• Soils that are not stratified and that formed entirely in sand and fine sand

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is black ash.
• American elm, paper birch, quaking aspen, and balsam fir are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Plant competition from undesirable species may be severe if the overstory is removed.
• Undesirable plants that invade clear-cut areas may

prevent the establishment of desired species.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness or flooding limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIIw
Woodland ordination symbol: 3W
Windbreak suitability group: 10

616—Effie silt loam

Composition

Effie soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on moraines and till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 3 inches—very dark gray silt loam
3 to 8 inches—grayish brown, mottled silt loam
8 to 12 inches—dark grayish brown, mottled clay loam that has interfingerings of light brownish gray silt loam
12 to 28 inches—olive gray, mottled silty clay
28 to 60 inches—light olive gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1.0 foot to 2.5 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer
• The moderately well drained Suomi soils, which are on slightly convex rises

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam, fine sandy loam, or clay loam
• Soils that have less clay
• Soils that formed in lacustrine silt

Use and Management

Cropland

Major management factors: Wetness
• The major crops are small grain, corn, and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is quaking aspen.
• Balsam poplar, black ash, balsam fir, and paper birch are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction

and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.
• Restricted permeability and a sticky and plastic subsoil limit the use of equipment in spring and during other excessively wet periods.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw, drained, and IVw, undrained
Woodland ordination symbol: 7W
Windbreak suitability group: 2

620B—Cutaway loamy fine sand, 1 to 6 percent slopes

Composition

Cutaway soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 250 acres

Typical Profile

0 to 3 inches—dark gray loamy fine sand
3 to 6 inches—brown loamy fine sand
6 to 24 inches—yellowish brown loamy fine sand
24 to 28 inches—pale brown loamy sand
28 to 32 inches—yellowish brown sandy clay loam that has interfingerings of pale brown loamy sand
32 to 38 inches—yellowish brown sandy clay loam
38 to 45 inches—yellowish brown loam
45 to 60 inches—light olive brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are in the less sloping areas
• The poorly drained Grygla soils, which are in swales and concave basins
• The somewhat poorly drained Sandwick soils, which are in concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils in which material from the sandy mantle does not interfinger into the subsoil
• Soils that have a gravelly lag line at the contact of the sandy mantle and the underlying glacial till

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and organic matter content
• The major crops are small grain and forage plants.
• Rotating crops, using tillage practices that leave crop residue on the surface, and returning crop residue to the soil conserve moisture.
• Maintaining crop residue on the surface, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to

the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations, plant competition, and seedling mortality
• The principal tree species is quaking aspen.
• Red pine, paper birch, eastern white pine, and white spruce are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• The seedling mortality rate may be high in summer because of inadequate soil moisture.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Plant competition should be controlled around new seedlings.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 6S
Windbreak suitability group: 5

620C—Cutaway loamy fine sand, 6 to 12 percent slopes

Composition

Cutaway soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 3 inches—dark gray loamy fine sand
3 to 6 inches—brown loamy fine sand
6 to 24 inches—yellowish brown loamy fine sand
24 to 28 inches—pale brown loamy sand
28 to 32 inches—yellowish brown sandy clay loam that has interfingerings of pale brown loamy sand
32 to 38 inches—yellowish brown sandy clay loam
38 to 45 inches—yellowish brown loam
45 to 60 inches—light olive brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Rapid in the upper part; moderate or moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: Low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are in the less sloping areas
• The poorly drained Grygla soils, which are in swales and concave basins
• The somewhat poorly drained Sandwick soils, which are in concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils in which material from the sandy mantle does not interfinger into the subsoil
• Soils that have a gravelly lag line at the contact of the sandy mantle and the underlying glacial till

Use and Management

Cropland

Major management factors: Soil blowing, available water

capacity, and organic matter content
• The major crops are small grain and forage plants.
• Leaving crop residue on the surface, using stubble mulch tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Rotating crops, using tillage practices that leave crop residue on the surface, and returning crop residue to the soil conserve moisture.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations, plant competition, and seedling mortality
• The principal tree species is quaking aspen.
• Red pine, paper birch, eastern white pine, and white spruce are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control water erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• The seedling mortality rate may be high in summer because of inadequate soil moisture.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Plant competition should be controlled around new seedlings.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 6S
Windbreak suitability group: 5

621—Morph fine sandy loam

Composition

Morph soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

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

Typical Profile

0 to 4 inches—very dark gray fine sandy loam
4 to 13 inches—grayish brown, mottled very fine sandy loam
13 to 21 inches—grayish brown, mottled loam that is penetrated by tongues and interfingerings of light brownish gray fine sandy loam
21 to 27 inches—olive gray, mottled loam
27 to 35 inches—olive gray, mottled loam and fine sandy loam
35 to 60 inches—light olive gray, mottled, calcareous, stratified silt loam, very fine sandy loam, loamy fine sand, and loam

Soil Properties and Qualities

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

Inclusions

Contrasting inclusions:
• The poorly drained Grygla soils, which are in adjacent

areas and have a sandy mantle overlying loamy glacial till
• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer
• The moderately well drained Rosy soils, which are on slightly convex rises

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or silt loam
• Soils that have less clay
• Soils that are underlain by fine sand
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil

Use and Management

Cropland

Major management factors: Wetness
• The major crops are small grain, corn, and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is quaking aspen.
• Black ash, paper birch, white spruce, and balsam fir are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness and a high content of lime in the soil should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw, drained, and IVw, undrained
Woodland ordination symbol: 7W
Windbreak suitability group: 2

624—Rosy sandy loam

Composition

Rosy soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on till-floored glacial lake plains and water-modified till plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 2 inches—very dark gray sandy loam
2 to 15 inches—light brownish gray fine sandy loam
15 to 23 inches—dark yellowish brown sandy loam that is penetrated by tongues and interfingerings of light brownish gray fine sandy loam

23 to 36 inches—dark yellowish brown, mottled sandy loam
36 to 42 inches—brown and yellowish brown, mottled, stratified fine sandy loam, sandy loam, loam, and silt loam
42 to 55 inches—light gray, mottled, stratified loamy fine sand, sandy loam, and silt loam
55 to 60 inches—light olive brown, mottled, calcareous, stratified loam and silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 3 to 5 feet

Inclusions

Contrasting inclusions:
• The well drained Balmlake and Lengby soils, which are in the more sloping areas
• The poorly drained Morph soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam, fine sandy loam, or silt loam
• Soils that have more clay
• Soils that are underlain by fine sand
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Returning crop residue to the soil and deferring field traffic when the soil is wet minimize soil compaction.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, and eastern white pine are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Limiting the use of heavy equipment during spring thaw and after heavy rains can minimize compaction of the surface layer.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L
Windbreak suitability group: 1

625—Sandwick loamy fine sand

Composition

Sandwick soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on till plains

Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

0 to 2 inches—very dark gray loamy fine sand
2 to 8 inches—grayish brown, mottled loamy fine sand
8 to 22 inches—grayish brown, mottled fine sand
22 to 29 inches—grayish brown, mottled clay loam that is penetrated by tongues and interfingerings of light brownish gray fine sand
29 to 40 inches—grayish brown, mottled loam
40 to 48 inches—brown, mottled loam
48 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid in the upper part; moderately slow in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 1 to 2 feet

Inclusions

Contrasting inclusions:
• The moderately well drained Eckvoll soils, which are on slightly convex rises
• The poorly drained Grygla soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil

Use and Management

Cropland

Major management factors: Wetness, soil blowing, available water capacity, and organic matter content
• The major crops are small grain and forage plants.
• The seasonal high water table provides supplemental moisture for plants.
• Maintaining crop residue on the surface, using minimum tillage, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Establishing field windbreaks, using tillage practices that leave crop residue on the surface, and returning crop residue to the soil conserve moisture.

Woodland

Major management factors: Equipment limitations, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Balsam fir, eastern white pine, and paper birch are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Trees commonly are subject to windthrow during periods of excessive wetness and strong winds.
• The seedling mortality rate may be high in summer because of inadequate soil moisture.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIw
Woodland ordination symbol: 8W
Windbreak suitability group: 1

626B—Suomi loam, 1 to 6 percent slopes

Composition

Suomi soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains (fig. 5)
Shape of areas: Irregular
Size of areas: 15 to 300 acres

Figure 5.—An area of Suomi loam, 1 to 6 percent slopes.

Typical Profile

0 to 2 inches—very dark grayish brown loam
2 to 6 inches—light brownish gray loam
6 to 14 inches—dark yellowish brown, mottled clay
14 to 23 inches—dark brown, mottled clay
23 to 60 inches—grayish brown, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: 2.5 to 5.0 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The poorly drained Effie soils, which are in swales and concave basins

• The well drained Nebish and Warba soils, which are in the more sloping areas

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam or silt loam
• Soils that have less clay
• Soils that formed in lacustrine silt

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize soil compaction.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, balsam fir, and northern red oak are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Restricted permeability and a sticky and plastic subsoil limit the use of equipment during spring thaw and after heavy rains.
• Trees commonly are subject to windthrow during periods of excessive wetness and strong winds.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7W
Windbreak suitability group: 4L

626C—Suomi loam, 6 to 12 percent slopes

Composition

Suomi soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 15 to 200 acres

Typical Profile

0 to 2 inches—black loam
2 to 8 inches—grayish brown fine sandy loam
8 to 16 inches—dark yellowish brown, mottled clay
16 to 28 inches—dark brown, mottled silty clay
28 to 60 inches—grayish brown, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Rapid

Depth to the water table: 2.5 to 5.0 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The poorly drained Effie soils, which are in swales and concave basins
• The well drained Nebish and Warba soils, which are on adjacent side slopes

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have less clay
• Soils that formed in lacustrine silt

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Tilling and planting across the slope, farming on the contour, using tillage practices that leave crop residue on the surface, and using grassed waterways reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Erosion, equipment limitations, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, and eastern white pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Trees may be shallow rooted because of a firm layer in the lower part of the subsoil, and some trees may be blown down during periods of high winds and excessive wetness.
• The restricted permeability and a sticky and plastic subsoil limit the use of equipment in spring and during other excessively wet periods.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 7W
Windbreak suitability group: 4L

626D—Suomi loam, 12 to 25 percent slopes

Composition

Suomi soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and till plains
Shape of areas: Irregular
Size of areas: 15 to 100 acres

Typical Profile

0 to 2 inches—very dark gray loam
2 to 5 inches—grayish brown loam

5 to 21 inches—dark yellowish brown and dark grayish brown, mottled clay loam
21 to 60 inches—dark grayish brown, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: 2.5 to 5.0 feet
Special characteristics: A few stones on the surface in some areas

Inclusions

Contrasting inclusions:
• The poorly drained Effie soils, which are in swales and concave basins
• The well drained Nebish and Warba soils, which are on adjacent side slopes

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have less clay
• Soils that formed in lacustrine silt
• Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Water erosion, slope, equipment limitations, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, and eastern white pine are tree species of limited extent.
• Operating equipment on the steeper slopes may result in the formation of gullies and can lead to serious erosion problems.
• Establishing skid roads and trails along the contour and sloping road surfaces reduce the hazard of water erosion.
• Water should be removed with water bars, culverts, and drop structures.
• Special care is needed when roads and landings are laid out or when equipment is operated.
• Roads should be designed so that they conform to the topography, and the grade should be less than 10 percent and should be kept as low as possible.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Trees may be shallow rooted because of a firm layer in the lower part of the subsoil, and some trees may be blown down during periods of high winds and excessive wetness.
• The restricted permeability and a sticky and plastic subsoil limit the use of equipment in spring and during other excessively wet periods.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality and the slope
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 7R
Windbreak suitability group: 4L

627—Tawas muck

Composition

Tawas soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Forested bogs on till-floored glacial lake plains and outwash plains
Slope range: 0 to 1 percent

Shape of areas: Irregular
Size of areas: 10 to 500 acres

Typical Profile

0 to 6 inches—very dark brown muck
6 to 33 inches—dark brown muck
33 to 60 inches—dark 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
Organic matter content: 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 adjacent bogs and are underlain by loamy glacial till
• The very poorly drained Markey soils, which are in sedge-covered bogs
• The very poorly drained Lupton soils, which are in the deeper forested bogs

Similar soils:
• Soils that formed in less decomposed organic material
• Soils that have a lower content of woody fragments
• Soils that have a thin, fibric surface layer consisting of sphagnum or hypnum moss
• Soils that are underlain by coprogenous earth or limnic material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is black spruce.
• Northern whitecedar, tamarack, balsam fir, and black ash are tree species of limited extent.
• Harvesting is limited to periods when the soil is adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on this soil.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from undesirable species may be severe if the overstory is removed.
• The seedling mortality rate is high because of seasonal wetness.

Wildlife habitat

• The natural vegetation is diverse and provides food and cover for many wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 3W

628—Talmoon muck

Composition

Talmoon soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Closed depressions on moraines and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—black muck
4 to 9 inches—black loam
9 to 14 inches—dark grayish brown, mottled fine sandy loam
14 to 18 inches—dark gray, mottled loam
18 to 24 inches—olive gray, mottled clay loam
24 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate in the upper part; moderately slow in the lower part
Available water capacity: High
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Hamre soils, which are in sedge-covered bogs and have an organic surface layer that is thicker than that of the Talmoon soil
• The poorly drained Shooker soils, which are on the adjacent mineral uplands and do not have an organic surface layer

Similar soils:
• Soils that have free carbonates at a depth of less than 20 inches
• Soils that have a thin sandy mantle between the organic surface layer and loamy glacial till
• Soils that have a thicker organic surface layer

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is black ash.
• Balsam fir, American elm, and black spruce are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate extreme wetness should be selected for windbreaks and environmental plantings.
• Because of the wetness, the seedling mortality rate is severe and spring planting may be delayed.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 3W
Windbreak suitability group: 2

653—Smiley muck

Composition

Smiley soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Closed depressions on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—black muck
4 to 11 inches—black loam
11 to 18 inches—very dark gray, mottled clay loam
18 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Hamre soils, which are in sedge-covered bogs and have a thicker surface layer than that of the Smiley soil
• The poorly drained Roliss and Smiley soils, which are on adjacent mineral uplands and do not have an organic surface layer

Similar soils:
• Soils on which the organic surface layer has been burned off

• Soils that have a thin sandy layer between the organic surface layer and the glacial till
• Soils that have a gravelly layer at the contact of the organic layer and glacial till

Use and Management

Cropland

Major management factors: Wetness
• The major crops are forage plants and small grain.
• Wetness limits the choice of plants, the period of grazing, and the productivity of deep-rooted crops.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Only hay and pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• The level of fertility generally is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas of this soil are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• Management for wildlife habitat should include grassland management practices and wetland restoration.

Interpretive Groups

Land capability classification: IIIw, drained, and VIw, undrained
Windbreak suitability group: 2(O), drained, and 10, undrained
Woodland ordination symbol: Not assigned

702—Bullwinkle-Cathro complex

Composition

Bullwinkle soil and similar soils: 40 to 60 percent
Cathro soil and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Bullwinkle—forested bogs on till-floored glacial lake plains and till plains; Cathro—sedge-covered bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 50 to 400 acres

Typical Profile

Bullwinkle

0 to 12 inches—black muck
12 to 34 inches—black muck
34 to 40 inches—very dark loam
40 to 60 inches—greenish gray, mottled, calcareous loam

Cathro

0 to 20 inches—black muck
20 to 24 inches—black loam
24 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Bullwinkle—moderately rapid in the upper part, moderate or moderately slow in the lower part; Cathro—moderately rapid to moderately slow in the upper part, moderate or moderately slow in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Bullwinkle—very slow; Cathro—very slow or ponded
Seasonal high water table: Bullwinkle—at the surface to 1 foot below the surface; Cathro—1 foot above to 1 foot below the surface
Special characteristics: Cathro—ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Hamre soils, which are on the margins of bogs adjacent to mineral uplands and have an organic surface layer that is thinner than that of the Bullwinkle and Cathro soils
• The very poorly drained Markey and Tawas soils, which are in adjacent bogs and are underlain by sand
• The very poorly drained Seelyeville and Lupton soils, which are in the deeper bogs

Similar soils:
• Soils that formed in less decomposed organic material
• Soils that have a gravelly layer at the contact of the organic material and the loamy glacial till
• Soils that have a sandy mantle between the organic material and the loamy glacial till
• Soils that are more acid

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition

• The principal tree species is black spruce.
• Northern whitecedar, tamarack, and balsam fir are tree species of limited extent.
• Harvesting is limited to periods when the soils are adequately frozen.
• Special harvesting equipment is needed because ordinary crawler tractors or rubber-tired skidders generally cannot be used on these soils.
• Equipment can be used during periods in winter when access roads are frozen.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition from undesirable species may be severe if the overstory is removed.
• The seedling mortality rate is high because of the seasonal wetness.

Wildlife habitat

• Many areas of these soils are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

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

709B—Lengby sandy loam, 1 to 6 percent slopes

Composition

Lengby soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 5 inches—black sandy loam
5 to 11 inches—brown loamy fine sand
11 to 18 inches—brown and dark yellowish brown loamy fine sand
18 to 28 inches—dark brown sandy clay loam
28 to 33 inches—light yellowish brown, calcareous very fine sandy loam
33 to 37 inches—light yellowish brown, calcareous coarse sand
37 to 41 inches—light olive brown, calcareous fine sandy loam
41 to 60 inches—light yellowish brown, calcareous loamy fine sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate in the upper part; moderately rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

• The well drained Debs soils, which are in adjacent areas and formed entirely in lacustrine silt
• The moderately well drained Rosy soils, which are in the less sloping areas
• The poorly drained Morph soils, which are in swales and concave basins

Similar soils:

• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or fine sandy loam
• Soils that have less clay
• Soils having a mantle of fine sand, as much as 30 inches thick, that is underlain by stratified sediments
• Soils that have more gravel
• Soils that are underlain by loamy glacial till
• Soils that are underlain entirely by fine sand

Use and Management

Cropland

Major management factors: Water erosion and organic matter content

• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Tilling and planting across the slope reduce the runoff rate, increase the rate of water infiltration, and help to control water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, and white oak are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 7L
Windbreak suitability group: 5

709C—Lengby sandy loam, 6 to 12 percent slopes

Composition

Lengby soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 3 inches—black sandy loam
3 to 11 inches—brown loamy fine sand
11 to 19 inches—brown loam
19 to 60 inches—dark brown and light yellowish brown, stratified, calcareous very fine sandy loam, loamy fine sand, and coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate in the upper part; moderately rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Debs soils, which are in adjacent areas and formed entirely in lacustrine silt
• The moderately well drained Rosy soils, which are in the less sloping areas
• The poorly drained Morph soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loam or fine sandy loam
• Soils that have less clay throughout
• Soils having a mantle of fine sand, as much as 30 inches thick, that is underlain by stratified sediments
• Soils that have more gravel
• Soils that are underlain by loamy glacial till
• Soils that are underlain entirely by fine sand

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.

• Tilling and planting across the slope, farming on the contour, using tillage practices that leave crop residue on the surface, and using grassed waterways reduce the runoff rate, increase the rate of water infiltration, and reduce the hazard of water erosion.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, paper birch, and white oak are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Building logging roads and skid trails across the slope or on the gentler slopes helps to control water erosion.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIe
Woodland ordination symbol: 7L
Windbreak suitability group: 5

709D—Lengby sandy loam, 12 to 25 percent slopes

Composition

Lengby soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Side slopes and hilltops on moraines and water-modified till plains
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 2 inches—dark grayish brown sandy loam
2 to 13 inches—brown loamy fine sand
13 to 26 inches—brown loam
26 to 60 inches—brown and light yellowish brown, stratified, calcareous very fine sandy loam, loamy fine sand, and coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate in the upper part; moderately rapid in the lower part
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Debs soils, which are in adjacent areas and formed entirely in lacustrine silt
• The moderately well drained Rosy soils, which are in the less sloping areas
• The poorly drained Morph soils, which are in swales and concave basins

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

- Soils that have less clay
- Soils having a mantle of fine sand, as much as 30 inches thick, that is underlain by stratified sediments
- Soils that have more gravel
- Soils that are underlain by loamy glacial till
- Soils that are underlain entirely by fine sand
- Soils that have slopes of more than 25 percent

Use and Management

Woodland

Major management factors: Erosion hazard, slope, equipment limitations, and plant competition

- The principal tree species is quaking aspen.
- Sugar maple, American basswood, paper birch, and white oak are tree species of limited extent.
- Operating equipment on the steeper slopes may result in the formation of gullies and can lead to serious erosion problems.
- Establishing skid roads and trails on the contour and sloping road surfaces can reduce the hazard of water erosion.
- Water should be removed with water bars, culverts, and drop structures.
- Special care is needed when logging roads, skid trails, and landings are laid out or when equipment is operated.
- Roads should be designed so that they conform to the topography, and the grade should be less than 10 percent and should be kept as low as possible.
- Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
- The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
- Ruts form easily if skidders are used when the soil is wet.
- Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
- Converting sites from northern hardwoods to conifers requires intensive management.
- If conifer species are planted, suckering and competition from hardwood seedlings are severe.
- Mechanical or chemical site preparation is needed to control competing vegetation.
- Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality

- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

- A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

- Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
- Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIe
Woodland ordination symbol: 7R
Windbreak suitability group: 5

712—Rosewood fine sandy loam

Composition

Rosewood soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

0 to 7 inches—black, calcareous fine sandy loam
7 to 11 inches—very dark gray and gray, calcareous fine sandy loam
11 to 18 inches—gray, mottled, calcareous loamy fine sand
18 to 60 inches—grayish brown, mottled, calcareous fine sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Available water capacity: Low
Organic matter content: High
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- The very poorly drained Deerwood soils, which are in closed depressions and have a thin organic surface layer
- The somewhat poorly drained Redby soils, which are on plane or slightly convex rises and are not calcareous

• The poorly drained Rockwell soils, which are in adjacent areas and are underlain by loamy glacial till at a depth of more than 40 inches

Similar soils:

• Soils that have a thinner surface layer
• Soils that have a surface layer of loamy fine sand or loam
• Soils that have more gravel
• Soils that do not have an accumulation of free carbonates below the surface layer or that are leached of carbonates to a depth of 30 inches

Use and Management

Cropland

Major management factors: Wetness, soil blowing, and a high pH level

• The major crops are small grain and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Leaving crop residue on the surface and establishing field windbreaks reduce the hazard of soil blowing.
• Selecting plants that can tolerate a high pH level can minimize the effects of a high content of lime in the soil.

Pasture

Major management factors: Forage quality

• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate a high content of lime should be selected for windbreaks and environmental plantings.
• Free carbonates in the soil limit the availability of plant nutrients.
• Because of the wetness, the seedling mortality rate is moderate and spring planting may be delayed.

Interpretive Groups

Land capability classification: IIIw
Windbreak suitability group: 2K
Woodland ordination symbol: Not assigned

765—Smiley loam

Composition

Smiley soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on till-floored glacial lake plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 8 inches—black loam
8 to 13 inches—dark gray, mottled clay loam
13 to 60 inches—light olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer
• The poorly drained Kratka soils, which are on slightly convex rises and have a sandy mantle that is 20 to 40 inches thick and is underlain by loamy glacial till
• The poorly drained Roliss soils, which are in adjacent areas and do not have an accumulation of clay in the subsoil

Similar soils:

• Soils that have a thinner surface layer
• Soils that have a surface layer of fine sandy loam or clay loam
• Soils that have less clay
• Soils that have a thin sandy mantle below the surface layer

Use and Management

Cropland

Major management factors: Wetness

• The major crops are small grain, corn, and forage plants.
• Most suitable crops can be grown if adequate drainage is provided.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Working the soil when it is too wet results in severe compaction and the formation of clods.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Interpretive Groups

Land capability classification: IIw, drained, and IVw, undrained
Windbreak suitability group: 2
Woodland ordination symbol: Not assigned

799—Seelyeville and Bowstring soils

Composition

Seelyeville, Bowstring, and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on flood plains (fig. 6)
Slope range: 0 to 1 percent
Shape of areas: Irregular or long and narrow
Size of areas: 50 to 500 acres

Typical Profile

Seelyeville

0 to 28 inches—black muck
28 to 60 inches—very dark brown muck

Bowstring

0 to 35 inches—very dark brown muck
35 to 43 inches—dark gray loamy sand
43 to 60 inches—black muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: Seelyeville—2 feet above to 2 feet below the surface; Bowstring—at the surface to 2 feet below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro and Markey soils, which are on the margins of bogs adjacent to mineral uplands and are underlain by mineral material
• The very poorly drained Lupton soils, which are in forested bogs
• The poorly drained Pengilly soils, which are in mineral areas and on islands on the flood plains and do not have an organic surface layer

Similar soils:
• Soils that formed entirely in less decomposed organic material
• Soils that have a mineral layer more than 12 inches thick within the organic material
• Soils that have more woody fragments
• Soils that are underlain by coprogenous earth or limnic material

Use and Management

Wildlife habitat

• Many areas of these soils are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

867B—Graycalm-Menahga complex, 1 to 6 percent slopes

Composition

Graycalm soil and similar soils: 45 to 70 percent
Menahga soil and similar soils: 20 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes, hilltops, and broad flats on outwash plains
Shape of areas: Irregular
Size of areas: 50 to 500 acres

Typical Profile

Graycalm

0 to 5 inches—very dark gray loamy sand
5 to 9 inches—dark yellowish brown loamy sand
9 to 32 inches—yellowish brown sand
32 to 46 inches—light yellowish brown sand that has several thin bands of dark yellowish brown loamy sand
46 to 60 inches—pale brown sand

Figure 6.—An area of Seelyeville and Bowstring soils in a sedge-covered bog.

Menahga

0 to 3 inches—very dark grayish brown loamy sand
3 to 36 inches—yellowish brown sand
36 to 60 inches—light yellowish brown coarse sand and sand

Soil Properties and Qualities

Drainage class: Graycalm—somewhat excessively drained; Menahga—excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Andrusia soils, which are in adjacent areas and have a clay-enriched subsoil
• The moderately well drained Hiwood soils, which are in plane or slightly concave basins
• The somewhat poorly drained Meehan soils, which are in concave basins

• The poorly drained Cormant soils, which are in swales

Similar soils:
• Soils that have a surface layer of sand or loamy coarse sand
• Soils that have more gravel
• Soils that formed entirely in fine sand
• Soils having loamy bands that are thicker or that contain more clay
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches
• Soils that have thin loamy bands at a depth of more than 60 inches
• Soils that have free carbonates at a depth of 40 to 60 inches

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and ground-water contamination
• The major crops are forage plants.
• Crops that can tolerate drought should be selected.
• Maintaining crop residue on the surface, establishing field windbreaks, and maintaining a plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Moisture can be conserved by using tillage practices that leave crop residue on the surface and by leaving crop stubble in the field to trap snow.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, and plant competition
• The principal tree species is red pine.
• Jack pine, eastern white pine, and paper birch are tree species of limited extent.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can withstand droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• The loose, sandy surface layer of these soils may limit the use of equipment.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.
• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: IVs
Woodland ordination symbol: Graycalm—7A; Menahga—8S
Windbreak suitability group: 7

867C—Graycalm-Menahga complex, 6 to 12 percent slopes

Composition

Graycalm soil and similar soils: 45 to 65 percent
Menahga soil and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes and hilltops on outwash plains
Shape of areas: Irregular
Size of areas: 50 to 200 acres

Typical Profile

Graycalm

0 to 3 inches—very dark grayish brown loamy sand
3 to 30 inches—dark yellowish brown sand
30 to 50 inches—light yellowish brown sand that has several thin bands of dark yellowish brown loamy sand
50 to 60 inches—pale brown sand

Menahga

0 to 2 inches—very dark grayish brown loamy sand
2 to 30 inches—dark brown sand
30 to 60 inches—light yellowish brown coarse sand and sand

Soil Properties and Qualities

Drainage class: Graycalm—somewhat excessively drained; Menahga—excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Andrusia soils, which are in adjacent areas and have a clay-enriched subsoil
• The moderately well drained Hiwood soils, which are in plane or slightly concave basins
• The somewhat poorly drained Meehan soils, which are in concave basins
• The poorly drained Cormant soils, which are in swales

Similar soils:
• Soils that have a surface layer of sand or loamy coarse sand
• Soils that have more gravel
• Soils that formed entirely in fine sand
• Soils having loamy bands that are thicker or that contain more clay
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches
• Soils that have thin loamy bands at a depth of more than 60 inches
• Soils that have free carbonates at a depth of 40 to 60 inches
• Soils that have slopes of more than 12 percent

Use and Management

Cropland

Major management factors: Available water capacity, soil blowing, and ground-water contamination
• The major crops are forage plants.
• Crops that can tolerate drought should be selected.
• Leaving crop residue on the surface, establishing field windbreaks, and maintaining a permanent plant cover reduce the hazard of soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Woodland

Major management factors: Equipment limitations, seedling mortality, and plant competition
• The principal tree species is red pine.
• Jack pine, eastern white pine, and paper birch are tree species of limited extent.
• The seedling survival rate can be improved by carefully planting vigorous nursery stock or containerized seedlings early in spring, when more moisture is available, but replanting may be necessary in some areas.
• Carefully selecting and preparing planting sites that subject seedlings to as little moisture stress as possible help to establish the seedlings and increase the survival rate.
• Plant competition should be controlled around new seedlings.
• Planting seedlings that can withstand droughty conditions, mulching, and shading the seedlings reduce the seedling mortality rate.
• Seeding logging roads, skid trails, and landings after the trees have been logged helps to prevent excessive soil loss.
• The loose, sandy surface layer of these soils may limit the use of equipment.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.
• Carefully controlling the use and application of fertilizers, herbicides, and pesticides reduces the hazard of ground-water contamination.

Pasture

Major management factors: Forage quality
• Adjusting stocking rates, especially on the steeper slopes, rotating grazing, and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate droughty conditions should be selected for windbreaks and environmental plantings.
• The seedling mortality rate is moderate because of the moisture stress caused by droughtiness.

• Leaving vegetation on the surface during the early years of establishment helps to control soil blowing.

Wildlife habitat

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.
• Block plantings of conifers, 1 to 5 acres in size, can provide winter cover for upland game birds in agricultural areas.

Interpretive Groups

Land capability classification: Graycalm—VIs; Menahga—IVs
Woodland ordination symbol: Graycalm—7A; Menahga—8S
Windbreak suitability group: 7

1029—Pits, gravel

Description of areas: Active or abandoned areas used as gravel pits and areas of filled land
Shape of areas: Irregular
Size of areas: 3 to 40 acres

Use and Management

• The size, shape, and depth of the pits are determined by the quality and quantity of gravel.
• Some pits are smaller than 3 acres in size.
• The surface layer, vegetation, and sand and gravel have been removed from areas of this map unit.

Interpretive groups: Not assigned

1085B—Urban land-Graycalm complex, 1 to 6 percent slopes

Composition

Urban land: 60 to 80 percent
Graycalm soil and similar soils: 10 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on outwash plains
Shape of areas: Irregular
Size of areas: 80 to 300 acres

Typical Profile

Graycalm

0 to 3 inches—black loamy sand
3 to 13 inches—light yellowish brown sand
13 to 36 inches—dark yellowish brown and yellowish brown sand
36 to 60 inches—light yellowish brown sand that has several thin bands of strong brown loamy sand and sandy loam

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Andrusia soils, which are in adjacent areas and have a clay-enriched subsoil
• The moderately well drained Hiwood soils, which are in plane or slightly concave basins
• The somewhat poorly drained Meehan soils, which are in concave basins
• The poorly drained Cormant soils, which are in swales
• The excessively drained Menahga soils, which are on adjacent side slopes and hilltops and do not have textural bands

Similar soils:
• Soils that have been backfilled with other soil material during construction
• Soils that have a surface layer of sand or loamy coarse sand
• Soils that have more gravel
• Soils that formed entirely in fine sand
• Soils having loamy bands that are thicker or that contain more clay
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches
• Soils that have thin loamy bands at a depth of more than 60 inches
• Soils that have free carbonates at a depth of 40 to 60 inches

Use and Management

Major uses: Residential and commercial development
Major management factors: Droughtiness, soil blowing, and water erosion on construction sites
• Areas of Urban land are mainly used for private residences, shopping centers, parking lots, city parks, schools, industrial parks, and airports.

Interpretive Groups

Land capability classification: Not assigned
Woodland ordination symbol: Not assigned

1085C—Urban land-Graycalm complex, 6 to 12 percent slopes

Composition

Urban land: 55 to 75 percent
Graycalm soil and similar soils: 15 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on outwash plains
Shape of areas: Irregular
Size of areas: 80 to 300 acres

Typical Profile

Graycalm

0 to 3 inches—black loamy sand
3 to 13 inches—light yellowish brown sand
13 to 36 inches—dark yellowish brown and yellowish brown sand
36 to 60 inches—light yellowish brown sand that has several thin bands of strong brown loamy sand and sandy loam

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:

• The well drained Andrusia soils, which are in adjacent areas and have a clay-enriched subsoil
• The moderately well drained Hiwood soils, which are in plane or slightly concave basins
• The somewhat poorly drained Meehan soils, which are in concave basins
• The poorly drained Cormant soils, which are in swales
• The excessively drained Menahga soils, which are on adjacent side slopes and hilltops and do not have textural bands

Similar soils:

• Soils that have been backfilled with other soil material during construction
• Soils that have a surface layer of sand or coarse loamy sand
• Soils that have more gravel
• Soils that formed entirely in fine sand
• Soils having loamy bands that are thicker or that contain more clay
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches
• Soils that have thin loamy bands at a depth of more than 60 inches
• Soils that have free carbonates at a depth of 40 to 60 inches

Use and Management

Major uses: Residential and commercial development
Major management factors: Droughtiness, soil blowing, and water erosion on construction sites

• Areas of Urban land are mainly used for private residences, shopping centers, parking lots, city parks, schools, industrial parks, and airports.

Interpretive Groups

Land capability classification: Not assigned
Woodland ordination symbol: Not assigned

1086—Urban land-Cormant complex

Composition

Urban land: 45 to 65 percent
Cormant soil and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane or slightly concave basins on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 50 to 150 acres

Typical Profile

Cormant

0 to 7 inches—black loamy sand
7 to 60 inches—grayish brown and light brownish gray, mottled sand

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

• The very poorly drained Deerwood soils, which are in closed depressions and have a thin organic surface layer
• The moderately well drained Hiwood soils, which are on slightly convex rises
• The somewhat poorly drained Meehan soils, which are on plane or slightly convex rises

• The excessively drained Menahga soils, which are on side slopes and hilltops

Similar soils:

• Soils that have been backfilled with other soil material during construction
• Soils that have a surface layer of sandy loam
• Soils that have more gravel
• Soils that formed entirely in fine sand
• Soils that have thin textural bands of loamy material at a depth of more than 30 inches
• Soils that are underlain by loamy glacial till at a depth of more than 60 inches

Use and Management

Major uses: Residential and commercial development
Major management factors: Wetness and water erosion on construction sites

• Areas of Urban land are mainly used for private residences, shopping centers, parking lots, city parks, schools, industrial parks, and airports.

Interpretive Groups

Land capability classification: Not assigned
Woodland ordination symbol: Not assigned

1804—Hamre muck, ponded

Composition

Hamre soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 40 to 300 acres

Typical Profile

0 to 10 inches—black muck
10 to 15 inches—black loam
15 to 60 inches—olive gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded for long periods
Seasonal high water table: 2.0 feet above the surface to 0.5 foot above the surface
Special characteristics: Ponding throughout the year

Inclusions

Contrasting inclusions:

• The very poorly drained Cathro soils, which are in adjacent sedge-covered bogs and formed in deeper organic material
• The very poorly drained Northwood soils, which are in adjacent sedge-covered bogs and have a sandy mantle between an organic surface layer and loamy glacial till

Similar soils:

• Soils on which the organic material has been partially or completely burned off
• Soils that have a thinner organic surface layer
• Soils that are not continually ponded

Use and Management

Wildlife habitat

• Many areas are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many species of wetland wildlife.

Interpretive Groups

Land capability classification: VIIIw
Woodland ordination symbol: Not assigned

1807—Cathro muck, ponded

Composition

Cathro soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains and till plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

0 to 10 inches—black muck
10 to 25 inches—very dark brown muck
25 to 60 inches—light olive gray, mottled, calcareous 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
Organic matter content: Very high

Surface runoff: Ponded for long periods
Seasonal high water table: 1.0 foot above the surface to 0.5 foot above the surface
Special characteristics: Ponding throughout the year

Inclusions

Contrasting inclusions:
• The very poorly drained Hamre soils, which are on the margins of bogs adjacent to mineral uplands and have an organic surface layer that is thinner than that of the Cathro soil
• The very poorly drained Markey soils, which are in adjacent sedge-covered bogs and are underlain by sand
• The very poorly drained Seelyeville soils, which are in the deeper bogs and formed entirely in organic material
Similar soils:
• Soils that have sandy or gravelly material at the contact of the organic material and the glacial till
• Soils that formed in less decomposed organic material
• Soils that are not continually ponded
• Soils that are underlain by coprogenous earth and limnic material

Use and Management

Wildlife habitat

• Many areas are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.

Interpretive Groups

Land capability classification: VIIIw
Woodland ordination symbol: Not assigned

1808—Markey muck, ponded

Composition

Markey soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored 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 muck
8 to 28 inches—very dark brown muck
28 to 60 inches—light brownish gray, mottled sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; rapid in the lower part
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Ponded for long periods
Seasonal high water table: 1.0 foot above the surface to 0.5 foot above the surface
Special characteristics: Ponding throughout the year

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are in adjacent sedge-covered bogs and are underlain by loamy glacial till
• The very poorly drained Deerwood soils, which are in adjacent sedge-covered bogs and have an organic layer that is thinner than that of the Markey soil
• The very poorly drained Seelyeville soils, which are in the deeper bogs and formed entirely in organic material
Similar soils:
• Soils that formed in less decomposed organic material
• Soils that have a gravelly layer at the contact of the organic material and the sand
• Soils that are not continually ponded
• Soils that are underlain by coprogenous earth and limnic material

Use and Management

Wildlife habitat

• Many areas are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.

Interpretive Groups

Land capability classification: VIIIw
Woodland ordination symbol: Not assigned

1878—Hamre muck

Composition

Hamre soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored 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 9 inches—very dark grayish brown muck
9 to 13 inches—very dark gray loam
13 to 60 inches—light brownish gray, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are in adjacent sedge-covered bogs and have an organic layer that is thicker than that of the Hamre soil
• The poorly drained Shooker and Smiley soils, which are on the adjacent mineral uplands and do not have an organic surface layer

Similar soils:
• Soils that have an organic surface layer less than 8 inches thick
• Soils that have a gravelly layer at the contact of the organic material and the glacial till
• Soils that have a sandy mantle between the organic material and the loamy glacial till
• Soils on which the organic material has been partially or completely burned off

Use and Management

Cropland

Major management factors: Wetness
• The major crops are forage plants and small grain.
• Wetness limits the choice of plants, the period of grazing, and the production of deep-rooted crops.
• Installing surface drains helps to maintain the level of the water table, minimizes ponding, and inhibits the growth of the less desirable water-tolerant plants.
• Only hay and pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quantity and quality of forage plants.
• The level of fertility is generally high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• The natural vegetation is diverse and provides food, cover, and nesting habitat for many wetland wildlife species.
• Management for wildlife habitat should include grassland management practices and wetland restoration.

Interpretive Groups

Land capability classification: IIIw, drained, and VIw, undrained
Windbreak suitability group: 10
Woodland ordination symbol: Not assigned

1922—Chilgren sandy loam, very stony

Composition

Chilgren soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

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

Typical Profile

0 to 3 inches—black sandy loam
3 to 8 inches—grayish brown loamy fine sand
8 to 17 inches—dark grayish brown, mottled clay loam
17 to 60 inches—light brownish gray, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 1 to 3 feet
Special characteristics: Stones covering 1 to 3 percent of the surface

Inclusions

Contrasting inclusions:
- The moderately well drained, stony Garnes soils, which are on slightly convex rises
- The poorly drained, stony Grygla soils, which are on slightly convex rises and have a sandy mantle 20 to 40 inches thick

Similar soils:
- Soils that have a higher or lower percentage of stones
- Soils that have a surface layer of loam or fine sandy loam
- Soils that are more than 24 inches deep over free carbonates
- Soils that have less clay in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
- The principal tree species is quaking aspen.
- Black ash, balsam fir, and white spruce are tree species of limited extent.
- The use of equipment is restricted during spring thaw and other excessively wet periods.
- Ruts form easily if skidders are used when the soil is wet.
- Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
- Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
- Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
- Plant competition can prevent the regeneration of trees.
- Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
- Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
- The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.
- Stones and boulders on the surface can interfere with the use of harvesting equipment.

Pasture

Major management factors: Forage quality and wetness
- Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

- Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

- Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
- Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 6W
Windbreak suitability group: 2

1923—Garnes fine sandy loam, very stony

Composition

Garnes soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on till-floored glacial lake plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 50 acres

Typical Profile

0 to 3 inches—black fine sandy loam
3 to 8 inches—grayish brown fine sandy loam
8 to 17 inches—dark brown, mottled sandy clay loam
17 to 60 inches—grayish brown and light brownish gray, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderate
Available water capacity: High
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: 2.5 to 6.0 feet
Special characteristics: Stones covering 1 to 3 percent of the surface

Inclusions

Contrasting inclusions:
- The poorly drained, stony Chilgren soils, which are in swales
- The poorly drained, stony Grygla soils, which are in

concave basins and have a sandy mantle that is 20 to 40 inches thick

Similar soils:
• Soils that have a higher or lower percentage of stones
• Soils that have a surface layer of sandy loam or loam
• Soils that are more than 20 inches deep over free carbonates
• Soils that have less clay in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is red pine.
• Bur oak, sugar maple, white spruce, and eastern white pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, competition from hardwood seedlings and suckering are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Stones and boulders on the surface can interfere with the use of harvesting equipment.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 7L
Windbreak suitability group: 1

1924—Grygla loamy fine sand, very stony

Composition

Grygla soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

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

Typical Profile

0 to 4 inches—black loamy fine sand
4 to 20 inches—dark grayish brown, mottled loamy fine sand
20 to 27 inches—grayish brown, mottled fine sand
27 to 60 inches—light brownish gray, mottled, calcareous fine sandy 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
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet
Special characteristics: Stones covering 1 to 3 percent of the surface

Inclusions

Contrasting inclusions:
• The poorly drained, stony Chilgren soils, which are in adjacent areas and formed entirely in loamy glacial till
• The moderately well drained, stony Eckvoll soils, which are on slightly convex rises
• The very poorly drained Northwood soils, which are in closed depressions and have a thin organic surface layer

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a higher or lower percentage of stones
• Soils that have less clay in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is quaking aspen.
• Jack pine is a tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• Plant competition can prevent the regeneration of trees.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
• Stones and boulders on the surface can interfere with the use of harvesting equipment.

Pasture

Major management factors: Forage quality
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 6X
Windbreak suitability group: 2

1925—Eckvoll loamy fine sand, very stony

Composition

Eckvoll soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on till-floored glacial lake plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 3 inches—black loamy fine sand
3 to 10 inches—pale brown fine sand
10 to 22 inches—yellowish brown, mottled fine sand
22 to 33 inches—brown, mottled sandy clay loam and clay loam
33 to 42 inches—light brownish gray, mottled, calcareous loam
42 to 60 inches—light yellowish brown, mottled, calcareous fine sandy 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
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 2 to 5 feet
Special characteristics: Stones covering 1 to 3 percent of the surface

Inclusions

Contrasting inclusions:
• The poorly drained, stony Chilgren soils, which are in concave basins and formed entirely in loamy glacial till
• The poorly drained, stony Grygla soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of loamy sand or fine sandy loam
• Soils that have a sandy mantle less than 20 inches thick or more than 40 inches thick
• Soils that have a higher or lower percentage of stones
• Soils that have less clay in the underlying material

Use and Management

Woodland

Major management factors: Equipment limitations, windthrow, and plant competition
• The principal tree species is quaking aspen.

• Bur oak and American basswood are tree species of limited extent.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Plant competition from hardwood seedlings is moderate if the overstory is removed, and pine trees may not be adequately restocked by natural regeneration.
• Trees commonly are subject to windthrow during periods of excessive wetness and strong winds.
• The seedling mortality rate may be high in summer because of inadequate soil moisture.
• Stones and boulders on the surface can interfere with the use of harvesting equipment.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: VIs
Woodland ordination symbol: 6L
Windbreak suitability group: 1

1935—Epoufette muck

Composition

Epoufette soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Closed depressions on outwash plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 4 inches—black muck
4 to 8 inches—black sandy loam
8 to 18 inches—grayish brown, mottled loamy sand
18 to 30 inches—olive gray, mottled sandy loam
30 to 60 inches—light olive gray, mottled, calcareous loamy coarse sand

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Available water capacity: Low
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains

Inclusions

Contrasting inclusions:
• The very poorly drained Deerwood and Tawas soils, which are in adjacent sedge-covered and forested bogs and have an organic surface layer that is thicker than that of the Epoufette soil
• The poorly drained Epoufette soils, which are on adjacent mineral uplands and do not have an organic surface layer
• The moderately well drained Karlstad soils, which are on mineral islands and adjacent uplands

Similar soils:
• Soils that have more gravel
• Soils that do not have gravel
• Soils that do not have a clay-enriched layer

Use and Management

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow, and plant competition
• The principal tree species is black spruce.
• Balsam fir and northern whitecedar are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and can permanently damage the site.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Because of the seasonal high water table, equipment should be used only during dry summer months and winter months when the soil is adequately frozen.
• Trees are shallow rooted because of the seasonal high water table, and many trees may be blown down during periods of high winds and excessive wetness.
• Plant competition prevents natural or planted

regeneration unless precautionary measures are taken.
• Plant competition from unwanted species may be severe if the overstory is removed.
• The seedling mortality rate is high because of seasonal wetness.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Generally, this soil is not suitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• The natural vegetation is diverse and provides food and cover for many wildlife species.
• Management for wildlife habitat should include forestry practices.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: 2W
Windbreak suitability group: 10

1939—Northwood muck, very stony

Composition

Northwood soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Sedge-covered bogs on till-floored glacial lake plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

0 to 11 inches—black muck
11 to 15 inches—black fine sandy loam
15 to 25 inches—olive gray, mottled loamy fine sand
25 to 60 inches—light olive gray, mottled, calcareous fine sandy 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: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface
Special characteristics: Ponding in the spring and after heavy rains; stones covering 1 to 3 percent of the surface

Inclusions

Contrasting inclusions:
• The very poorly drained Cathro soils, which are in adjacent sedge-covered bogs and formed in deeper organic material than that of the Northwood soil
• The very poorly drained Deerwood soils, which are in adjacent bogs and are not underlain by glacial till
• The very poorly drained Hamre soils, which are in adjacent bogs and do not have a sandy layer underlying an organic surface layer
• The poorly drained, stony Kratka soils, which are on adjacent mineral uplands and do not have an organic surface layer

Similar soils:
• Soils that are less than 20 inches or more than 40 inches deep over loamy underlying material
• Soils that have a gravelly layer at the contact of the sandy mantle and the loamy glacial till
• Soils that have an organic surface layer less than 8 inches thick
• Soils that have a higher or lower percentage of stones

Use and Management

Pasture

Major management factors: Wetness
• Deferring grazing during wet periods helps to maintain the quality and quantity of forage plants.
• Only hay and pasture plants that can tolerate periodic inundation and seasonal wetness should be seeded.
• Generally, the level of fertility is high enough for the sustained production of high-quality pasture.

Windbreaks

• Generally, this soil is unsuitable for windbreaks because wetness limits the planting, survival, or growth of trees and shrubs. Onsite investigation is needed to determine whether trees and shrubs should be planted.

Wildlife habitat

• Many areas are suitable for the establishment or restoration of wetlands.
• Establishing open water areas attracts waterfowl and aquatic animals.
• Management for wildlife habitat should include grassland management practices and wetland restoration.

Interpretive Groups

Land capability classification: VIw
Woodland ordination symbol: Not assigned

Windbreak suitability group: 10

1959—Nary cobbly fine sandy loam

Composition

Nary soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on moraines and till plains
Slope range: 1 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 4 inches—very dark brown cobbly fine sandy loam
4 to 14 inches—grayish brown cobbly fine sandy loam
14 to 22 inches—dark yellowish brown, mottled sandy clay loam that is penetrated by tongues and interfingerings of grayish brown fine sandy loam
22 to 31 inches—dark yellowish brown, mottled sandy clay loam
31 to 45 inches—yellowish brown, mottled fine sandy loam
45 to 60 inches—light olive brown, mottled, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderately low
Surface runoff: Slow
Depth to the water table: 2.5 to 5.0 feet
Special characteristics: Stones and cobbles on the surface in many areas

Inclusions

Contrasting inclusions:
• The moderately well drained Bemidji soils, which are in adjacent areas and have a sandy mantle that is 20 to 40 inches thick
• The well drained Sol soils, which are in the more sloping areas
• The somewhat poorly drained Stuntz soils, which are in swales and concave basins

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of cobbly sandy loam or loam
• Soils that have free carbonates at a depth of less than 40 inches
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that do not contain cobbles or that have fewer cobbles

Use and Management

Cropland

Major management factors: Rock fragments, water erosion, and organic matter content
• The major crops are small grain, corn, and forage plants.
• Cobbles and stones on or near the surface cause rapid wear of equipment and may limit tillage (fig. 7).
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize soil compaction.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, northern red oak, and American elm are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Stones and boulders on the surface can interfere with the use of harvesting equipment.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Figure 7.—An area of Nary cobbly fine sandy loam. Cobbles and stones on or near the surface of this soil can interfere with the use of equipment.

Pasture

Major management factors: Forage quality

• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.

• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIIs
Woodland ordination symbol: 7L
Windbreak suitability group: 1

1991—Stuntz loam

Composition

Stuntz soil and similar soils: 88 to 98 percent
Contrasting inclusions: 2 to 12 percent

Setting

Landform and position on the landform: Swales and concave basins on moraines and till plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

0 to 6 inches—black loam
6 to 16 inches—grayish brown fine sandy loam
16 to 30 inches—brown, mottled loam that is penetrated by tongues and interfingerings of light brownish gray fine sandy loam
30 to 46 inches—olive brown, mottled clay loam
46 to 60 inches—light olive brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Depth to the water table: 1.5 to 3.0 feet
Special characteristics: Stones and cobbles on the surface in many areas

Inclusions

Contrasting inclusions:
• The moderately well drained Bemidji soils, which are on plane or slightly convex rises and have a sandy mantle that is 20 to 40 inches thick
• The very poorly drained Hamre soils, which are in closed depressions and have a thin organic surface layer
• The moderately well drained Nary soils, which are on plane or slightly convex rises

Similar soils:
• Soils that have a thicker surface layer
• Soils that have a surface layer of fine sandy loam or sandy loam
• Soils in which material from the subsurface layer does not tongue and interfinger into the subsoil
• Soils that have more cobbles
• Soils that have free carbonates at a depth of 52 to 60 inches

Use and Management

Cropland

Major management factors: Wetness
• The major crops are small grain, corn, and forage plants.
• The seasonal high water table provides supplemental moisture for plants.
• Working the soil when it is too wet can result in severe compaction and the formation of clods.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.

Woodland

Major management factors: Equipment limitations, seedling mortality, plant competition, and windthrow
• The principal tree species is quaking aspen.
• Paper birch, American elm, white spruce, and balsam fir are tree species of limited extent.
• The use of equipment is restricted during spring thaw and other excessively wet periods.
• Because of the seasonal high water table, equipment should be used only during dry summer months and during winter months when the soil is adequately frozen.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.
• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Plant competition prevents natural or planted regeneration unless precautionary measures are taken.
• Undesirable plants that invade clear-cut areas may prevent the establishment of desired species.
• Trees may be shallow rooted because of the seasonal high water table, and some trees may be blown down during periods of high winds and excessive wetness.
• The seedling mortality rate may be moderate because of the seasonal high water table, but the seedling mortality rate can be reduced by planting vigorous nursery stock on microsites that are elevated above the water table and by planting species and varieties that are adapted to wet soils.

Pasture

Major management factors: Forage quality and wetness
• Rotating grazing, applying fertilizer, and deferring grazing during wet periods help to maintain the quality and quantity of forage plants.

Windbreaks

• Trees and shrubs that can tolerate wetness should be selected for windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIw
Woodland ordination symbol: 7W
Windbreak suitability group: 2

1993B—Snellman-Wykeham complex, 1 to 6 percent slopes

Composition

Snellman soil and similar soils: 40 to 60 percent
Wykeham soil and similar soils: 30 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Snellman—side slopes and hilltops on moraines and till plains; Wykeham—plane or slightly concave basins on moraines and till plains
Shape of areas: Irregular
Size of areas: 40 to 300 acres

Typical Profile

Snellman

0 to 5 inches—very dark grayish brown fine sandy loam
5 to 13 inches—brown fine sandy loam
13 to 20 inches—dark yellowish brown sandy clay loam that has interfingerings of brown fine sandy loam
20 to 28 inches—dark yellowish brown sandy clay loam
28 to 60 inches—light olive brown, calcareous fine sandy loam

Wykeham

0 to 8 inches—very dark gray fine sandy loam
8 to 14 inches—grayish brown fine sandy loam
14 to 22 inches—brown, mottled loam that has interfingerings of grayish brown fine sandy loam
22 to 32 inches—brown, mottled loam
32 to 60 inches—olive brown, mottled, calcareous fine sandy loam

Soil Properties and Qualities

Drainage class: Snellman—well drained; Wykeham—moderately well drained
Permeability: Moderate
Available water capacity: Moderate
Organic matter content: Snellman—moderately low; Wykeham—moderate
Surface runoff: Medium
Depth to the water table: Snellman—more than 6.0 feet; Wykeham—2.5 to 4.0 feet
Special characteristics: A few stones and cobbles on the surface in some areas

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are on adjacent side slopes and hilltops and have a sandy mantle that is more than 20 inches thick
• The moderately well drained Eckvoll soils, which are in concave basins and have a sandy mantle that is more than 20 inches thick
• The poorly drained Shooker soils, which are in swales and concave basins

Similar soils:
• Soils in which material from the subsurface layer does not interfinger into the subsoil
• Soils that have more clay
• Soils that are leached of free carbonates to a depth of more than 40 inches
• Soils that have a surface layer of sandy loam or loam

Use and Management

Cropland

Major management factors: Water erosion and organic matter content
• The major crops are small grain, corn, and forage plants.
• Using tillage practices that leave crop residue on the surface helps to control water erosion and soil blowing.
• Using a cropping system that includes grasses or legumes, rotating crops, and returning crop residue to the soil help to maintain the content of organic matter and improve fertility and tilth.
• Returning crop residue to the soil and deferring field traffic when the soil is wet can minimize soil compaction.
• Using a balanced soil fertility program that is based on the results of soil tests increases crop production.

Woodland

Major management factors: Equipment limitations and plant competition
• The principal tree species is quaking aspen.
• Sugar maple, American basswood, white spruce, northern red oak, and eastern white pine are tree species of limited extent.
• The use of equipment is briefly restricted during spring thaw and other excessively wet periods.
• Operating heavy equipment when the soil is wet can result in excessive rut formation and soil compaction and can permanently damage the site.

• Ruts form easily if skidders are used when the soil is wet.
• Deep ruts can restrict lateral drainage and alter soil structure, which results in damage to tree roots and affects natural regeneration.
• Limiting the use of heavy equipment during spring thaw and after heavy rains helps to prevent soil compaction.
• Converting sites from northern hardwoods to conifers requires intensive management.
• If conifer species are planted, suckering and competition from hardwood seedlings are severe.
• Mechanical or chemical site preparation is needed to control competing vegetation.
• Establishing filter strips in areas adjacent to lakes and perennial or intermittent streams minimizes water contamination caused by the runoff of sediment and other pollutants.

Pasture

Major management factors: Forage quality
• Rotating grazing and applying fertilizer according to the results of soil tests help to maintain the quality and quantity of forage plants.

Windbreaks

• A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings.

Wildlife habitat

• Commercial aspen management practices are needed for the economical management of habitat for deer and ruffed grouse.
• Block plantings of suitable trees and shrubs can provide winter cover for upland wildlife.

Interpretive Groups

Land capability classification: IIe
Woodland ordination symbol: 6L

Descriptions of Soils in the Chippewa National Forest

H87—Suomi-Aeric Glossaqualfs, loamy association, nearly level and undulating

Composition

Suomi soil and similar soils: 40 to 50 percent
Aeric Glossaqualfs and similar soils: 25 to 35 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Suomi—plane or slightly convex side slopes on moraines; Aeric Glossaqualfs—plane or slightly concave toe slopes, depressions, and drainageways on moraines
Slope range: Suomi—0 to 8 percent; Aeric Glossaqualfs—0 to 2 percent
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 15 to 280 acres

Sample Profile

Suomi

0 to 5 inches—dark grayish brown silt loam
5 to 14 inches—dark brown very fine sandy loam
14 to 23 inches—brown very fine sandy loam
23 to 28 inches—dark brown very fine sandy loam and brown clay loam
28 to 34 inches—brown, mottled silty clay loam
34 to 37 inches—yellowish brown, mottled silty clay loam
37 to 60 inches—yellowish brown, mottled clay loam

Aeric Glossaqualfs

0 to 5 inches—gray fine sandy loam
5 to 9 inches—brown fine sandy loam
9 to 13 inches—yellowish brown, mottled fine sandy loam
13 to 24 inches—gray, mottled fine sandy loam and dark brown, mottled clay loam
24 to 35 inches—dark yellowish brown, mottled clay loam
35 to 60 inches—dark brown, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Suomi—moderately well drained; Aeric Glossaqualfs—somewhat poorly drained
Permeability: Suomi—moderate in the upper part, slow in the lower part; Aeric Glossaqualfs—moderately rapid or moderate in the upper part, moderately slow or slow in the lower part
Available water capacity: Suomi—high; Aeric Glossaqualfs—high
Organic matter content: Moderate or moderately low
Surface runoff: Suomi—medium; Aeric Glossaqualfs—slow
Depth to the water table: Suomi—1.0 to 2.0 feet; Aeric Glossaqualfs—1.5 to 3.0 feet

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in depressions
• The well drained Warba soils on convex slopes
• Very poorly drained mineral soils in swales and depressions

H88—Suomi-Aeric Glossaqualfs, loamy association, gently undulating to hilly

Composition

Suomi soil and similar soils: 40 to 50 percent
Aeric Glossaqualfs and similar soils: 30 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Suomi—side slopes and shoulders on moraines; Aeric Glossaqualfs—foot slopes and toe slopes on moraines
Slope range: Suomi—8 to 25 percent; Aeric Glossaqualfs—1 to 3 percent
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 15 to 280 acres

Sample Profile

Suomi

0 to 5 inches—dark grayish brown silt loam
5 to 14 inches—dark brown very fine sandy loam
14 to 23 inches—brown very fine sandy loam
23 to 28 inches—dark brown very fine sandy loam and brown clay loam
28 to 34 inches—brown, mottled silty clay loam
34 to 37 inches—yellowish brown, mottled silty clay loam
37 to 60 inches—yellowish brown, mottled clay loam

Aeric Glossaqualfs

0 to 5 inches—gray fine sandy loam
5 to 9 inches—brown fine sandy loam
9 to 13 inches—yellowish brown, mottled fine sandy loam
13 to 24 inches—gray, mottled fine sandy loam and dark brown, mottled clay loam
24 to 35 inches—dark yellowish brown, mottled clay loam
35 to 60 inches—dark brown, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Suomi—moderately well drained; Aeric Glossaqualfs—somewhat poorly drained
Permeability: Suomi—moderate in the upper part, slow in the lower part; Aeric Glossaqualfs—moderately rapid or moderate in the upper part, moderate to slow in the lower part
Available water capacity: High
Organic matter content: Moderate or moderately low
Surface runoff: Suomi—medium; Aeric Glossaqualfs—slow
Depth to the water table: Suomi—1.0 to 2.0 feet; Aeric Glossaqualfs—1.5 to 3.0 feet

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in depressions
• The well drained Warba soils, which are on convex slopes
• Very poorly drained mineral soils in swales and depressions

H94—Typic Ochraqualfs, ponded

Composition

Typic Ochraqualfs and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Depressions, drainageways, and flats on moraines and outwash plains
Slope range: 0 to 2 percent
Shape of areas: Circular or elongated
Size of areas: 5 to 150 acres

Sample Profile

0 to 5 inches—black silt loam
5 to 10 inches—gray, mottled very fine sandy loam
10 to 19 inches—dark gray and gray, mottled gravelly loam
19 to 26 inches—olive gray, mottled clay loam
26 to 35 inches—olive gray and olive, mottled clay loam
35 to 44 inches—olive gray, mottled loam
44 to 49 inches—olive gray and light olive gray, mottled loam
49 to 60 inches—light olive gray and olive gray, mottled loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Very slow or ponded
Seasonal high water table: 2 feet above to 2 feet below the surface
Special characteristics: Ponding in spring

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in landscape positions similar to those of the Typic Ochraqualfs

Similar soils:
• Mineral soils that are better drained

J5—Alfic Udipsamments, nearly level and undulating

Composition

Alfic Udipsamments and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains
Slope range: 0 to 8 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 10 to 100 acres

Sample Profile

0 to 3 inches—black grayish brown loamy sand
3 to 17 inches—yellowish brown and brown fine sand and loamy fine sand
17 to 26 inches—light yellowish brown fine sand
26 to 58 inches—light brownish gray and brown fine sand and sand with bands of yellowish brown sandy loam and dark brown fine sandy loam and loamy sand
58 to 60 inches—light brownish gray sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are on isolated swells and have more clay in the subsoil and underlying material than the Alfic Udipsamments
• The moderately well drained Hiwood soils, which are in the lower landscape positions and are not banded
• The somewhat poorly drained Redby soils, which are in the lower, nearly level areas

Similar soils:
• Soils that do not have thin, fine textured bands
• Soils that have fine textured bands having a total thickness of more than 6 inches
• Soils that have more clay in the surface layer

J6—Graycalm-Typic Udipsamments association, nearly level and undulating

Composition

Graycalm soil and similar soils: 45 to 55 percent
Typic Udipsamments and similar soils: 30 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines and outwash plains
Slope range: 0 to 8 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 15 to 450 acres

Sample Profile

Graycalm

0 to 5 inches—very dark gray loamy sand
5 to 9 inches—dark yellowish brown loamy sand
9 to 32 inches—yellowish brown sand
32 to 46 inches—light yellowish brown sand that has several thin bands of dark yellowish brown loamy sand
46 to 60 inches—pale brown sand

Typic Udipsamments

0 to 3 inches—very dark grayish brown loamy sand
3 to 36 inches—yellowish brown sand
36 to 60 inches—light yellowish brown coarse sand and sand

Soil Properties and Qualities

Drainage class: Graycalm—somewhat excessively drained; Typic Udipsamments—excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The well drained Warba soils, which are on isolated swells and have more clay in the subsoil and underlying material than the major soils
• The moderately well drained Hiwood soils, which are in the lower landscape positions and are not banded
• The somewhat poorly drained Redby soils, which are in the lower, nearly level areas
• Very poorly drained mineral soils in drainageways and depressions

Similar soils:
• Soils that have loamy underlying material

J7—Warba-Stuntz association, nearly level and undulating

Composition

Warba soil and similar soils: 40 to 45 percent

Stuntz soil and similar soils: 35 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Warba—side slopes and summits on moraines; Stuntz—plane or slightly concave toe slopes, depressions, and drainageways on moraines
Slope range: Warba—1 to 8 percent; Stuntz—0 to 2 percent
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 15 to 1,000 acres

Sample Profile

Warba

0 to 1 inch—black very fine sandy loam
1 to 3 inches—dark grayish brown fine sandy loam
3 to 9 inches—yellowish brown fine sandy loam
9 to 14 inches—light brownish gray fine sandy loam
14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam
18 to 28 inches—olive brown loam
28 to 36 inches—olive brown clay loam
36 to 40 inches—light olive brown clay loam
40 to 60 inches—light olive brown loam

Stuntz

1 inch to 0—black, slightly decomposed forest litter
0 to 1 inch—very dark gray silt loam
1 to 5 inches—grayish brown and light grayish brown very fine sandy loam
5 to 10 inches—light brownish gray, mottled very fine sandy loam
10 to 17 inches—grayish brown, mottled very fine sandy loam and olive brown and grayish brown, mottled sandy clay loam
17 to 22 inches—olive brown, mottled sandy clay loam and grayish brown, mottled very fine sandy loam
22 to 27 inches—olive brown, mottled sandy clay loam
27 to 34 inches—light olive brown, mottled clay loam
34 to 39 inches—light olive brown, mottled loam
39 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Warba—well drained; Stuntz—somewhat poorly drained
Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Stuntz—moderately rapid in the upper part, moderately slow in the lower part
Available water capacity: High
Organic matter content: Warba—moderate; Stuntz—moderately low or moderate
Surface runoff: Warba—slow or medium; Stuntz—slow
Depth to the water table: Warba—more than 6.0 feet; Stuntz—1.5 to 3.0 feet

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in small depressions
• Well drained soils that have 20 to 40 inches of sandy material overlying the loamy subsoil; in landscape positions similar to those of the Warba and Stuntz soils

J8—Glossic Eutroboralfs, loamy, rolling and hilly

Composition

Glossic Eutroboralfs and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and shoulders on moraines
Slope range: 8 to 20 percent
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 15 to 500 acres

Sample Profile

0 to 1 inch—very dark gray very fine sandy loam
1 to 6 inches—pale brown very fine sandy loam
6 to 18 inches—yellowish brown very fine sandy loam
18 to 23 inches—pale brown very fine sandy loam and dark yellowish brown sandy loam
23 to 26 inches—dark yellowish brown sandy loam and pale brown very fine sandy loam
26 to 48 inches—dark yellowish brown sandy loam
48 to 56 inches—brown sandy loam
56 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderately rapid to moderately slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Rapid
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils in small depressions
• The well drained Cutaway soils, which are in landscape positions similar to those of the Glossic Eutroboralfs and have 20 to 40 inches of sandy material overlying the loamy subsoil
• The somewhat poorly drained Stuntz soils, which are on toe slopes and in swales

Similar soils:
- Soils that have sandy underlying material
- Soils that have slightly more clay in the subsoil

J9—Aeric Glossaqualfs, clayey subsoil

Composition

Aeric Glossaqualfs and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Slight depressions and toe slopes on moraines
Slope range: 0 to 3 percent
Shape of areas: Moderately long and narrow with curvilinear edges
Size of areas: 5 to 500 acres

Sample Profile

0 to 2 inches—dark grayish brown fine sandy loam
2 to 9 inches—grayish brown, mottled loamy fine sand
9 to 13 inches—grayish brown and dark yellowish brown, mottled clay loam
13 to 19 inches—dark yellowish brown and pale brown, mottled clay loam
19 to 33 inches—brown, mottled silty clay
33 to 60 inches—brown, mottled silt loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part; moderately slow or slow in the lower part
Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:
- Very poorly drained organic soils in depressions
- The well drained Warba soils, which are on convex slopes
- Very poorly drained mineral soils in swales and depressions

Similar soils:
- Soils that are better drained

J10—Aqualfs

Composition

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

Setting

Landform and position on the landform: Depressions and drainageways on moraines
Slope range: 0 to 2 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 5 to 120 acres

Sample Profile

1 inch to 0—slightly decomposed forest litter
0 to 2 inches—very dark gray loamy fine sand
2 to 6 inches—light gray loamy fine sand
6 to 12 inches—pale brown, mottled loamy fine sand
12 to 17 inches—dark yellowish brown, mottled fine sandy loam
17 to 31 inches—dark grayish brown, mottled clay loam
31 to 37 inches—brown, mottled clay loam
37 to 60 inches—light brownish gray, mottled clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained and poorly drained
Permeability: Moderately rapid or moderate in the upper part; moderate or moderately slow in the lower part
Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 1.0 foot to 2.5 feet

Inclusions

Contrasting inclusions:
- Very poorly drained organic soils in depressions
- The well drained Warba soils on convex slopes
- The very poorly drained mineral soils in swales and depressions

Similar soils:
- Soils that have layers of silt loam or silty clay loam in the subsoil and underlying material
- Soils in which the high water table is closer to the surface

J11—Warba-Stuntz-Arenic Eutroboralfs association, nearly level and undulating

Composition

Warba soil and similar soils: 35 to 40 percent
Stuntz soil and similar soils: 30 to 35 percent
Arenic Eutroboralfs and similar soils: 15 to 20 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Warba—plane or convex side slopes on moraines; Stuntz—plane or slightly concave toe slopes, depressions, and

drainageways on moraines; Arenic Eutroboralfs—convex side slopes and summits on moraines
Slope range: Warba—1 to 8 percent; Stuntz—0 to 2 percent; Arenic Eutroboralfs—0 to 8 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 10 to 250 acres

Sample Profile

Warba

0 to 2 inches—very dark brown fine sandy loam
2 to 12 inches—brown fine sandy loam
12 to 16 inches—brown fine sandy loam that tongues into dark yellowish brown loam
16 to 22 inches—dark yellowish brown clay loam that has interfingerings of brown fine sandy loam
22 to 35 inches—dark yellowish brown clay loam
35 to 60 inches—light olive brown, calcareous loam

Stuntz

1 inch to 0—black, slightly decomposed forest litter
0 to 1 inch—very dark gray silt loam
1 to 5 inches—grayish brown and light grayish brown very fine sandy loam
5 to 10 inches—light brownish gray, mottled very fine sandy loam
10 to 17 inches—grayish brown, mottled very fine sandy loam and olive brown and grayish brown, mottled sandy clay loam
17 to 22 inches—olive brown, mottled sandy clay loam and grayish brown, mottled very fine sandy loam
22 to 27 inches—olive brown, mottled sandy clay loam
27 to 34 inches—light olive brown, mottled clay loam
34 to 39 inches—light olive brown, mottled loam
39 to 60 inches—light olive brown loam

Arenic Eutroboralfs

0 to 1 inch—very dark gray loamy fine sand
1 to 6 inches—dark grayish brown loamy fine sand
6 to 10 inches—dark brown loamy fine sand
10 to 20 inches—brown loamy fine sand
20 to 30 inches—yellowish brown sand
30 to 36 inches—dark yellowish brown sandy loam
36 to 60 inches—light olive brown silty clay loam

Soil Properties and Qualities

Drainage class: Warba—well drained; Stuntz—somewhat poorly drained; Arenic Eutroboralfs—well drained
Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Stuntz—moderately rapid in the upper part, moderately slow in the lower part; Arenic Eutroboralfs—rapid in the upper part, moderately slow in the lower part
Available water capacity: Warba—high; Stuntz—high; Arenic Eutroboralfs—moderate
Organic matter content: Warba—moderate; Stuntz—moderately low or moderate; Arenic Eutroboralfs—low or moderately low
Surface runoff: Warba—slow or medium; Stuntz—slow; Arenic Eutroboralfs—slow
Depth to the water table: Warba—more than 6 feet; Stuntz—1.5 to 3.0 feet; Arenic Eutroboralfs—more than 6 feet

Inclusions

Contrasting inclusions:
• Very poorly drained mineral soils in shallow depressions
• Very poorly drained organic soils in the deeper depressions
• Somewhat poorly drained soils that are sandy throughout or that are underlain by loamy material
Similar soils:
• Soils that are moderately well drained

J12—Warba-Histosols association, nearly level to gently rolling

Composition

Warba soil and similar soils: 45 to 55 percent
Histosols and similar soils: 30 to 35 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform and position on the landform: Warba—side slopes, shoulders, and summits on moraines; Histosols—depressions on moraines
Slope range: Warba—1 to 12 percent; Histosols—0 to 2 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 40 to 200 acres

Sample Profile

Warba

0 to 2 inches—very dark brown fine sandy loam
2 to 12 inches—brown fine sandy loam
12 to 16 inches—brown fine sandy loam that tongues into dark yellowish brown loam
16 to 22 inches—dark yellowish brown clay loam that has interfingerings of brown fine sandy loam
22 to 35 inches—dark yellowish brown clay loam
35 to 60 inches—light olive brown, calcareous loam

Histosols

0 to 17 inches—black mucky peat
17 to 32 inches—very dark gray mucky peat
32 to 45 inches—dark brown muck

45 to 60 inches—black muck

Soil Properties and Qualities

Drainage class: Warba—well drained; Histosols—very poorly drained
Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Histosols—moderately slow to rapid
Available water capacity: Warba—high; Histosols—very high
Organic matter content: Warba—moderate; Histosols—very high
Surface runoff: Warba—medium or rapid; Histosols—very slow
Seasonal high water table: Warba—at a depth of more than 6 feet; Histosols—2 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• The well drained Cutaway soils, which are in landscape positions similar to those of the major soils and have 20 to 40 inches of sandy material overlying a loamy subsoil
• The somewhat poorly drained Stuntz soils, which are on toe slopes or in swales
• The excessively drained Menahga soils, which are in landscape positions similar to those of the major soils and are sandy throughout
• Very poorly drained, sandy soils that are on the edges of depressions

Similar soils:
• Soils that have slightly more clay in the subsoil
• Soils that are moderately well drained

J19—Aquic Eutroboralfs, loamy, nearly level and undulating

Composition

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

Setting

Landform and position on the landform: Convex to concave foot slopes on moraines and outwash plains
Slope range: 0 to 8 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 15 to 450 acres

Sample Profile

0 to 2 inches—very dark gray fine sandy loam
2 to 4 inches—grayish brown fine sandy loam
4 to 8 inches—yellowish brown loamy fine sand
8 to 16 inches—light yellowish brown, mottled sandy loam
16 to 47 inches—yellowish brown loam
47 to 60 inches—yellowish brown sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Permeability: Moderately rapid or moderate
Available water capacity: Moderate
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:
• The well drained Warba soils, which are on convex rises
• The well drained Cutaway soils, which are in the higher landscape positions and have a sandy mantle

Similar soils:
• Soils that have a clayey subsoil

N77—Udipsamments, nearly level and undulating

Composition

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

Setting

Landform and position on the landform: Side slopes and summits on outwash plains
Slope range: 0 to 8 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 15 to 450 acres

Sample Profile

0 to 1 inch—very dark gray fine sand
1 to 4 inches—dark gray fine sand
4 to 8 inches—dark yellowish brown fine sand
8 to 18 inches—yellowish brown fine sand
18 to 60 inches—light yellowish brown fine sand

Soil Properties and Qualities

Depth: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Redby soils, which are in the lower landscape positions
• Very poorly drained mineral soils in drainageways and depressions
• Very poorly drained organic soils in drainageways and depressions

Similar soils:
• Soils that have loamy underlying material
• Soils that have thin bands of fine textured material

N78—Psammentic Eutroboralfs, sandy, nearly level and undulating

Composition

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

Setting

Landform and position on the landform: Side slopes and summits on outwash plains
Slope range: 0 to 8 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 15 to 450 acres

Sample Profile

2 inches to 0—moderately decomposed forest litter
0 to 2 inches—very dark grayish brown loamy sand
2 to 12 inches—brown loamy sand
12 to 26 inches—dark yellowish brown sand
26 to 34 inches—dark yellowish brown gravelly loamy coarse sand
34 to 48 inches—yellowish brown sand
48 to 58 inches—pale brown coarse sand
58 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Well drained and excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Redby soils, which are in the lower landscape positions
• Very poorly drained mineral soils in drainageways and depressions
• Very poorly drained organic soils in drainageways and depressions

Similar soils:
• Soils that have loamy underlying material

N79—Psammentic Eutroboralfs, sandy, rolling and hilly

Composition

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

Setting

Landform and position on the landform: Side slopes and shoulders on outwash plains
Slope range: 8 to 20 percent
Shape of areas: Moderately long and narrow with curvilinear edges
Size of areas: 15 to 300 acres

Sample Profile

2 inches to 0—moderately decomposed forest litter
0 to 2 inches—very dark gray loamy sand
2 to 9 inches—brown loamy sand
9 to 19 inches—dark yellowish brown sand
19 to 25 inches—cobbly coarse sand
25 to 31 inches—dark brown loamy coarse sand
31 to 40 inches—yellowish brown sand
40 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Well drained and somewhat excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow or medium
Depth to the water table: More than 6 feet

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Redby soils, which are in the lower landscape positions
• Very poorly drained mineral soils in drainageways and depressions
• Very poorly drained organic soils in drainageways and depressions

Similar soils:
• Soils that have loamy underlying material

N80—Cutaway-Hiwood association, nearly level and undulating

Composition

Cutaway soil and similar soils: 40 to 50 percent
Hiwood soil and similar soils: 25 to 35 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Cutaway—side slopes and summits; Hiwood—slight rises and shallow drainageways on outwash plains
Slope range: Cutaway—0 to 8 percent; Hiwood—0 to 2 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 10 to 250

Sample Profile

Cutaway

0 to 1 inch—very dark gray loamy sand
1 to 2 inches—dark gray loamy sand
2 to 9 inches—brown sand
9 to 22 inches—light yellowish brown sand
22 to 27 inches—pale brown sand
27 to 31 inches—yellowish brown loamy sand and loam
31 to 42 inches—brown loam
42 to 48 inches—light olive brown sandy loam
48 to 60 inches—light yellowish brown, calcareous sandy loam

Hiwood

0 to 2 inches—very dark brown loamy fine sand
2 to 5 inches—very dark grayish brown loamy fine sand
5 to 9 inches—dark brown loamy fine sand
9 to 14 inches—dark yellowish brown loamy fine sand
14 to 30 inches—yellowish brown, mottled loamy fine sand
30 to 60 inches—grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Cutaway—well drained; Hiwood—moderately well drained
Permeability: Cutaway—rapid in the upper part, moderately slow or slow in the lower part; Hiwood—rapid
Available water capacity: Cutaway—moderate; Hiwood—low
Organic matter content: Cutaway—low or moderately low; Hiwood—low or moderately low
Surface runoff: Slow
Depth to the water table: Cutaway—more than 6 feet; Hiwood—2 to 5 feet

Inclusions

Contrasting inclusions:
• The well drained Warba soils, which are in landscape positions similar to those of the Cutaway and Hiwood soils and are loamy throughout
• The excessively drained Menahga soils, which are in landscape positions similar to those of the Cutaway and Hiwood soils and are sandy throughout
• Very poorly drained mineral and organic soils in depressions and drainageways

Similar soils:
• Soils that have a sandy mantle that is thinner or thicker

N84—Humaquepts

Composition

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

Setting

Landform and position on the landform: Depressions on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 5 to 120 acres

Sample Profile

4 inches to 0—dark reddish brown muck
0 to 4 inches—dark gray and gray fine sandy loam
4 to 10 inches—light brownish gray loamy fine sand
10 to 29 inches—light olive gray, mottled fine sand
29 to 60 inches—gray, mottled fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained and very poorly drained
Permeability: Rapid to moderate
Available water capacity: Low to moderate
Organic matter content: Moderate to high
Surface runoff: Very slow or slow
Seasonal high water table: At the surface to 2 feet below the surface

Inclusions

Contrasting inclusions:
• Areas that are better drained
• Organic soils that are near the center of depressions

Similar soils:
• Soils that have a thicker organic layer

O92—Hiwood-Zimmerman association, nearly level to hilly

Composition

Hiwood soil and similar soils: 40 to 50 percent
Zimmerman soil and similar soils: 35 to 40 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform and position on the landform: Hiwood—slightly convex swells on outwash plains; Zimmerman—plane or slightly convex back slopes, shoulders, and summits on outwash plains
Slope range: Hiwood—0 to 3 percent; Zimmerman—0 to 20 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 15 to 450 acres

Sample Profile

Zimmerman

1 inch to 0—black forest litter
0 to 1 inch—very dark grayish brown fine sand
1 to 4 inches—dark gray fine sand
4 to 9 inches—dark yellowish brown fine sand
9 to 16 inches—light yellowish brown fine sand
16 to 26 inches—yellowish brown fine sand
26 to 41 inches—pale brown fine sand
41 to 60 inches—pale brown fine sand and thin bands of brown loamy fine sand

Hiwood

0 to 2 inches—very dark brown loamy fine sand
2 to 5 inches—very dark grayish brown loamy fine sand
5 to 9 inches—dark brown loamy fine sand
9 to 14 inches—dark yellowish brown loamy fine sand
14 to 30 inches—yellowish brown, mottled loamy fine sand
30 to 60 inches—grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Hiwood—moderately well drained; Zimmerman—excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Hiwood—slow; Zimmerman—slow or medium
Depth to the water table: Hiwood—2 to 5 feet; Zimmerman—more than 6 feet

Inclusions

Contrasting inclusions:
• Somewhat poorly drained and very poorly drained soils in shallow depressions
• Very poorly drained organic soils that are in the deeper depressions
• Soils that are loamy throughout or that are underlain by loamy sediments

Similar soils:
• Soils that have thin lenses of gravelly material
• Soils that have thin lenses of silty material

O94—Redby fine sand

Composition

Redby soil and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Plane or concave foot slopes and toe slopes on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 15 to 350 acres

Sample Profile

0 to 3 inches—very dark brown fine sand
3 to 5 inches—very dark grayish brown loamy fine sand
5 to 9 inches—dark brown loamy fine sand
9 to 14 inches—brown, mottled loamy fine sand
14 to 27 inches—yellowish brown, mottled loamy fine sand
27 to 60 inches—grayish brown, mottled loamy fine sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: 1.5 to 3.0 feet

Inclusions

Contrasting inclusions:
• Well drained or excessively drained soils in the more sloping areas
• Very poorly drained mineral soils in shallow depressions
• Very poorly drained organic soils in the deeper depressions

Similar soils:
• Soils that have thin bands of fine textured material in the subsoil

O97—Humaquepts, sandy

Composition

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

Setting

Landform and position on the landform: Depressions and drainageways on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and narrow with curvilinear edges
Size of areas: 20 to 300

Sample Profile

4 inches to 0—black muck
0 to 6 inches—very dark gray fine sand
6 to 26 inches—gray, mottled fine sand
26 to 40 inches—light brownish gray, mottled sand
40 to 60 inches—dark gray, mottled fine sand

Soil Properties and Qualities

Drainage class: Poorly drained and very poorly drained
Permeability: Rapid or moderately rapid
Available water capacity: Moderate or high
Organic matter content: Moderate or high
Surface runoff: Very slow
Seasonal high water table: At the surface to 1 foot below the surface

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils
• Soils in the more sloping areas that are better drained
• Very poorly drained mineral soils that are loamy throughout
• Areas that are ponded

Similar soils:
• Soils that have a thin organic surface layer
• Soils that have a loamy surface layer

X01—Histosols, depressional

Composition

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

Setting

Landform and position on the landform: Closed depressions on moraines and outwash plains
Slope range: 0 to 2 percent
Shape of areas: Circular or elongated
Size of areas: 5 to 20 acres

Sample Profile

0 to 15 inches—black muck
15 to 23 inches—very dark gray muck
23 to 49 inches—reddish brown mucky peat
49 to 60 inches—very dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:
• Mineral soils in sloping areas that are better drained than the Histosols

Similar soils:
• Mineral soils that are very poorly drained

X02—Typic Borohemists, acid

Composition

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

Setting

Landform and position on the landform: Broad flats and depressions on moraines and outwash plains
Slope range: 0 to 2 percent
Shape of areas: Long and wide with curvilinear edges
Size of areas: 20 to 2,500 acres

Sample Profile

0 to 60 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:
• Very poorly drained mineral soils on the edges of depressions and drainageways

Similar soils:
• Less acid soils that formed in predominantly woody fibers

• Soils that are more decomposed throughout
• Soils that have finer textured underlying material

X03—Typic Borohemists, nonacid-Typic Borosaprists association

Composition

Typic Borohemists and similar soils: 40 to 50 percent
Typic Borosaprists and similar soils: 30 to 40 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Depressions on outwash plains and moraines
Slope range: 0 to 2 percent
Shape of areas: Circular or moderately long and wide with smooth edges
Size of areas: 40 to 1,000 acres

Sample Profile

Typic Borohemists

0 to 15 inches—dark reddish brown mucky peat
15 to 26 inches—very dark grayish brown mucky peat
26 to 50 inches—dark reddish brown mucky peat
50 to 60 inches—dark brown mucky peat

Typic Borosaprists

0 to 20 inches—black muck
20 to 60 inches—dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Borohemists—moderately rapid or moderate; Borosaprists—moderately slow to moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils, in raised areas in large bogs, that are more acid than the major soils
• Very poorly drained mineral soils on the edges of depressions
Similar inclusions:
• Soils that have sandy or loamy underlying material at a depth of less than 51 inches
• Soils that are subject to ponding for short periods

X04—Typic Borosaprists-Bowstring association

Composition

Typic Borosaprists and similar soils: 40 to 50 percent
Bowstring soil and similar soils: 35 to 45 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Flood plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 15 to 800 acres

Sample Profile

Typic Borosaprists

0 to 20 inches—black muck
20 to 60 inches—dark brown muck

Bowstring

0 to 10 inches—very dark brown muck
10 to 28 inches—dark reddish brown muck
28 to 34 inches—very dark gray sand
34 to 50 inches—dark reddish brown muck
50 to 60 inches—very dark grayish brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 2 feet above to 2 feet below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils that are not subject to flooding
Similar inclusions:
• Mineral soils that are subject to occasional flooding

X05—Typic Borohemists, nonacid

Composition

Typic Borohemists: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and broad basins on moraines and outwash plains
Slope range: 0 to 2 percent

Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 80 to 600 acres

Sample Profile

0 to 15 inches—dark reddish brown mucky peat
15 to 26 inches—very dark grayish brown mucky peat
26 to 50 inches—dark reddish brown mucky peat
50 to 60 inches—dark brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:
• Very poorly drained organic soils, in raised areas in large bogs, that are more acid than the Typic Borohemists
• Very poorly drained mineral soils on the edges of depressions and drainageways

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 306,765 acres in Beltrami County is prime farmland. Most of this land is in the basin of glacial Lake Agassiz, which is in the northwestern part of the county. Most areas consist of nearly level, poorly drained, dark prairie soils. Small grain is grown extensively in these areas.

Some areas of prime farmland form a band that runs from east to west across the central part of the county. These areas consist mostly of gently sloping or sloping, moderately well drained and well drained, light colored forest soils. Small grain, hay, and corn for silage are grown extensively in these areas.

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.

In 1984, about 134,800 acres in Beltrami County was suitable for crops. Of this acreage, 92,700 acres was used for crops, 23,900 acres was used for grazing, and 18,200 acres was idle land. Of the acreage used for crops, 14,700 acres was used for oats, 8,600 acres for wheat, 5,000 acres for barley, 1,800 acres for rye, 5,700 acres for corn as silage, and 4,600 acres for corn as grain. Small acreages were used for sunflowers and flax. About 2,900 acres was irrigated. Most of the irrigated areas were flooded wild rice paddies. A small acreage of potatoes was grown using center-pivot irrigation. Small acreages of vegetable and fruit crops were grown using trickle irrigation. Alfalfa and other hay crops were harvested from 48,200 acres. Areas of pasture and rangeland that were unsuitable for use as cropland covered 23,400 acres. Woodland and woodland pasture covered another 71,300 acres.

Cropland areas in the basin of glacial Lake Agassiz are mostly poorly drained, and a network of deep judicial ditches and shallow private ditches has been installed. The soils in these areas, such as Smiley and Kratka soils, have a dark surface layer because they have a high content of organic matter. The high content of organic matter makes these soils friable and easy to till, but it also makes them susceptible to soil blowing. Conservation tillage practices that leave crop residue on the surface can reduce the hazard of soil blowing.

Sandy soils, such as Eckvoll and Redby soils, are very susceptible to soil blowing. Field windbreaks may be needed to minimize soil loss in areas of these soils. A few soils, such as Rockwell and Rosewood soils, have a nutrient imbalance and are subject to wetness and erosion. Properly applying fertilizer according to the results of soil tests helps to correct the nutrient imbalance. Organic soils, such as Cathro and Hamre soils, are very poorly drained. They range in depth from shallow to deep. Forage plants that can tolerate wetness can produce good yields in areas of these soils, but they are subject to drought and fire and to frequent frosts in early and late summer.

In the part of the survey area that includes the moraine-outwash complex, cropland areas are mostly well drained or moderately well drained. The soils in these areas are friable and have a moderate content of organic matter.

Moderately well drained soils, such as Beltrami and Wykeham soils, have few limitations that affect crops. They have a water-holding capacity that is sufficient for good yields of most crops. Conservation tillage and crop rotations help to control water erosion. Soils that have a high content of clay, such as Suomi soils, become cloddy if they are tilled when wet. Minimum tillage and conservation tillage help to minimize water erosion and the formation of clods. Silty soils, such as Baudette soils, are especially susceptible to water erosion, but conservation tillage and crop rotations help to minimize soil losses. In areas of poorly drained soils, such as Shooker and Spooner soils, a drainage system helps to maximize yields.

Gently sloping and sloping, medium textured soils, such as Nebish soils, can produce good yields of most crops, but they are subject to water erosion. Silty soils, such as Debs soils, are especially susceptible to water erosion. Using conservation tillage, rotating crops, stripcropping, and installing terraces help to control water erosion.

Excessively drained soils, such as Menahga soils, are droughty and are subject to water erosion and soil blowing. Using conservation tillage, mulching, and establishing field windbreaks conserve moisture and minimize water erosion and soil blowing.

Steep areas that are suitable for cropland are commonly used for permanent pasture. Some of these pastures can be renovated by interseeding with no-till drills. Rotating grazing, applying fertilizer, and controlling brush and weeds help to keep pastures in good condition. Some fairly large areas of poorly drained and very poorly drained soils also are used for permanent pasture. The forage plants in these areas are mostly sedges and coarse grasses. Using a surface drainage system and reseeding grasses that can tolerate wetness can improve the pasture in these areas.

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.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). 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

A large part of Beltrami County is wooded, and much of the woodland is commercial forest land. Hardwood forest makes up 67 percent of the commercial forest land, and softwood forest makes up 33 percent (Minnesota Department of Natural Resources, 1977). Aspen is the dominant forest type (about 319,300 acres). Other major hardwood forest types include elm-ash-cottonwood (77,600 acres), balsam-poplar (70,500 acres), paper birch (48,500 acres), maple-basswood (40,800 acres), and oak (8,600 acres). The major softwood forest types are tamarack (63,500 acres), whitecedar (53,100 acres), jack pine (46,100 acres), black spruce (34,500 acres), balsam fir (26,300 acres), red pine (15,700 acres), eastern white pine (7,100 acres), and white spruce (4,100 acres).

In 1983, approximately 200,000 cords of timber was harvested in Beltrami County. Aspen was the most commonly harvested species (135,000 cords). A total of 25,000 cords of the other hardwood species also was harvested. Roughly 40,000 cords of softwood species was harvested, of which 20,000 cords was pine and 20,000 cords was balsam fir, spruce, and tamarack. Most of the timber harvested in the survey area (150,000 cords) is used by chipboard plants and pulp and paper mills. The remaining timber is used for lumber (25,000 cords) and fuelwood (25,000 cords).

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. Additional, more detailed information about forestry equipment use is provided in table 8.

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced 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.

Forestry Equipment Use

Table 8 can be used by woodland owners or forest managers as an aid in selecting the season during which forestry equipment can be used most efficiently. Only the soils that are suitable for wood crops are listed. These soils are rated for the most limiting season or seasons and for the preferred operating season or seasons. In Beltrami County, the spring season normally is April through June, the summer season is July and August, the fall season is September through November, and the winter season is December through March.

On many soils, spring is the most limiting season because of snowmelt and the alternating freezing and thawing of the surface layer. In winter, traction is reduced on snow-covered slopes.

Wetness is a limitation that varies with the seasons. The water table in wet soils generally is closer to the surface in the spring than in other seasons. Also, it is high for longer periods. It is deeper in the summer and is closer to the surface again in the fall. In some soils, it is at or near the surface throughout the year. Wheel-track rutting results if trees are logged when the soils are wet. Ruts can impede the use of equipment and the growth of seedlings. Because of poor traction, logging is difficult when clayey soils are wet. Winter is often the preferred season of use on wet soils because the frozen ground can support logging equipment. On soils that have a surface layer of sand, coarse sand, or fine sand, traction tends to be poor during very dry periods.

Table 8 shows the degree and kind of soil limitations that affect the operation of wheeled logging equipment in logging areas and on skid trails, log landings, and haul roads. *Logging areas* and *skid trails* include areas where trees are logged and the trails over which the logs are dragged or hauled from the stump to a log landing. Equipment traffic is generally least intensive in the logging areas. The landscape is not altered in these areas. The chief soil properties and site features considered in rating the soils for logging areas and skid trails are slope, wetness, flooding, rock outcrops, and texture of the surface layer. A rating of *slight* indicates that operating the usual kinds of logging equipment is not limited or is limited only to a minor extent when normal logging procedures are used. A rating of *moderate* or *severe* indicates that equipment use is more seriously restricted by one or more soil features or site factors during the season of use.

Log landings are areas where logs are assembled for transportation. Commonly, some modification of the landscape is needed to level the landings. Slope, rock outcrops, wetness, and flooding affect the ease of excavating and shaping the landings. Soil strength (as inferred from the engineering classification of the soil) and wetness affect the traffic-supporting capacity. Texture affects trafficability, which varies with moisture content. Measures that protect areas where flooding is a hazard are needed. A rating of *slight* indicates that soil properties or site features are generally favorable and limitations are minor and can be easily overcome. A rating of *moderate* indicates that soil properties and site features are not favorable and special planning, design, land shaping, or maintenance is needed to overcome or minimize the limitations. A rating of *severe* indicates that 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. If possible, sites that have a rating of severe should not be used as landings.

Haul roads serve as transportation routes from log landings to primary roads. Generally, haul roads are unpaved. Some are graveled. Cuts may be needed to reduce the road grade. The ratings are based on soil properties and site features. A high water table, flooding, rock outcrops, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil) and wetness affect the traffic-supporting capacity. Texture affects trafficability, which varies with moisture content. The limitations are considered *slight* if soil properties and site features are generally favorable and limitations are minor and can be easily overcome; *moderate* if soil properties and site features are not favorable 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 and increased maintenance are required.

Windbreaks and Environmental Plantings

Windbreaks and environmental plantings are needed in Beltrami County. In many areas, the native forests have been logged and open fields remain. Also, the northwestern part of the county is a wet prairie and has never supported many trees and shrubs. Farmsteads are commonly more than a quarter of a mile away from the nearest effective windbreak. As a result, fields and homesteads are exposed to the effects of windchill and are susceptible to soil blowing.

Many types of local trees and shrubs are suitable for windbreaks. Many of them tend to colonize areas where they are most competitive. Willow and alder trees prefer wet areas. Whitecedar, black spruce, and tamarack prefer wet areas where water moves in the subsoil. Areas that have a stagnant, saturated water table commonly do not support trees. Pine and oak are suited to droughty sites. Many species of hardwoods, conifers, and shrubs grow well on sites where conditions are between these extremes.

Exotic species also are used in windbreaks and environmental plantings. These domestic plants are hybrids that are faster growing than many native species. They can beautify an area and add color to the landscape. Some species are particularly adapted to adverse soil conditions, such as wet, droughty, alkaline, or acid conditions. Many species produce abundant flowers and fruit.

If necessary, sites for windbreaks can be physically altered. For example, adding loamy material and mulch can improve the ability of droughty soils to retain moisture. Applying fertilizer and manure to a site can increase the growth and vigor of windbreaks and environmental plantings by increasing the content of plant nutrients in the soil.

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 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 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.

Some detailed soil map units have been assigned to a windbreak suitability group. These groups are listed at the end of the map unit descriptions. Windbreak suitability groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the survey area are provided in the Technical Guide, which is available in the local office of the Natural Resources Conservation Service.

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

Beltrami County has many recreational areas and offers opportunities for many recreational activities, such as fishing, boating, canoeing, hunting, cross-country skiing, camping, jogging, and snowmobiling.

Most of the lakes, streams, and rivers are in the southern part of the county. Opportunities for fishing, boating, and swimming are available on most of the lakes and streams. Most canoeing is done on the Mississippi and Turtle Rivers. Many lakes are clear enough for scuba diving.

Game birds and big and small game animals are hunted in most areas of Beltrami County. The northwestern part of the county has large autumn migrations of waterfowl. Camping is available in county and State parks and in the Chippewa National Forest. Snowmobile trails are throughout the county. Groomed trails for cross-country skiing are maintained in State and county parks and in the Chippewa National Forest. The State and county parks have hard-surfaced bicycle trails. Seasonally abundant wildflowers offer many opportunities for viewing or photography. Also, private facilities are available for horseback riding, downhill skiing, golfing, and other sports.

The soils of the survey area are rated in table 10 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 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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 or a hardpan 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

The soils of Beltrami County are varied and are capable of supporting large and diverse wildlife populations.

The habitat in the northwestern part of the county is a mixture of broad to narrow, nearly level cultivated fields and bogs. The fields are intermingled with blocks of forest. The forests are mostly aspen, but willow and alder grow at the edges of the bogs. Most of the bogs are covered with sedges but have few trees. Beach ridges and eskers are commonly vegetated with pine trees. Some bogs adjacent to these landforms are forested with conifers. This habitat is good for big game, such as moose, white-tailed deer, and black bear. The aspen and conifer stands provide good habitat for snowshoe hare and ruffed grouse. The open habitat of the fields is suited to jackrabbits and sharp-tailed grouse. Drainage ditches and burnouts in the bogs provide habitat for resident waterfowl. Harvested fields are used as autumn feeding grounds by migrating waterfowl. Ground-nesting birds and many wet-prairie wildflowers also are in this area. Habitat for wildlife can be improved by establishing windbreaks and ponds.

The southern part of the county has a mixture of habitat types. The habitat ranges from large open fields that have a fringe of trees to small open fields and large areas of forest. In moraine areas, the forest consists mostly of hardwoods. It consists mostly of conifers in outwash areas. Big game species in these areas include white-tailed deer and black bear. Snowshoe hare and ruffed grouse inhabit the forests. Gray squirrels inhabit the hardwood forests, but red squirrels prefer the conifer forests. In the spring, potholes in the moraine areas are filled with water and are used by resident and migratory waterfowl. Songbirds use all of the habitat types. Some sandy areas support large conifers, which are used as nesting sites by ospreys and eagles in areas adjacent to streams and lakes. Logging mature trees, establishing windbreaks, and excavating permanent waterholes can improve the habitat for wildlife.

The northern and northeastern parts of the county consist of the Red Lake bog. This bog covers a large acreage and includes raised areas that are covered by black spruce. It supports very little wildlife, except along the edges. The area once provided habitat for woodland caribou, but the bog was drained so that it could be farmed. The farms were later abandoned because of the cost of maintaining the drainage ditches. Caribou were re-introduced to the area, but the survival rate was poor because calves drowned in the open ditches. No further attempt has been made to introduce big game into the area. Currently, the area provides habitat for migrating songbirds.

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 11, 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 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, wildrye, 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 oak, poplar, chokecherry, apple, hawthorn, dogwood, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive 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 rice, 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, Hungarian partridge, meadowlark, field sparrow, jackrabbit, 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, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, 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, 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 12 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 13 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 13 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 13 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 13 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, and soil reaction 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 14 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 14, 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 15 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, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In 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 and a high content of stones or boulders or 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.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of 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, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

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.

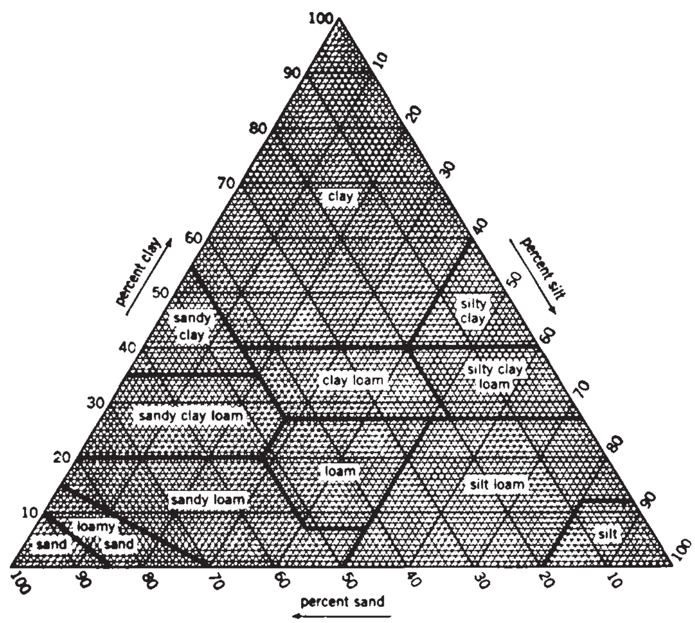

Figure 8.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 16 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. 8). "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 larger than 3 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 17 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 17, 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 18 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 18, 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 18 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 18 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 18.

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.

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 18 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 19 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 Inceptisol.

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 Aquept (*Aqu,* meaning water, plus *ept,* from Inceptisol).

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 Humaquepts (*Hum,* meaning humus, plus *aquept,* the suborder of the Inceptisols 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. An example is Histic Humaquepts.

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 sandy, mixed, frigid Histic Humaquepts.

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, 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."

Andrusia Series

Drainage class: Well drained
Permeability: Moderately rapid in the upper part; rapid in the lower part

Landform: Outwash plains, stream terraces, and beach ridges
Parent material: Sandy and gravelly deposits
Slope range: 1 to 25 percent
Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Andrusia loamy sand, 1 to 6 percent slopes, 800 feet west and 1,000 feet south of the northeast corner of sec. 18, T. 147 N., R. 34 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; about 3 percent gravel; moderately acid; abrupt smooth boundary.

E1—3 to 19 inches; brown (10YR 4/3) sand, brown (10YR 5/3) dry; single grain; loose; about 4 percent gravel; moderately acid; clear wavy boundary.

E2—19 to 29 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; about 4 percent gravel; moderately acid; clear wavy boundary.

Bt—29 to 39 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; many faint dark brown (10YR 3/3) clay films on faces of peds; about 14 percent gravel; slightly acid; clear wavy boundary.

C1—39 to 50 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 25 percent gravel; strong effervescence; moderately alkaline; abrupt wavy boundary.

C2—50 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 30 to 50 inches
Content of rock fragments: 15 to 35 percent gravel

A or Ap horizon:
- Hue—10YR
- Value—3 or 4
- Chroma—1 to 3
- Texture—loamy sand

E horizon:
- Hue—10YR
- Value—4 to 6
- Chroma—3 to 6
- Texture—fine sand, sand, loamy sand, or coarse sand
- Content of rock fragments—0 to 15 percent gravel

Bt horizon:
- Hue—7.5YR or 10YR
- Value—3 to 5
- Chroma—4 to 6
- Texture—fine sandy loam, loam, sandy loam, or coarse sandy loam

C horizon:
- Hue—7.5YR or 10YR
- Value—5 to 7
- Chroma—3 to 6
- Texture—fine sand, sand, or coarse sand

Balmlake Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines and water-modified till plains
Parent material: Stratified sandy, loamy, and silty sediments
Slope range: 1 to 25 percent
Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Balmlake fine sandy loam, 1 to 6 percent slopes, about 1,200 feet west and 150 feet south of the northeast corner of sec. 29, T. 150 N., R. 35 W.

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

E—3 to 11 inches; yellowish brown (10YR 5/4) fine sandy loam, light yellowish brown (10YR 6/4) dry; weak thin platy structure; very friable; about 1 percent gravel; moderately acid; abrupt wavy boundary.

Bt—11 to 24 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine subangular blocky structure; friable; few distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; about 1 percent gravel; moderately acid; clear wavy boundary.

2C—24 to 60 inches; pale brown (10YR 6/3), stratified fine sand, very fine sand, and silt; massive; very friable; about 3 percent gravel; violent effervescence; moderately alkaline.

Range in Characteristics

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

A or Ap horizon:
- Hue—10YR
- Value—2 to 5
- Chroma—1 to 3
- Texture—fine sandy loam

E horizon:
- Hue—10YR
- Value—4 to 6

Chroma—2 to 4
Texture—very fine sand, loamy fine sand, or fine sandy loam

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

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 to 6
Texture—stratified bands of sand, fine sand, loamy fine sand, silt, silt loam, or very fine sand

Baudette Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Water-modified till plains
Parent material: Calcareous lacustrine sediments
Slope range: 1 to 3 percent
Taxonomic class: Fine-silty, mixed Aquic Eutroboralfs

Typical Pedon

Baudette silt loam, about 1,320 feet west and 50 feet north of the southeast corner of sec. 35, T. 149 N., R. 32 W.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 6/1) dry; weak fine granular structure; very friable; neutral; clear smooth boundary.

E—4 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; neutral; clear smooth boundary.

Bt1—8 to 16 inches; dark brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

Bt2—16 to 35 inches; olive brown (2.5Y 4/4) silt loam; few fine distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; moderate fine subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear wavy boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) silt loam; common medium distinct olive yellow (2.5Y 6/6) and grayish brown (2.5Y 5/2) mottles; massive; very friable; common fine irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 36 inches

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

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—very fine sandy loam, fine sandy loam, loam, or silt loam

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—silt loam, silty clay loam, or loam

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

Beltrami Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Beltrami fine sandy loam, about 1,700 feet south and 100 feet east of the northwest corner of sec. 28, T. 150 N., R. 30 W.

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

E—5 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; few fine distinct yellowish brown (10YR 5/4) mottles; weak thin platy structure; very friable; about 2 percent gravel; neutral; clear smooth boundary.

Bt1—10 to 17 inches; dark brown (10YR 4/3) clay loam; few fine faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; common distinct dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel;

slightly acid; clear wavy boundary.

Bt2—17 to 26 inches; olive brown (2.5Y 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) and common fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium subangular blocky structure; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear smooth boundary.

C—26 to 60 inches; light olive brown (2.5Y 5/4) loam; few fine distinct yellowish brown (10YR 5/6) and common fine distinct grayish brown (2.5Y 5/2) mottles; massive; friable; about 4 percent gravel; common fine irregularly shaped carbonates in soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 22 to 40 inches
Content of rock fragments: 2 to 10 percent gravel

A or Ap horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—fine sandy loam

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

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

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

Bemidji Series

Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderately slow in the lower part
Landform: Till plains and outwash plains
Parent material: Sandy sediments overlying till
Slope range: 1 to 3 percent
Taxonomic class: Loamy, mixed Aquic Arenic Eutroboralfs

Typical Pedon

Bemidji loamy sand, 1,200 feet south and 300 feet west of the northeast corner of sec. 25, T. 146 N., R. 33 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; friable; about 14 percent gravel; moderately acid; clear wavy boundary.

E1—4 to 12 inches; dark brown (10YR 4/3) cobbly loamy sand, light gray (10YR 7/2) dry; single grain; loose; about 30 percent cobbles and gravel; slightly acid; clear irregular boundary.

E2—12 to 26 inches; dark yellowish brown (10YR 4/4) cobbly sand, brown (10YR 5/3) dry; single grain; loose; about 30 percent cobbles and gravel; slightly acid; abrupt wavy boundary.

2B/E—26 to 34 inches; light olive brown (2.5Y 5/4) fine sandy loam (Bt); weak medium angular blocky structure; firm; interfingerings of dark grayish brown (2.5Y 4/2) loamy sand (E); single grain; loose; few fine prominent yellowish brown (10YR 5/6) mottles; few distinct brown (10YR 4/3) clay films on faces of peds; about 10 percent gravel; moderately acid; clear wavy boundary.

2Bt—34 to 44 inches; light olive brown (2.5Y 5/4) fine sandy loam; common fine distinct dark grayish brown (2.5Y 4/2) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; common distinct dark brown (10YR 3/3) clay films on faces of peds and in tubular pores; about 10 percent gravel and cobbles; slightly acid; clear wavy boundary.

2C—44 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; common fine distinct dark grayish brown (2.5Y 4/2) and few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 10 percent gravel and cobbles; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 55 inches
Thickness of the sandy sediments: 20 to 40 inches
Content of rock fragments: 5 to 35 percent gravel
Other features: An E/B, EB, or BE horizon in some pedons

A or Ap horizon:
Hue—10YR
Value—2 to 4
Chroma—1 to 3
Texture—loamy sand

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

2B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

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

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

Bowstring Series

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

Typical Pedon

Bowstring muck, in an area of Seelyeville and Bowstring soils; 2,500 feet west and 100 feet north of the southeast corner of sec. 16, T. 146 N., R. 35 W.

Oa—0 to 35 inches; sapric material, very dark brown (10YR 2/2) broken face, rubbed, and pressed; about 10 percent fiber, 2 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fibers; about 5 percent mineral material; neutral; abrupt smooth boundary.

C—35 to 43 inches; dark gray (10YR 4/1) loamy sand; single grain; loose; neutral; abrupt smooth boundary.

O'a—43 to 60 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 5 percent fiber, 1 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fiber; about 10 percent mineral material; neutral.

Range in Characteristics

Depth to mineral material: 24 to 48 inches

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

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

Bullwinkle Series

Drainage class: Very poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Landform: Till-floored glacial lake plains and till plains
Parent material: Highly decomposed woody organic material overlying calcareous till or lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Bullwinkle muck, 15 feet north and 375 feet west of the southeast corner of sec. 34, T. 155 N., R. 35 W.

Oa1—0 to 17 inches; sapric material, black (5YR 2.5/1) broken face, dark reddish brown (5YR 3/2) rubbed, and dark reddish brown (5YR 3/3) pressed; about 30 percent fiber, about 10 percent rubbed; weak thick platy structure; very friable; nonplastic, nonsticky; about 30 percent woody fragments more than 2 millimeters in size; moderately acid; clear smooth boundary.

Oa2—17 to 31 inches; sapric material, very dark brown (10YR 2/2) broken face, black (5YR 2.5/1) rubbed, and dark reddish brown (5YR 3/2) pressed; about 30 percent fiber, about 5 percent rubbed; weak thick platy structure; very friable; nonplastic, nonsticky; about 50 percent woody fragments more than 2 millimeters in size; moderately acid; clear smooth boundary.

Oa3—31 to 41 inches; sapric material, black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed and pressed; about 25 percent fiber, about 5 percent rubbed; weak thick platy structure; very friable; nonplastic, nonsticky; about 50 percent woody fragments more than 2 millimeters in size; moderately acid; clear smooth boundary.

A—41 to 45 inches; black (10YR 2/1) loam; massive; friable; neutral; abrupt smooth boundary.

Cg—45 to 60 inches; olive gray (5Y 5/2) loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; common fine irregularly shaped carbonates in soft masses; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of organic material: 16 to 51 inches
Depth to mineral soil: 16 to 51 inches
Depth to carbonates: 17 to 59 inches

Organic material:
Content of fiber—20 to 50 percent unrubbed; 0 to 10 percent rubbed

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

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 4
Chroma—0 to 4
Texture—loam, sandy clay loam, sandy loam, or clay loam

Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—5 to 7
Chroma—1 or 2
Texture—loam, clay loam, sandy loam, or fine sandy loam

Cathro Series

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; moderate or moderately slow in the lower part
Landform: Till-floored glacial lake plains and till plains
Parent material: Highly decomposed herbaceous organic material overlying calcareous till or lacustrine sediments
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 1,800 feet north and 100 feet west of the southeast corner of sec. 16, T. 155 N., R. 37 W.

Oa1—0 to 8 inches; sapric material, black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed and pressed; about 20 percent fiber, about 1 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fibers; neutral; clear wavy boundary.

Oa2—8 to 30 inches; sapric material, very dark brown (10YR 2/2) broken face, dark brown (10YR 3/3) rubbed and pressed; about 20 percent fiber, about 5 percent rubbed; weak medium platy structure; very friable; mostly herbaceous fibers; neutral; abrupt smooth boundary.

A—30 to 34 inches; black (N 2/0) silt loam; massive; very friable; neutral; clear wavy boundary.

Cg—34 to 60 inches; light olive gray (5Y 6/2) loam; few medium prominent yellowish brown (10YR 5/6) mottles; massive; very friable; violent effervescence; slightly alkaline.

Range in Characteristics

Thickness of organic material: 16 to 51 inches
Depth to mineral soil: 16 to 51 inches
Depth to carbonates: 16 to more than 60 inches

Organic material:
Content of fiber—15 to 35 percent unrubbed; 0 to 10 percent rubbed

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

A horizon:
Hue—2.5Y, 5Y, or neutral
Value—1 or 2
Chroma—0 to 2
Texture—silt loam, loam, clay loam, silty clay loam, or sandy loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—sandy loam, fine sandy loam, loam, clay loam, or silty clay loam

Chilgren Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Till-floored glacial lake plains
Parent material: Calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Ochraqualfs

Typical Pedon

Chilgren loam, 1,320 feet north and 1,000 feet west of the southeast corner of sec. 35, T. 155 N., R. 37 W.

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

E—3 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; very friable; about 5 percent gravel; slightly acid; abrupt wavy boundary.

Btg1—11 to 14 inches; grayish brown (2.5Y 5/2) loam; few fine faint light olive brown (2.5Y 5/4) mottles; weak fine angular blocky structure; friable; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

Btg2—14 to 18 inches; grayish brown (2.5Y 5/2) clay loam; few fine faint light olive brown (2.5Y 5/4) mottles; moderate fine angular blocky structure; friable; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 5 percent coarse fragments; neutral; abrupt wavy boundary.

Cg—18 to 60 inches; light olive gray (5Y 6/2) loam; few fine prominent light olive brown (2.5Y 5/6) mottles; massive; very friable; about 5 percent gravel; common medium irregularly shaped carbonates in seams and soft masses; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 24 inches
Content of rock fragments: 0 to 10 percent gravel

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

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

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

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam, sandy loam, or fine sandy loam

Cormant Series

Drainage class: Poorly drained
Permeability: Rapid
Landform: Till-floored glacial lake plains
Parent material: Lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Mixed, frigid Mollic Psammaquents

Typical Pedon

Cormant loamy fine sand, 100 feet north and 1,800 feet east of the southwest corner of sec. 6, T. 151 N., R. 31 W.

Ap—0 to 8 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; neutral; abrupt wavy boundary.

Cg—8 to 60 inches; light olive gray (5Y 6/2) and grayish brown (2.5Y 5/2) fine sand; few coarse prominent reddish yellow (7.5YR 6/6) mottles; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 36 to 80 inches

A or Ap horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand or loamy sand

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

Cutaway Series

Drainage class: Well drained
Permeability: Rapid in the upper part; moderate to slow in the lower part
Landform: Moraines and till plains
Parent material: Sandy outwash overlying calcareous till
Slope range: 1 to 12 percent
Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Cutaway loamy fine sand, 1 to 6 percent slopes, about 1,500 feet north and 200 feet east of the southwest corner of sec. 15, T. 149 N., R. 34 W.

A—0 to 3 inches; dark gray (10YR 4/1) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; about 8 percent gravel; moderately acid; abrupt wavy boundary.

E—3 to 6 inches; brown (10YR 5/3) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; about 5 percent gravel; moderately acid; clear wavy boundary.

Bw—6 to 24 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; very friable; about 5 percent gravel; moderately acid; clear wavy boundary.

E′—24 to 28 inches; pale brown (10YR 6/3) loamy sand; weak fine subangular blocky structure; loose; about 5 percent gravel; moderately acid; abrupt wavy boundary.

2B/E—28 to 32 inches; yellowish brown (10YR 5/6) sandy clay loam (Bt); interfingerings of pale brown (10YR 6/3) loamy sand (E); moderate medium angular blocky structure; friable; common distinct dark brown (10YR 4/4) clay films on faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.

2Bt1—32 to 38 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium angular blocky structure; friable; common distinct dark brown (10YR 4/4) clay films on faces of peds; about 5 percent gravel; slightly acid; clear wavy boundary.

2Bt2—38 to 45 inches; yellowish brown (10YR 5/4) loam; moderate medium angular blocky structure; friable; few distinct dark brown (10YR 4/4) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

2C—45 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; massive; friable; about 5 percent coarse fragments; common medium irregularly shaped carbonates in seams and soft masses; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 36 to 60 inches
Thickness of the sandy mantle: 20 to 40 inches
Content of coarse fragments: 1 to 10 percent gravel

A or Ap horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—loamy fine sand

E horizon:
Hue—10YR or 7.5YR
Value—5 to 7
Chroma—1 to 3
Texture—loamy sand or loamy fine sand

Bw horizon:
Hue—10YR or 7.5YR
Value—3 to 6
Chroma—3 to 6
Texture—loamy sand, loamy fine sand, loamy coarse sand, sand, or coarse sand

E' horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 or 3
Texture—sandy loam, loamy sand, or loamy coarse sand

2Bt horizon:
Hue—7.5YR, 10YR, or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam, clay loam, sandy clay loam, sandy loam, fine sandy loam, or silt loam

2C horizon:
Hue—10YR or 2.5Y
Value—3 to 7
Chroma—2 to 4
Texture—loam, clay loam, sandy loam, fine sandy loam, or silt loam

Debs Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines and water-modified till plains
Parent material: Lacustrine sediments
Slope range: 1 to 12 percent
Taxonomic class: Fine-silty, mixed Typic Eutroboralfs

Typical Pedon

Debs silt loam, 1 to 6 percent slopes, about 800 feet south and 100 feet west of the northeast corner of sec. 22, T. 150 N., R. 32 W.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; neutral; abrupt wavy boundary.

E—4 to 12 inches; brown (10YR 5/3) very fine sandy loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; very friable; neutral; abrupt wavy boundary.

Bt—12 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium prismatic structure parting to moderate fine subangular blocky; firm; many distinct dark brown (10YR 3/3) clay films on faces of peds; neutral; abrupt wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) silt loam; massive; very friable; common faint irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 39 inches
Content of coarse fragments: 0 to 2 percent gravel

A or Ap horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—silt loam

E horizon:
Hue—10YR
Value—5 to 7
Chroma—2 to 4
Texture—very fine sand, fine sand, very fine sandy loam, loamy fine sand, or silt loam

Bt horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—silt loam or silty clay loam

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

Deerwood Series

Drainage class: Very poorly drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Landform: Till-floored glacial lake plains and outwash plains
Parent material: Highly decomposed organic material overlying sandy sediments
Slope range: 0 to 1 percent
Taxonomic class: Sandy, mixed, frigid Histic Humaquepts

Typical Pedon

Deerwood muck, 1,400 feet north and 1,000 feet east of the southwest corner of sec. 32, T. 158 N., R. 38 W.

Oa—0 to 12 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 15 percent fiber, about 5 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fiber; neutral; clear wavy boundary.

A—12 to 16 inches; black (5Y 2.5/1) fine sandy loam, very dark gray (5Y 3/1) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

Cg—16 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; few fine faint grayish brown (2.5Y 5/2) and few medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; about 10 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the histic epipedon: 8 to 16 inches
Depth to carbonates: 8 to 16 inches

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

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

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—sand, fine sand, coarse sand, loamy sand, or loamy fine sand

Eckvoll Series

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; moderate in the lower part
Landform: Till-floored glacial lake plains and water-modified till plains
Parent material: Lacustrine sediments overlying till
Slope range: 1 to 3 percent
Taxonomic class: Loamy, mixed Aquic Arenic Eutroboralfs

Typical Pedon

Eckvoll loamy fine sand, 100 feet north and 100 feet east of the southwest corner of sec. 26, T. 158 N., R. 38 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; slightly acid; abrupt wavy boundary.

E1—4 to 13 inches; dark grayish brown (10YR 4/2) fine sand, light brownish gray (10YR 6/2) dry; weak thin platy structure; loose; slightly acid; clear wavy boundary.

E2—13 to 25 inches; pale brown (10YR 6/3) fine sand, very pale brown (10YR 7/3) dry; few medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; slightly acid; abrupt wavy boundary.

2Bt—25 to 32 inches; light olive brown (2.5Y 5/4) clay loam; few fine distinct brown (2.5Y 5/2) and common medium distinct brownish yellow (10YR 6/6) mottles; weak fine prismatic structure parting to weak medium angular blocky; friable; common distinct olive brown (2.5Y 4/4) clay films on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

2C—32 to 60 inches; light yellowish brown (2.5Y 6/4) loam; few medium distinct olive yellow (2.5Y 6/8) and light brownish gray (2.5Y 6/2) mottles; massive; very friable; about 4 percent gravel; common fine irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 36 inches
Thickness of the sandy mantle: 20 to 36 inches

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loamy fine sand

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—loamy sand, fine sand, or sand

2Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 6
Chroma—2 to 4
Texture—sandy clay loam, loam, or clay loam
Content of rock fragments—2 to 10 percent gravel

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam, sandy loam, or clay loam
Content of rock fragments—2 to 10 percent gravel

Effie Series

Drainage class: Poorly drained
Permeability: Slow
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Fine, mixed, frigid Typic Ochraqualfs

Typical Pedon

Effie silt loam, about 2,000 feet west and 200 feet north of the southeast corner of sec. 21, T. 149 N., R. 34 W.

A—0 to 3 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak thin platy structure; very friable; about 1 percent gravel; slightly acid; abrupt wavy boundary.

E—3 to 8 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; few fine distinct light olive brown (2.5Y 5/6) mottles; weak thin platy structure; very friable; about 1 percent gravel; slightly acid; abrupt wavy boundary.

B/E—8 to 12 inches; dark grayish brown (2.5Y 4/2) clay loam (Bt); interfingerings of grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silt loam (E); few fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; about 1 percent coarse fragments; slightly acid; clear wavy boundary.

Btg1—12 to 18 inches; olive gray (5Y 4/2) silty clay; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium angular blocky; firm; many distinct dark olive gray (5Y 3/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Btg2—18 to 28 inches; olive gray (5Y 4/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; many distinct dark olive gray (5Y 3/2) clay films on faces of peds; about 5 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Cg—28 to 60 inches; light olive gray (5Y 6/2) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 5 percent gravel; common fine irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 13 to 32 inches
Content of coarse fragments: 1 to 5 percent gravel

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

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

B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

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

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—clay loam, silty clay loam, silty clay, clay, or loam

Epoufette Series

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Landform: Outwash plains
Parent material: Stratified sandy sediments
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Epoufette sandy loam, about 300 feet north and 100 feet west of the southeast corner of sec. 31, T. 158 N., R. 36 W.

A—0 to 4 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

Eg—4 to 13 inches; grayish brown (10YR 5/2) loamy sand, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; very friable; about 5 percent gravel; neutral; clear wavy boundary.

Btg—13 to 18 inches; grayish brown (2.5Y 5/2) sandy loam; common fine distinct gray (10YR 5/1) mottles; weak medium angular blocky structure; friable; few distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 10 percent gravel; neutral; abrupt wavy boundary.

2Cg—18 to 60 inches; light brownish gray (2.5Y 6/2) gravelly coarse sand; few fine prominent light yellowish brown (10YR 6/4) mottles; single grain; loose; about 20 percent gravel; slightly alkaline; slight effervescence.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam or sapric material
Content of rock fragments—2 to 25 percent gravel

Oa horizon (if it occurs):
Thickness—8 inches
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—muck

E horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loamy coarse sand, loamy sand, sand, or the gravelly analogs of those textures
Content of rock fragments—2 to 25 percent gravel

Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—sandy loam, coarse sandy loam, or the gravelly analogs of those textures
Content of rock fragments—2 to 25 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—gravelly sand or gravelly coarse sand

Garnes Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till-floored glacial lake plains
Parent material: Water-sorted sediments overlying till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Garnes loam, 1,000 feet south and 100 feet east of the northwest corner of sec. 27, T. 155 N., R. 37 W.

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

E—3 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, gray (10YR 6/1) dry; weak thin platy structure; very friable; about 4 percent gravel; slightly acid; abrupt wavy boundary.

Bt1—7 to 16 inches; dark brown (10YR 4/3) clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles in the lower part; moderate medium subangular blocky structure; friable; common faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bt2—16 to 20 inches; dark brown (10YR 4/3) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent coarse fragments; neutral; abrupt wavy boundary.

Cg—20 to 60 inches; grayish brown (2.5Y 5/2) loam; few medium distinct light olive brown (2.5Y 5/6) and few fine faint light gray (2.5Y 7/2) mottles; massive; very friable; about 5 percent gravel; common medium irregularly shaped carbonates in soft masses; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 8 to 20 inches

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

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

Bt horizon:
Hue—10YR
Value—3 or 4
Chroma—2 or 3
Texture—loam, sandy clay loam, or clay loam

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

Graycalm Series

Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy sediments
Slope range: 1 to 12 percent
Taxonomic class: Mixed, frigid Alfic Udipsamments

Typical Pedon

Graycalm loamy sand, in an area of Graycalm-Menahga complex, 1 to 6 percent slopes; 1,320 feet east and 100 feet south of the northwest corner of sec. 17, T. 147 N., R. 34 W.

A—0 to 5 inches; very dark gray (10YR 3/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; about 3 percent gravel; moderately acid; abrupt smooth boundary.

Bw1—5 to 9 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine granular structure; very friable; about 3 percent gravel; moderately acid; clear smooth boundary.

Bw2—9 to 32 inches; yellowish brown (10YR 5/6) sand; single grain; loose; about 3 percent gravel; moderately acid; clear wavy boundary.

E&Bt—32 to 46 inches; light yellowish brown (10YR 6/4) sand (E); single grain; loose; several lamellae and bands of dark yellowish brown (10YR 4/4) loamy sand (Bt) that are ⅛ to 1 inch thick and have a combined thickness of 4 inches; weak fine subangular blocky structure; very friable; common faint dark brown (10YR 3/3) clay bridges between sand grains; about 5 percent gravel; slightly acid; clear wavy boundary.

C—46 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 12 percent gravel; moderately acid.

Range in Characteristics

Depth to carbonates: 40 to 60 inches
Content of rock fragments: 0 to 15 percent gravel
Other features: An E horizon in some pedons

A or Ap horizon:
Hue—10YR or 7.5YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

Bw horizon:
Hue—7.5YR or 10YR
Value—4 to 7
Chroma—4 to 6
Texture—sand or loamy sand

E&Bt horizon:
Hue—7.5YR or 10YR
Value—6 or 7 (E); 4 to 6 (Bt)
Chroma—2 to 4 (E); 4 to 6 (Bt)
Texture—bands of sand or coarse sand (E) and loamy sand, sandy loam, or fine sandy loam (Bt) that range in thickness from 1/16 inch to 3 inches and that have a total thickness of less than 6 inches

C horizon:
Hue—10YR
Value—5 to 7
Chroma—2 to 4
Texture—sand or coarse sand

Greenwood Series

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Landform: Till-floored glacial lake plains
Parent material: Moderately decomposed herbaceous organic material
Slope range: 0 to 1 percent
Taxonomic class: Dysic Typic Borohemists

Typical Pedon

Greenwood peat, 600 feet west and 500 feet north of the southeast corner of sec. 12, T. 155 N., R. 31 W.

Oi—0 to 4 inches; fibric material, dark yellowish brown (10YR 3/4) broken face, dark brown (7.5YR 4/4) rubbed and pressed; 95 percent fiber, about 80 percent rubbed; weak thin platy structure; very friable; primarily live roots and sphagnum moss; extremely acid; clear smooth boundary.

Oe—4 to 63 inches; hemic material, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 80 percent fiber, about 20 percent rubbed; weak thick platy structure; very friable; primarily herbaceous fibers; extremely acid.

Range in Characteristics

Thickness of organic material: More than 60 inches

Reaction: Extremely acid

Organic material: Fibric material extending from the surface and ranging from 0 to 10 inches in thickness

Oi horizon:

Hue—10YR or 7.5YR

Value—2 to 4

Chroma—2 to 4

Content of fiber—90 to 100 percent unrubbed; 80 to 100 percent rubbed

Oe horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 4

Chroma—2 to 4

Content of fiber—35 to 70 percent unrubbed; 20 to 45 percent rubbed

Grygla Series

Drainage class: Poorly drained

Permeability: Rapid in the upper part; moderate or moderately slow in the lower part

Landform: Till-floored glacial lake plains

Parent material: Lacustrine sediments overlying calcareous till

Slope range: 0 to 2 percent

Taxonomic class: Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents

Typical Pedon

Grygla loamy fine sand, 2,600 feet east and 50 feet north of the southwest corner of sec. 7, T. 153 N., R. 30 W.

Ap—0 to 7 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

Cg1—7 to 12 inches; grayish brown (2.5Y 5/2) fine sand, few fine faint light olive brown (2.5Y 5/4) mottles; single grain; loose; neutral; clear smooth boundary.

Cg2—12 to 25 inches; grayish brown (2.5Y 5/2) fine sand; common medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; neutral; abrupt smooth boundary.

2Cg3—25 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium distinct light olive brown (2.5Y 5/6) and few fine faint olive brown (2.5Y 4/4) mottles; massive; friable; about 4 percent gravel; common medium irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the sandy mantle: 20 to 40 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

Cg horizon:

Hue—2.5Y

Value—5 or 6

Chroma—1 or 2

Texture—fine sand, sand, or loamy fine sand

2Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 7

Chroma—1 or 2

Texture—loam, fine sandy loam, or silt loam

Content of rock fragments—2 to 15 percent gravel

Hamre Series

Drainage class: Very poorly drained

Permeability: Moderate or moderately slow

Landform: Till-floored glacial lake plains and till plains

Parent material: Highly decomposed organic material overlying calcareous till

Slope range: 0 to 1 percent

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

Typical Pedon

Hamre muck, 1,500 feet east and 100 feet south of the northwest corner of sec. 27, T. 155 N., R. 37 W.

Oa—0 to 9 inches; sapric material, very dark grayish brown (10YR 3/2) broken face, very dark brown (10YR 2/2) rubbed and pressed; about 20 percent fiber, about 5 percent rubbed; weak thin platy structure; very friable; primarily herbaceous fibers;

neutral; abrupt smooth boundary.

A—9 to 13 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; slightly alkaline; clear smooth boundary.

Cg—13 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium prominent yellow (10YR 7/6) mottles; massive; friable; about 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the histic epipedon: 8 to 16 inches
Depth to carbonates: 12 to 25 inches

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

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—clay loam, silt loam, loam, or the mucky analogs of those textures

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, clay loam, or silt loam

Hiwood Series

Drainage class: Moderately well drained
Permeability: Rapid
Landform: Till-floored glacial lake plains
Parent material: Lacustrine sediments
Slope range: 1 to 3 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Hiwood loamy fine sand, 2,500 feet north and 1,300 feet east of the southwest corner of sec. 13, T. 151 N., R. 32 W.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; moderately acid; abrupt smooth boundary

E—2 to 6 inches; dark grayish brown (10YR 4/2) fine sand, light brownish gray (10YR 6/2) dry; single grain; loose; moderately acid; abrupt smooth boundary.

Bw1—6 to 12 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; moderately acid; clear wavy boundary.

Bw2—12 to 26 inches; yellowish brown (10YR 5/4) fine sand; few fine distinct very pale brown (10YR 7/3) and yellowish brown (10YR 5/6) mottles; single grain; loose; moderately acid; clear wavy boundary.

Bw3—26 to 42 inches; pale brown (10YR 6/3) fine sand; few fine faint light brownish gray (10YR 6/2) and few fine prominent strong brown (7.5YR 5/6) mottles; single grain; loose; moderately acid; clear wavy boundary.

C—42 to 60 inches; yellowish brown (10YR 5/4) fine sand; many medium distinct strong brown (7.5YR 4/6) and light brownish gray (10YR 6/2) mottles; single grain; loose; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 2 percent gravel

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

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—fine sand, loamy fine sand, loamy sand, or sand

Bw horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 8
Texture—fine sand, sand, or loamy fine sand

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

Karlstad Series

Drainage class: Moderately well drained
Permeability: Moderately rapid in the upper part; rapid or very rapid in the lower part
Landform: Outwash plains and beach ridges
Parent material: Sandy and loamy sediments
Slope range: 1 to 3 percent
Taxonomic class: Coarse-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Karlstad loamy sand, 1,000 feet west and 600 feet south of the northeast corner of sec. 32, T. 151 N., R. 31 W.

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

E—3 to 7 inches; brown (10YR 5/3) loamy sand, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; about 5 percent gravel; slightly acid; clear wavy boundary.

Bt1—7 to 12 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; common faint dark brown (10YR 4/3) clay films on faces of peds and common clay bridges between sand grains; about 5 percent gravel; neutral; clear smooth boundary.

2Bt2—12 to 18 inches; dark brown (10YR 4/3) gravelly coarse sandy loam; common medium faint grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very friable; common distinct dark brown (10YR 3/3) clay films on faces of peds; about 20 percent coarse fragments; neutral; clear smooth boundary.

2C—18 to 60 inches; brown (10YR 5/3) very gravelly coarse sand; few fine distinct yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles; single grain; loose; about 40 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 8 to 30 inches

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand
Content of rock fragments—0 to 15 percent gravel

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—loamy sand, sand, sandy loam, or fine sandy loam
Content of rock fragments—0 to 15 percent gravel

Bt1 horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—2 to 4
Texture—coarse sandy loam, sandy loam, fine sandy loam, or sandy clay loam
Content of rock fragments—0 to 15 percent gravel

2Bt2 horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—2 to 4
Texture—gravelly or very gravelly coarse sandy loam, sandy loam, fine sandy loam, or sandy clay loam
Content of rock fragments—15 to 60 percent gravel

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 to 4
Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the gravelly analogs of those textures
Content of rock fragments—0 to 50 percent gravel

Kratka Series

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Landform: Till-floored glacial lake plains
Parent material: Sandy lacustrine sediments overlying calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Sandy over loamy, mixed, frigid Typic Haplaquolls

Typical Pedon

Kratka fine sandy loam, about 1,320 feet north and 50 feet east of the southwest corner of sec. 21, T. 157 N., R. 38 W.

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

Bg—10 to 22 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; few fine distinct light olive brown (2.5Y 5/6) mottles; weak fine granular structure; very friable; about 4 percent gravel; neutral; clear wavy boundary.

Cg1—22 to 28 inches; grayish brown (2.5Y 5/2) loamy fine sand; few medium distinct light olive brown (2.5Y 5/6) mottles; weak fine granular structure; very friable; about 4 percent coarse fragments; neutral; abrupt wavy boundary.

2Cg2—28 to 60 inches; light brownish gray (2.5Y 6/2) loam; few fine distinct light olive brown (2.5Y 5/6) and gray (5Y 5/1) mottles; massive; very friable; about 5 percent gravel; common medium irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 18 inches
Depth to carbonates: 20 to 40 percent

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam
Content of rock fragments—0 to 10 percent

Bg horizon:
Hue—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 10 percent

Cg horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—fine sand, sand, loamy fine sand, or loamy sand
Content of rock fragments—0 to 10 percent

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 or 3
Texture—loam, clay loam, sandy loam, or fine sandy loam
Content of rock fragments—2 to 8 percent gravel

Lengby Series

Drainage class: Well drained
Permeability: Moderate in the upper part; moderately rapid in the lower part
Landform: Moraines and water-modified till plains
Parent material: Stratified deposits
Slope range: 1 to 25 percent
Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Lengby sandy loam, 1 to 6 percent slopes, 1,340 feet west and 40 feet north of the center of sec. 29, T. 148 N., R. 34 W.

A—0 to 5 inches; black (10YR 2/1) sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

E1—5 to 11 inches; brown (10YR 5/3) loamy fine sand; weak medium subangular blocky structure; very friable; neutral; clear wavy boundary.

E2—11 to 18 inches; brown (10YR 5/3) loamy fine sand that has a few streaks of dark yellowish brown (10YR 4/4); moderate medium subangular blocky structure; very friable; slightly acid; clear wavy boundary.

Bt—18 to 28 inches; dark brown (10YR 4/3) sandy clay loam; moderate medium subangular blocky structure; friable; many faint dark brown (10YR 3/3) clay films on faces of peds; neutral; abrupt wavy boundary.

C1—28 to 33 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; massive; very friable; 2 percent coarse fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

C2—33 to 37 inches; light yellowish brown (10YR 6/4) coarse sand; single grain; loose; 15 percent coarse fragments; slight effervescence; moderately alkaline; abrupt wavy boundary.

C3—37 to 41 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; very friable; 10 percent coarse fragments; strong effervescence; moderately alkaline; abrupt wavy boundary.

C4—41 to 60 inches; light yellowish brown (2.5Y 6/4) loamy fine sand; massive; very friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Content of rock fragments: 0 to 14 percent gravel
Other features: An E/B or B/E horizon in some pedons; a BC horizon in some pedons

A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—fine sandy loam or sandy loam

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 4
Texture—fine sand and loamy fine sand

Bt horizon:
Hue—10YR or 7.5YR
Value—3 to 5
Chroma—3 or 4
Texture—fine sandy loam, loam, sandy clay loam, or clay loam

C horizon:
Hue—2.5Y or 10YR
Value—5 to 7
Chroma—2 to 4
Texture—stratified sand, coarse sand, fine sand, loamy fine sand, fine sandy loam, very fine sandy loam, loam, or silt loam

Lobo Series

Drainage class: Very poorly drained
Permeability: Rapid in the upper part; moderate or moderately rapid in the lower part
Landform: Till-floored glacial lake plains
Parent material: Slightly decomposed herbaceous material (sphagnum moss) underlain by moderately decomposed herbaceous material
Slope range: 0 to 1 percent
Taxonomic class: Dysic, frigid Hemic Sphagnofibrists

Typical Pedon

Lobo peat, in an area of Greenwood-Lobo complex; 1,750 feet north and 2,125 feet west of the southeast corner of sec. 8, T. 156 N., R. 30 W.

Oi—0 to 37 inches; fibric material, light yellowish brown (10YR 6/4) broken face and rubbed, very pale brown (10YR 7/4) pressed; about 100 percent fiber, about 80 percent rubbed; weak thick platy structure; very friable; mostly sphagnum fibers; extremely acid; clear smooth boundary.

Oe—37 to 84 inches; hemic material, dark reddish brown (5YR 3/2) broken face, rubbed, and pressed; about 70 percent fiber, about 40 percent rubbed; weak thick platy structure; very friable; primarily herbaceous fibers; about 4 percent mineral material; extremely acid.

Range in Characteristics

Thickness of organic material: More than 60 inches
Reaction: Extremely acid
Organic material: Fibric material extending from the surface to a depth of 35 to 53 inches and thin layers of hemic or sapric material that have a total thickness of less than 5 inches

Oi horizon:
Hue—10YR, 7.5YR, or 5YR
Value—3 to 7
Chroma—2 to 4
Content of fiber—90 to 100 percent unrubbed; 80 to 100 percent rubbed

Oe horizon:
Hue—10YR, 7.5YR, or 5YR
Value—2 or 3
Chroma—1 or 2
Content of fiber—35 to 70 percent unrubbed; 20 to 45 percent rubbed

Lupton Series

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Till-floored glacial lake plains and till plains
Parent material: Highly decomposed woody organic material
Slope range: 0 to 1 percent
Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Lupton muck, 30 feet north and 50 feet east of the southwest corner of sec. 29, T. 149 N., R. 31 W.

Oa1—0 to 25 inches; sapric material, dark reddish brown (5YR 2.5/2) broken face, dark reddish brown (5YR 3/2) rubbed and pressed; about 15 percent fiber, about 5 percent rubbed; weak medium platy structure; very friable; about 15 percent woody fragments more than 2 millimeters in size; neutral; abrupt wavy boundary.

Oa2—25 to 60 inches; sapric material, dark reddish brown (5YR 3/2) broken face, dark brown (7.5YR 3/2) rubbed and pressed; about 10 percent fiber, about 3 percent rubbed; weak thin platy structure; very friable; about 30 percent woody fragments more than 2 millimeters in size; neutral.

Range in Characteristics

Thickness of organic material: More than 51 inches
Depth to mineral soil: More than 51 inches
Organic material: Sapric material that has a fiber content ranging from 20 to 50 percent unrubbed and from 0 to 10 percent rubbed; contains 0 to 30 percent wood fragments more than 2 millimeters in size

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

Markey Series

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; rapid in the lower part
Landform: Till-floored glacial lake plains and outwash plains
Parent material: Highly decomposed herbaceous organic material overlying outwash sediments
Slope range: 0 to 1 percent
Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Markey muck, 100 feet east and 100 feet south of the northwest corner of sec. 29, T. 155 N., R. 38 W.

Oa—0 to 24 inches; sapric material, black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed and pressed; about 10 percent fiber, about 3 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fibers; neutral; clear wavy boundary.

C—24 to 60 inches; grayish brown (2.5Y 5/2) loamy sand; few fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; neutral.

Range in Characteristics

Thickness of organic material: 16 to 51 inches
Depth to mineral soil: 16 to 51 inches

Organic material:
Content of fiber—15 to 35 percent unrubbed; 0 to 10 percent rubbed
Hue—5YR, 7.5YR, or 10YR
Value—2 or 3
Chroma—1 or 2

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

Marquette Series

Drainage class: Excessively drained
Permeability: Moderately rapid in the upper part; very rapid in the lower part
Landform: Beach ridges and outwash plains
Parent material: Sandy and gravelly deposits
Slope range: 1 to 12 percent
Taxonomic class: Loamy-skeletal, mixed Psammentic Eutroboralfs

Typical Pedon

Marquette loamy sand, 1 to 6 percent slopes, 10 feet north and 10 feet west of the southeast corner of sec. 19, T. 158 N., R. 36 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; about 2 percent gravel; slightly acid; abrupt wavy boundary.

E—3 to 13 inches; dark yellowish brown (10YR 4/4) sand, yellowish brown (10YR 5/4) dry; single grain; loose; about 12 percent gravel; slightly acid; abrupt wavy boundary.

Bt—13 to 18 inches; dark yellowish brown (10YR 3/4) very gravelly sandy loam; few medium faint dark brown (7.5YR 3/4) organic stains; weak medium subangular blocky structure; very friable; common faint dark grayish brown (10YR 4/3) clay films on faces of peds; about 40 percent gravel; neutral; clear wavy boundary.

C—18 to 60 inches; pale brown (10YR 6/3) gravelly sand; single grain; loose; about 25 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 8 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand
Content of rock fragments—0 to 15 percent gravel

E horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—loamy sand, loamy coarse sand, sand, coarse sand, or the gravelly analogs of those textures
Content of rock fragments—0 to 35 percent gravel

Bt horizon:
Hue—7.5YR or 10YR
Value—3 to 5
Chroma—3 or 4
Texture—the very gravelly or extremely gravelly analogs of sandy loam, fine sandy loam, coarse sandy loam, or loam
Content of rock fragments—35 to 75 percent gravel

C horizon:
Hue—10YR
Value—5 or 6
Chroma—2 to 5
Texture—sand, coarse sand, loamy sand, loamy coarse sand, or the gravelly, very gravelly, or extremely gravelly analogs of those textures
Content of rock fragments—10 to 75 percent gravel

Meehan Series

Drainage class: Somewhat poorly drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy glacial deposits
Slope range: 0 to 2 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Meehan loamy sand, 1,000 feet north and 1,000 feet east of the southwest corner of sec. 19, T. 147 N., R. 34 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) loamy sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; moderately acid; clear smooth boundary.

Bw—5 to 14 inches; yellowish brown (10YR 5/4) sand; few fine distinct grayish brown (10YR 4/2) and common medium distinct brown (7.5YR 4/4) mottles; single grain; loose; slightly acid; clear smooth boundary.

BC—14 to 30 inches; light yellowish brown (10YR 6/4) sand; common medium distinct brown (7.5YR 4/4) and few fine distinct dark grayish brown (10YR 4/2) mottles; single grain; loose; slightly acid; clear smooth boundary.

C—30 to 60 inches; light gray (10YR 7/2) sand; few medium prominent brown (7.5YR 4/4) mottles; single grain; loose; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent gravel
Other features: An E horizon in some pedons

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand

Bw horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 to 8
Texture—sand, loamy sand, coarse sand, or loamy coarse sand

BC horizon:
Colors—similar to those of the B and C horizons
Textures—similar to those of the B and C horizons

C horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 to 4
Texture—sand, coarse sand

Menahga Series

Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and valley trains
Parent material: Sandy sediments
Slope range: 1 to 25 percent
Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Menahga loamy sand, 1 to 6 percent slopes, 600 feet north and 300 feet east of the southwest corner of sec. 23, T. 146 N., R. 35 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; moderately acid; abrupt smooth boundary.

Bw—3 to 30 inches; yellowish brown (10YR 5/4) sand; single grain; loose; moderately acid; clear wavy boundary.

C—30 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent
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—10YR or 7.5YR
Value—3 to 5
Chroma—3 to 6
Texture—coarse sand, sand

C horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—coarse sand, sand

Mooselake Series

Drainage class: Very poorly drained
Permeability: Moderately rapid
Landform: Outwash plains and till plains
Parent material: Moderately decomposed woody organic material
Slope range: 0 to 1 percent
Taxonomic class: Euic Typic Borohemists

Typical Pedon

Mooselake mucky peat, about 100 feet south and 2,500 feet east of the northwest corner of sec. 3, T. 154 N., R. 30 W.

Oe1—0 to 40 inches; hemic material, very dark grayish brown (10YR 3/2) broken faced, rubbed, and pressed; about 50 percent fiber, about 30 percent rubbed; weak thick platy structure; very friable; about 15 percent woody fragments more than 2 millimeters in size; strongly acid; gradual smooth boundary.

Oe2—40 to 60 inches; hemic material, dark brown (7.5YR 3/2) broken face, brown (7.5YR 4/2) rubbed and pressed; about 40 percent fiber, about 20 percent rubbed; weak thick platy structure; very friable; about 15 percent woody fragments more than 2 millimeters in size; moderately acid.

Range in Characteristics

Thickness of organic material: More than 51 inches
Depth to mineral soil: More than 51 inches
Organic material:
Content of fiber—35 to 65 percent unrubbed; 15 to 45 percent rubbed
Hue—5YR, 7.5YR, or 10YR
Value—2 or 3
Chroma—2 or 3

Morph Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Till-floored glacial lake plains and water-modified till plains
Parent material: Stratified loamy and sandy glaciofluvial or lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Glossaqualfs

Typical Pedon

Morph fine sandy loam, about 1,500 feet south and 100 feet west of the northeast corner of sec. 13, T. 152 N., R. 32 W.

A—0 to 4 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; slightly acid; clear wavy boundary.

Eg—4 to 13 inches; grayish brown (2.5Y 5/2) very fine sandy loam, gray (10YR 6/1) dry; few fine distinct light olive brown (2.5Y 5/6) mottles; weak thin platy structure; very friable; moderately acid; clear wavy boundary.

B/E—13 to 21 inches; grayish brown (2.5Y 5/2) loam (Bt); penetrated by tongues and interfingerings of light brownish gray (2.5Y 6/2) fine sandy loam (E); distinct light yellowish brown (2.5Y 6/4) mottles; weak fine subangular blocky structure; very friable; moderately acid; clear wavy boundary.

Btg1—21 to 27 inches; olive gray (5Y 5/2) loam; common fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure; friable; few faint olive gray (5Y 4/2) clay films on faces of peds; moderately acid; clear wavy boundary.

Btg2—27 to 35 inches; olive gray (5Y 5/2) loam and fine sandy loam; common fine prominent light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure; friable; few faint olive gray (5Y 4/2) clay films on faces of peds; moderately acid; clear wavy boundary.

Cg—35 to 60 inches; light olive gray (5Y 6/2), stratified silt loam, very fine sandy loam, loamy fine sand, and loam; common medium prominent olive yellow (2.5Y 6/6) mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 22 to 50 inches
Content of rock fragments: 0 to 3 percent gravel
Other features: An E/B horizon in some pedons

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

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

B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

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

C horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—stratified loam, fine sandy loam, very fine sandy loam, loamy fine sand, silt loam, or sandy loam

Nary Series

Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines and till plains
Parent material: Till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Nary cobbly fine sandy loam, about 800 feet east and 1,800 feet north of the southwest corner of sec. 30, T. 146 N., R. 32 W.

A—0 to 4 inches; very dark brown (10YR 2/2) cobbly fine sandy loam, grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine roots; about 5 percent pebbles and 20 percent cobbles; moderately acid; clear wavy boundary.

E—4 to 14 inches; grayish brown (10YR 5/2) cobbly fine sandy loam; weak thin platy structure; friable; many fine roots; about 5 percent pebbles and 20 percent cobbles; moderately acid; clear irregular boundary.

B/E—14 to 22 inches; dark yellowish brown (10YR 4/4) sandy clay loam (Bt); weak fine subangular blocky structure; penetrated by tongues of grayish brown (10YR 5/2) fine sandy loam (E); single grain; loose; few fine faint dark grayish brown (2.5Y 4/2) mottles in the lower part; about 5 percent pebbles and 5 percent cobbles; strongly acid; clear irregular boundary.

Bt1—22 to 31 inches; dark yellowish brown (10YR 4/4) sandy clay loam; few fine faint grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to moderate medium angular blocky; grayish brown (10YR 5/2) clean sand and silt coatings on faces of prisms; many prominent dark grayish brown (10YR 4/2) clay films on faces of peds and in root channels; about 5 percent coarse fragments; strongly acid; gradual wavy boundary.

Bt2—31 to 45 inches; yellowish brown (10YR 5/4) fine sandy loam; few fine distinct light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; many prominent dark grayish brown (2.5Y 4/2) clay films on faces of peds and in root channels; about 5 percent coarse fragments; neutral; gradual wavy boundary.

C—45 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; common fine faint grayish brown (2.5Y 5/2) mottles; massive; friable; few fine distinct brown (10YR 4/3) clay films in old root channels; about 5 percent coarse fragments; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches
Other features: An E/B horizon in some pedons

A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—cobbly fine sandy loam
Content of rock fragments—0 to 10 percent gravel; 5 to 15 percent cobbles

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—cobbly loamy sand, cobbly loamy fine sand, cobbly fine sandy loam, or cobbly sandy loam
Content of rock fragments—0 to 10 percent gravel; 5 to 15 percent cobbles

B/E horizon:
Colors—similar to those of the B and E horizons
Texture—similar to those of the B and E horizons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—sandy clay loam, loam, or fine sandy loam
Content of rock fragments—2 to 5 percent gravel; 0 to 1 percent cobbles

C horizon:
Hue—2.5Y or 10YR
Value—3 to 6
Chroma—2 to 5
Texture—fine sandy loam or sandy loam
Content of rock fragments—2 to 5 percent gravel; 0 to 1 percent cobbles

Nebish Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines and till plains
Parent material: Till
Slope range: 1 to 25 percent
Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Nebish sandy loam, 1 to 6 percent slopes, 1,300 feet north and 100 feet east of the southwest corner of sec. 4, T. 149 N., R. 30 W.

A—0 to 3 inches; very dark gray (10YR 3/1) sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

E—3 to 9 inches; grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; friable; about 5 percent gravel; neutral; abrupt wavy boundary.

Bt—9 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium angular blocky structure; firm; common distinct brown (10YR 4/3) clay films on faces of peds; about 3 percent gravel; neutral; gradual wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; very friable; about 5 percent gravel; common medium irregularly shaped carbonates in seams and soft masses; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 36 inches
Content of rock fragments: 2 to 8 percent gravel

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

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—sandy loam, fine sandy loam, very fine sandy loam, or loam

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—clay loam or loam

C horizon:
Hue—2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—loam or clay loam

Northwood Series

Drainage class: Very poorly drained
Permeability: Moderately rapid or rapid in the upper part; moderate in the lower part
Landform: Till-floored glacial lake plains
Parent material: Highly decomposed organic material and sandy sediments overlying till
Slope range: 0 to 1 percent
Taxonomic class: Sandy over loamy, mixed, nonacid, frigid Histic Humaquepts

Typical Pedon

Northwood muck, 2,000 feet east and 60 feet north of the southwest corner of sec. 32, T. 157 N., R. 38 W.

Oa—0 to 9 inches; black (10YR 2/1) muck, very dark gray (10YR 3/1) dry; weak thin platy structure; very friable; about 2 percent fibers rubbed; neutral; abrupt smooth boundary.

A—9 to 14 inches; very dark gray (5Y 3/1) fine sandy loam; weak fine angular blocky structure; very friable; about 3 percent gravel; neutral; clear wavy boundary.

Bg1—14 to 18 inches; olive gray (5Y 4/2) loamy fine sand; few fine faint gray (5Y 6/1) and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

Bg2—18 to 24 inches; grayish brown (2.5Y 5/2) loamy fine sand; common fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; about 10 percent gravel; neutral; abrupt wavy boundary.

Cg—24 to 60 inches; olive gray (5Y 5/2) loam; few fine faint gray (5Y 6/1) and common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; about 3 percent gravel; common distinct irregularly shaped carbonates in seams and soft masses; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the histic epipedon: 8 to 16 inches
Depth to carbonates: 20 to 60 inches
Content of rock fragments: 0 to 15 percent gravel

Oa horizon:
Hue—5Y, 2.5Y, or 10YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material

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

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, or loamy fine sand

2Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—4 to 7
Chroma—1 or 2
Texture—loam, fine sandy loam, clay loam, or silty clay loam
Content of rock fragments—0 to 8 percent gravel

Pelan Series

Drainage class: Moderately well drained
Permeability: Rapid in the upper part; moderate in the lower part
Landform: Till-floored glacial lake plains
Parent material: Thin mantle of sandy and gravelly material overlying till

Slope range: 1 to 3 percent
Taxonomic class: Loamy-skeletal, mixed Psammentic Eutroboralfs

Typical Pedon

Pelan sandy loam, about 1,500 feet west and 500 feet north of the southeast corner of sec. 23, T. 158 N., R. 37 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

E—3 to 12 inches; brown (10YR 5/3) gravelly sand, grayish brown (10YR 5/2) dry; single grain; loose; about 25 percent gravel; slightly acid; abrupt wavy boundary.

Bt—12 to 17 inches; dark brown (10YR 3/3) very gravelly sandy loam; moderate fine angular blocky structure; friable; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 40 percent gravel; neutral; gradual wavy boundary.

C1—17 to 24 inches; olive brown (2.5Y 5/4) very gravelly sand; single grain; loose; about 40 percent gravel; strong effervescence; moderately alkaline; abrupt wavy boundary.

2C2—24 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; common medium distinct grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) mottles; massive; friable; about 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 10 to 24 inches

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

E horizon:
Hue—10YR
Value—4 or 5
Chroma—2 or 3
Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the gravelly analogs of those textures
Content of rock fragments—0 to 25 percent gravel

Bt horizon:
Hue—10YR
Value—3 or 4
Chroma—2 to 4
Texture—coarse sand, sandy loam, sandy clay loam, or the very gravelly analogs of those textures
Content of rock fragments—35 to 65 percent gravel

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the very gravelly analogs of those textures
Content of rock fragments—35 to 65 percent gravel

2C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 or 3
Texture—sandy loam, loam, or fine sandy loam
Content of rock fragments—5 to 15 percent gravel

Pengilly Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Stratified loamy, silty, and sandy alluvium
Slope range: 0 to 2 percent
Taxonomic class: Coarse-loamy, mixed, nonacid, frigid Typic Fluvaquents

Typical Pedon

Pengilly very fine sandy loam, 200 feet north and 100 feet west of the southeast corner of sec. 4, T. 151 N., R. 31 W.

A—0 to 4 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

Cg1—4 to 12 inches; grayish brown (10YR 5/2) loamy very fine sand; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; very friable; neutral; clear smooth boundary.

Cg2—12 to 22 inches; dark grayish brown (2.5Y 4/2) very fine sandy loam; few medium distinct light brownish gray (2.5Y 6/2) and few fine prominent yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; very friable; neutral; clear wavy boundary.

Cg3—22 to 30 inches; dark olive gray (5Y 3/2) silt loam; few fine prominent yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very friable; neutral; clear wavy boundary.

Cg4—30 to 60 inches; dark grayish brown (2.5Y 4/2), stratified very fine sandy loam, silt loam, loam, and fine sandy loam; common medium prominent dark brown (7.5YR 4/4) and reddish brown (5YR 4/4) and common medium distinct light brownish gray (10YR 6/2) mottles; laminated; very friable; neutral.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Content of rock fragments: 0 to 5 percent gravel

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

Cg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6
Chroma—1 or 2
Texture—stratified very fine sandy loam, loamy very fine sand, fine sandy loam, silt loam, loam, or sandy loam

Redby Series

Drainage class: Somewhat poorly drained
Permeability: Rapid
Landform: Till-floored glacial lake plains
Parent material: Sandy sediments
Slope range: 1 to 3 percent
Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Redby loamy fine sand, 2,680 feet south and 50 feet east of the northwest corner of sec. 23, T. 151 N., R. 32 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; moderately acid; abrupt wavy boundary.

E—3 to 8 inches; grayish brown (10YR 5/2) fine sand, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; moderately acid; clear wavy boundary.

Bw—8 to 30 inches; yellowish brown (10YR 5/4) fine sand; common medium distinct light brownish gray (10YR 6/2) and common medium prominent strong brown (7.5YR 4/6) and reddish brown (5YR 4/4) mottles; single grain; loose; slightly acid; clear wavy boundary.

C—30 to 60 inches; light brownish gray (10YR 6/2) fine sand; common medium prominent strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; single grain; loose; slightly acid.

Range in Characteristics

Depth to carbonates: 30 to 80 inches
Content of rock fragments: 0 to 2 percent gravel

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

E horizon:
Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—loamy fine sand, fine sand

Bw horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—fine sand, sand

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 or 3
Texture—fine sand, sand

Rifle Series

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Landform: Till-floored glacial lake plains and till plains
Parent material: Moderately decomposed herbaceous organic material
Slope range: 0 to 1 percent
Taxonomic class: Euic Typic Borohemists

Typical Pedon

Rifle mucky peat, 2,640 feet south and 300 feet east of the northwest corner of sec. 18, T. 156 N., R. 30 W.

Oe1—0 to 18 inches; hemic material, dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 3/3) rubbed and pressed; about 50 percent fiber, about 20 percent rubbed; weak thick platy structure; very friable; mostly herbaceous fibers; slightly acid; gradual smooth boundary.

Oe2—18 to 63 inches; hemic material, dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 3/4) rubbed and pressed; about 70 percent fiber, about 20 percent rubbed; weak thick platy structure; very friable; mostly herbaceous fibers; slightly acid.

Range in Characteristics

Thickness of organic material: More than 51 inches

Depth to mineral soil: More than 51 inches

Organic material:
Content of fiber—35 to 65 percent unrubbed; 15 to 45 percent rubbed
Hue—5YR, 7.5YR, or 10YR
Value—2 to 4
Chroma—2 to 4

Rockwell Series

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; moderate or moderately slow in the lower part
Landform: Glacial lake plains
Parent material: Loamy and sandy mantle over calcareous till
Slope range: 0 to 1 percent
Taxonomic class: Coarse-loamy, frigid Typic Calciaquolls

Typical Pedon

Rockwell fine sandy loam, 2,800 feet south and 100 feet west of the northeast corner of sec. 21, T. 156 N., R. 38 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bk—9 to 17 inches; dark gray (5Y 4/1) and olive gray (5Y 5/2) fine sandy loam; weak fine subangular blocky structure; very friable; disseminated carbonates; violent effervescence; moderately alkaline; abrupt wavy boundary.

Cg1—17 to 26 inches; light olive gray (5Y 6/2) sand; common medium distinct dark grayish brown (2.5Y 4/2) mottles; single grain; loose; few thin strata that are as much as 5 percent gravel; strong effervescence; slightly alkaline; abrupt smooth boundary.

2Cg2—26 to 60 inches; light brownish gray (2.5Y 6/2) loam; few fine faint gray (5Y 5/1) and light olive brown (2.5Y 5/6) mottles; massive; very friable; about 3 percent gravel; many distinct irregularly shaped carbonates in seams; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 18 inches
Carbonates: Throughout the profile

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

Bk horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 6
Chroma—1 or 2
Texture—sandy loam, fine sandy loam, or loam

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

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—loam, silt loam, fine sandy loam, very fine sandy loam, or clay loam
Content of rock fragments—0 to 8 percent gravel

Roliss Series

Drainage class: Poorly drained
Permeability: Moderate or moderately slow
Landform: Till-floored glacial lake plains
Parent material: Calcareous till
Slope range: 0 to 1 percent
Taxonomic class: Fine-loamy, mixed (calcareous), frigid Typic Haplaquolls

Typical Pedon

Roliss loam, 2,640 feet north and 2,300 feet east of the southwest corner of sec. 29, T. 156 N., R. 38 W.

A—0 to 8 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine granular structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

Bg—8 to 12 inches; dark gray (5Y 4/1) loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; about 5 percent gravel; slight effervescence; slightly alkaline; abrupt wavy boundary.

Cg—12 to 60 inches; light olive gray (5Y 6/2) loam; few fine prominent yellowish brown (10YR 5/6) and few fine distinct light olive brown (2.5Y 5/4) mottles; massive; very friable; about 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 18 inches
Content of rock fragments: 2 to 10 percent gravel

A horizon:
Hue—10YR or neutral

Value—2
Chroma—0 or 1
Texture—loam

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

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

Rondeau Series

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; slow in the lower part
Landform: Postglacial lakes
Parent material: Highly decomposed herbaceous organic material overlying limnic sediments
Slope range: 0 to 1 percent
Taxonomic class: Marly, euic Limnic Borosaprists

Typical Pedon

Rondeau muck, about 2,640 feet west and 50 feet south of the northeast corner of sec. 14, T. 149 N., R. 35 W.

Oa—0 to 18 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 10 percent fiber, less than 1 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fibers; about 25 percent mineral material; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg1—18 to 24 inches; black (N 2/0) coprogenous earth; massive; very friable; slightly sticky; about 3 percent shells and shell fragments 1 to 5 millimeters in size; about 75 percent mineral material; strong effervescence; slightly alkaline; abrupt smooth boundary.

Cg2—24 to 60 inches; light gray (10YR 7/2) marl; few fine distinct yellow (10YR 7/6) mottles; massive; friable; about 10 percent shells and shell fragments 1 to 5 millimeters in size; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to marl: 16 to 51 inches

Oa horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sapric material

Rosewood Series

Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part; rapid in the lower part
Landform: Till-floored glacial lake plains
Parent material: Sandy, calcareous lacustrine deposits
Slope range: 0 to 2 percent
Taxonomic class: Sandy, frigid Typic Calciaquolls

Typical Pedon

Rosewood fine sandy loam, 1,320 feet west and 1,320 feet south of the northeast corner of sec. 8, T. 158 N., R. 38 W.

A—0 to 7 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; slight effervescence; slightly alkaline; abrupt wavy boundary.

ABk—7 to 11 inches; very dark gray (5Y 3/1) and gray (5Y 5/1) fine sandy loam; weak fine subangular blocky structure; very friable; disseminated carbonates; violent effervescence; slightly alkaline; clear wavy boundary.

Bkg—11 to 18 inches; gray (5Y 5/1) loamy fine sand; few fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; very friable; disseminated carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

Cg—18 to 60 inches; grayish brown (2.5Y 5/2) fine sand; few medium distinct olive yellow (2.5Y 6/8) mottles; single grain; loose; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to calcic horizon: 0 to 16 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 0 to 10 percent
Other features: A BA horizon in some pedons

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

ABk horizon:
Colors—similar to those of the A and B horizons
Textures—similar to those of the A and B horizons

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

Chroma—1 or 2
Texture—loamy fine sand, loamy sand, sandy loam, or fine sandy loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—fine sand, sand, or coarse sand

Rosy Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till-floored glacial lake plains and water-modified till plains
Parent material: Stratified loamy and sandy sediments
Slope range: 1 to 3 percent
Taxonomic class: Coarse-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Rosy sandy loam, about 1,800 feet south and 50 feet east of the northwest corner of sec. 15, T. 148 N., R. 31 W.

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

E—2 to 15 inches; light brownish gray (10YR 6/2) fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; moderately acid; abrupt wavy boundary.

B/E—15 to 23 inches; dark yellowish brown (10YR 4/4) sandy loam (Bt); penetrated by tongues and interfingerings of light brownish gray (10YR 6/2) fine sandy loam (E); weak fine angular blocky structure; very friable; moderately acid; clear wavy boundary.

Bt—23 to 36 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak fine angular blocky structure; very friable; common distinct brown (10YR 4/3) clay films on faces of peds; moderately acid; abrupt wavy boundary.

E&Bt—36 to 42 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4), stratified fine sandy loam, sandy loam, loam, and silt loam (Bt); few fine faint light brownish gray (10YR 6/2) mottles; weak fine angular blocky structure; very friable; interlayered with grayish brown (10YR 5/2) sand and loamy sand (E); weak fine subangular blocky structure; very friable; common distinct brown (10YR 4/3) clay films on faces of peds; moderately acid; abrupt wavy boundary.

C1—42 to 55 inches; light gray (10YR 7/2) and light yellowish brown (10YR 6/4), stratified loamy fine sand, sandy loam, and silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; very friable; neutral; abrupt wavy boundary.

C2—55 to 60 inches; light olive brown (2.5Y 5/4), stratified loam and silt loam; few fine faint grayish brown (2.5Y 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; very friable; violent effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches
Other features: An E/B horizon in some pedons

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

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

B/E and E&Bt horizons:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

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

C horizon:
Hue—2.5Y or 10YR
Value—4 to 7
Chroma—2 to 4
Texture—stratified sandy loam, loamy sand, loamy fine sand, fine sandy loam, very fine sandy loam, loam, or silt loam

Sandwick Series

Drainage class: Somewhat poorly drained
Permeability: Rapid in the upper part; moderately slow in the lower part
Landform: Till plains
Parent material: Sandy glacial outwash overlying loamy till
Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, frigid Arenic Glossaqualfs

Typical Pedon

Sandwick loamy fine sand, about 1,800 feet south and 50 feet west of the northeast corner of sec. 36, T. 152 N., R. 30 W.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; moderately acid; clear smooth boundary.

E1—2 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, gray (10YR 6/1) dry; common fine faint yellowish brown (10YR 5/4) mottles; weak thin platy structure; very friable; moderately acid; clear smooth boundary.

E2—8 to 22 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; common medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; moderately acid; clear wavy boundary.

2B/E—22 to 29 inches; grayish brown (10YR 5/2) clay loam (Bt); penetrated by tongues and interfingerings of light brownish gray (2.5Y 6/2) fine sand (E); many coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 2 percent gravel; moderately acid; gradual smooth boundary.

2Btg1—29 to 40 inches; grayish brown (10YR 5/2) loam; many coarse prominent strong brown (7.5YR 5/6) and many medium faint light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

2Btg2—40 to 48 inches; brown (10YR 5/3) loam; many coarse prominent strong brown (7.5YR 4/6) and many medium faint light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

2Cg—48 to 60 inches; grayish brown (2.5Y 5/2) loam; common coarse prominent yellowish brown (10YR 5/6) and common coarse distinct light olive brown (2.5Y 5/4) mottles; massive; friable; about 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches
Depth to carbonates: 40 to more than 60 inches
Other features: An E/B horizon in some pedons

A or Ap horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—loamy fine sand
Content of rock fragments—2 to 10 percent gravel

E horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—1 to 3
Texture—loamy fine sand, loamy sand, fine sand, or sand
Content of rock fragments—2 to 10 percent gravel

2B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

2Btg horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 or 3
Texture—loam, clay loam, or sandy clay loam

2Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7
Chroma—1 or 2
Texture—loam, clay loam, fine sandy loam, or sandy loam

Sartell Series

Drainage class: Excessively drained
Permeability: Rapid
Landform: Till-floored glacial lake plains and outwash plains
Parent material: Sandy sediments
Slope range: 1 to 6 percent slopes
Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Sartell loamy fine sand, 1 to 6 percent slopes, 2,640 feet west and 2,640 feet south of the northeast corner of sec. 5, T. 158 N., R. 37 W.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; moderately acid; abrupt wavy boundary.

Bw—6 to 40 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; moderately acid; clear wavy boundary.

C—40 to 60 inches; yellow (10YR 7/6) fine sand; single grain; loose; moderately acid.

Range in Characteristics

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

B horizon:
Hue—10YR
Value—3 to 5
Chroma—3 to 5
Texture—fine sand, sand

C horizon:
Hue—10YR
Value—5 to 7
Chroma—2 to 6
Texture—fine sand, sand

Seelyeville Series

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Landform: Till-floored glacial lake plains, till plains, and flood plains
Parent material: Highly decomposed herbaceous organic material
Slope range: 0 to 1 percent
Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Seelyeville muck, 2,000 feet south and 100 feet west of the northeast corner of sec. 22, T. 155 N., R. 38 W.

Oa1—0 to 10 inches; sapric material, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed and pressed; about 15 percent fiber, about 1 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fiber; slightly acid; clear wavy boundary.

Oa2—10 to 63 inches; sapric material, very dark brown (10YR 2/2) broken face, rubbed, and pressed; about 5 percent fiber, about 1 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fiber; neutral.

Range in Characteristics

Thickness of organic material: More than 51 inches
Depth to mineral soil: More than 51 inches

Organic material:
Content of fiber—15 to 25 percent unrubbed; 0 to 10 percent rubbed
Hue—7.5YR or 10YR
Value—2 or 3
Chroma—1 or 2

Shooker Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Ochraqualfs
Taxadjunct features: The Shooker soils in this survey area have a darker A horizon than is defined as the range for the series. They are classified as Mollic Ochraqualfs.

Typical Pedon

Shooker loam, 800 feet east and 50 feet north of the southwest corner of sec. 5, T. 147 N., R. 35 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; about 2 percent gravel; slightly acid; abrupt smooth boundary.

E—6 to 9 inches; light brownish gray (2.5Y 6/2) fine sandy loam, light gray (2.5Y 7/2) dry; few fine prominent olive yellow (2.5Y 6/8) mottles; weak thin platy structure; very friable; about 2 percent gravel; neutral; abrupt wavy boundary.

Btg—9 to 28 inches; grayish brown (2.5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; strong medium angular blocky structure; firm; many distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 4 percent gravel; neutral; clear wavy boundary.

Cg—28 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium prominent olive yellow (10YR 6/8) mottles; massive; very friable; about 6 percent gravel; weak effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 44 inches
Content of rock fragments: 2 to 8 percent
Other features: An E/B or B/E horizon in some pedons

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

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

Btg horizon:
Hue—2.5Y, 5Y, or 10YR
Value—4 to 6
Chroma—1 or 2
Texture—loam, clay loam, or sandy clay loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 to 7
Chroma—2 to 4
Texture—loam or sandy clay loam

Smiley Series

Drainage class: Poorly drained and very poorly drained
Permeability: Moderate
Landform: Till-floored glacial lake plains
Parent material: Calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Typic Argiaquolls

Typical Pedon

Smiley loam, 2,640 feet north and 100 feet west of the southeast corner of sec. 7, T. 155 N., R. 37 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; about 5 percent gravel; neutral; abrupt wavy boundary.

Btg—8 to 13 inches; dark gray (5Y 4/1) clay loam; few fine prominent dark yellowish brown (10YR 4/4) mottles; weak fine angular blocky structure; friable; common distinct very dark grayish brown (2.5Y 3/2) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Cg—13 to 60 inches; light olive gray (5Y 6/2) loam; few medium prominent light olive brown (2.5Y 5/6) mottles; massive; very friable; about 5 percent gravel; violent effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 10 to 26 inches
Thickness of the mollic epipedon: 7 to 14 inches
Content of rock fragments: 2 to 10 percent
Other features: An Oa horizon in some pedons

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

Btg horizon:
Hue—2.5Y or 5Y
Value—3 to 5
Chroma—1 to 3
Texture—clay loam, sandy clay loam, or loam

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam or clay loam

Snellman Series

Drainage class: Well drained
Permeability: Moderate
Landform: Moraines and till plains
Parent material: Till
Slope range: 1 to 25 percent
Taxonomic class: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Snellman fine sandy loam, 1 to 6 percent slopes, 300 feet north and 200 feet west of the southeast corner of sec. 22, T. 150 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; very friable; about 2 percent gravel; moderately acid; clear smooth boundary.

E—3 to 12 inches; brown (10YR 5/3) fine sandy loam, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; very friable; about 2 percent gravel; moderately acid; clear smooth boundary.

B/E—12 to 19 inches; dark yellowish brown (10YR 4/4) sandy clay loam (Bt); interfingerings of brown (10YR 5/3) fine sandy loam (E); moderate medium subangular blocky structure; friable; common faint dark brown (10YR 4/3) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt—19 to 29 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; friable; common faint dark brown (10YR 4/3) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

C—29 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; very friable; common fine irregularly shaped carbonates in seams; about 8 percent gravel; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 2 to 15 percent
Other features: An E/B horizon in some pedons

A horizon:
Hue—10YR

Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam

E horizon:
Hue—10YR
Value—5 or 6
Chroma—2 or 3
Texture—fine sandy loam, loamy fine sand, sandy loam, or loamy sand

B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

Bt horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—loam, sandy clay loam, or sandy loam

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—fine sandy loam or sandy loam

Sol Series

Drainage class: Well drained
Permeability: Moderate in the upper part; moderately slow in the lower part
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 1 to 12 percent
Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Sol cobbly sandy loam, 1 to 6 percent slopes, 2,500 feet west and 20 feet north of the southeast corner of sec. 24, T. 146 N., R. 33 W.

A—0 to 4 inches; very dark gray (10YR 3/1) cobbly sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; about 20 percent coarse fragments, mostly more than 3 inches in size; moderately acid; abrupt smooth boundary.

E—4 to 13 inches; brown (10YR 5/3) cobbly loamy sand, light gray (10YR 7/2) dry; weak thin platy structure; very friable; about 25 percent coarse fragments, including about 15 percent that are more than 3 inches in size; moderately acid; clear irregular boundary.

B/E—13 to 20 inches; dark yellowish brown (10YR 4/4) loam (Bt); weak medium angular blocky structure; friable; penetrated by tongues and interfingerings of grayish brown (10YR 5/2) fine sand (E); massive; very friable; few distinct very dark grayish brown (10YR 3/2) clay films in root channels; about 10 percent coarse fragments; moderately acid; gradual wavy boundary.

Bt1—20 to 28 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium prismatic structure parting to weak medium angular blocky; firm; many prominent very dark brown (10YR 3/2) clay films on faces of peds and in root channels; about 5 percent coarse fragments; slightly acid; clear wavy boundary.

Bt2—28 to 52 inches; olive brown (2.5Y 4/4) loam; weak coarse prismatic structure parting to weak medium angular blocky; firm; many prominent very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in root channels; about 5 percent coarse fragments; slightly acid; gradual wavy boundary.

C—52 to 60 inches; olive brown (2.5Y 4/4) fine sandy loam; weak medium angular blocky structure; friable; about 5 percent coarse fragments; few fine filaments of lime; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches
Content of rock fragments: 2 to 10 percent gravel
Other features: An E/B horizon in some pedons

A or Ap horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—cobbly sandy loam
Content of rock fragments—5 to 35 percent cobbles

E horizon:
Hue—10YR
Value—5 or 6
Chroma—2 or 3
Texture—loamy sand, loamy fine sand, fine sand, or the cobbly analogs of those textures
Content of rock fragments—5 to 35 percent cobbles

B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

Bt horizon:
Hue—10YR or 2.5Y in the lower part
Value—3 to 5
Chroma—3 to 5
Texture—generally loam or sandy clay loam; thin subhorizons of sandy loam or fine sandy loam in some pedons

C horizon:
Hue—2.5Y
Value—4 to 6

Chroma—4 or 5
Texture—sandy loam or fine sandy loam

Spooner Series

Drainage class: Poorly drained
Permeability: Moderate
Landform: Water-modified till plains
Parent material: Lacustrine sediments
Slope range: 0 to 2 percent
Taxonomic class: Fine-silty, mixed, frigid Typic Ochraqualfs

Typical Pedon

Spooner silt loam, 100 feet west and 100 feet north of the southeast corner of sec. 35, T. 149 N., R. 32 W.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

E—4 to 7 inches; grayish brown (2.5Y 5/2) very fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak thin platy structure; very friable; neutral; clear wavy boundary.

Btg1—7 to 15 inches; olive gray (5Y 4/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; firm; common faint dark olive gray (5Y 3/2) clay films on faces of peds; neutral; abrupt wavy boundary.

Btg2—15 to 25 inches; olive gray (5Y 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few distinct olive (5Y 4/3) clay films on faces of peds; neutral; abrupt wavy boundary.

Cg—25 to 60 inches; light olive gray (5Y 6/2) silt loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; very friable; common distinct irregularly shaped carbonates in seams and soft masses; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches
Other features: An E/B horizon in some pedons

A or Ap horizon:
Hue—10YR
Value—2 or 3 (A), 3 to 5 (Ap)
Chroma—1 or 2
Texture—silt loam

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

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

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 3
Texture—very fine sandy loam, loam, silty clay loam, silt loam, or silt

Strandquist Series

Drainage class: Poorly drained
Permeability: Rapid in the upper part; moderate in the lower part
Landform: Glacial lake plains
Parent material: Water-sorted loamy and sandy sediments overlying calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Sandy-skeletal over loamy, mixed (calcareous), frigid Typic Haplaquolls

Typical Pedon

Strandquist loam, 50 feet south and 50 feet east of the northwest corner of sec. 30, T. 158 N., R. 38 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 5 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

Cg1—9 to 32 inches; grayish brown (2.5Y 5/2) very gravelly sand; few fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; about 40 percent gravel; strong effervescence; moderately alkaline; abrupt wavy boundary.

2Cg2—32 to 40 inches; light brownish gray (2.5Y 6/2) fine sandy loam; few fine distinct dark grayish brown (2.5Y 4/2) mottles; massive; friable; about 5 percent gravel; violent effervescence; moderately alkaline; abrupt wavy boundary.

2Cg3—40 to 60 inches; grayish brown (2.5Y 5/2) loam; few coarse distinct yellowish brown (2.5Y 5/6) mottles; massive; friable; about 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 16 inches
Thickness of the water-sorted mantle: 20 to 40 inches

A or Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—2 to 10 percent gravel

Cg horizon:
Hue—2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—very gravelly coarse sand, very gravelly sand, very gravelly loamy coarse sand, or very gravelly loamy sand
Content of rock fragments—35 to 65 percent gravel

2Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—fine sandy loam, sandy loam, loam, or clay loam
Content of rock fragments—2 to 15 percent gravel

Stuntz Series

Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Aeric Glossaqualfs

Typical Pedon

Stuntz fine sandy loam, about 100 feet south and 100 feet west of the northeast corner of sec. 10, T. 146 N., R. 32 W.

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

E—2 to 10 inches; grayish brown (2.5Y 5/2) very fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak thin platy structure; very friable; about 5 percent gravel; moderately acid; clear wavy boundary.

E/B—10 to 16 inches; tongues and interfingerings of grayish brown (2.5Y 5/2) fine sandy loam (E) penetrating olive brown (2.5Y 4/4) sandy clay loam (Bt); few fine faint light brownish gray (2.5Y 6/2) mottles; weak medium angular blocky structure; friable; about 5 percent gravel; moderately acid; clear wavy boundary.

B/E—16 to 23 inches; olive brown (2.5Y 4/4) clay loam (Bt); penetrated by interfingerings of grayish brown (2.5Y 5/2) fine sandy loam (E); few fine distinct light brownish gray (2.5Y 6/2) mottles; weak fine angular blocky structure; friable; common faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 3 percent gravel; slightly acid; clear wavy boundary.

Btg1—23 to 28 inches; olive brown (2.5Y 4/4) clay loam; few fine faint light brownish gray (2.5Y 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Btg2—28 to 35 inches; light olive brown (2.5Y 5/4) loam; few fine faint light brownish gray (2.5Y 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; common distinct dark grayish brown (2.5Y 4/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

C—35 to 60 inches; light yellowish brown (2.5Y 6/4) loam; few fine faint light brownish gray (2.5Y 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; common distinct irregularly shaped carbonates in seams and soft masses; about 3 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 32 to 52 inches
Content of rock fragments: 2 to 10 percent gravel

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

E horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—1 to 3
Texture—very fine sandy loam, silt loam, fine sandy loam, or loam

E/B and B/E horizons:
Colors—similar to those of the E and B horizons
Textures—similar to those of the E and B horizons

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

Cg horizon:
Hue—2.5Y or 10YR
Value—5 to 7

Chroma—2 to 4
Texture—loam, sandy clay loam, or clay loam

Suomi Series

Drainage class: Moderately well drained
Permeability: Slow
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 1 to 25 percent
Taxonomic class: Fine, mixed Glossaquic Eutroboralfs
Taxadjunct features: The Suomi soils in this survey area do not have the tonguing that is characteristic of the series. They are classified as Aquic Eutroboralfs.

Typical Pedon

Suomi loam, 1 to 6 percent slopes, about 1,000 feet east and 100 feet south of the northwest corner of sec. 6, T. 148 N., R. 34 W.

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

E—2 to 6 inches; light brownish gray (10YR 6/2) loam, light gray (10YR 7/2) dry; weak thin platy structure; friable; about 2 percent gravel; slightly acid; abrupt wavy boundary.

Bt1—6 to 14 inches; dark yellowish brown (10YR 4/4) clay; few fine faint grayish brown (10YR 5/2) mottles in the lower part; strong fine angular blocky structure; firm; many faint dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; moderately acid; clear wavy boundary.

Bt2—14 to 23 inches; dark brown (10YR 3/3) clay; common fine distinct light brownish gray (2.5Y 6/2) mottles; moderate coarse subangular blocky structure; firm; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent gravel; moderately acid; clear wavy boundary.

Bkg—23 to 60 inches; grayish brown (2.5Y 5/2) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; common fine irregularly shaped carbonates in soft masses; about 3 percent gravel; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 1 to 6 percent gravel
Other features: A B/E or E/B horizon in some pedons

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

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

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay, silty clay, silty clay loam, or clay loam

Bkg horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—1 to 4
Texture—clay, silty clay, silty clay loam, clay loam, or loam

Tacoosh Series

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the upper part; moderate or moderately slow in the lower part
Landform: Till-floored glacial lake plains and till plains
Parent material: Moderately decomposed herbaceous organic material overlying calcareous till
Slope range: 0 to 1 percent
Taxonomic class: Loamy, mixed, euic Terric Borohemists

Typical Pedon

Tacoosh muck, about 100 feet north and 100 feet west of the southeast corner of sec. 10, T. 156 N., R. 33 W.

Oa—0 to 7 inches; sapric material, black (5YR 2.5/1) broken face, rubbed, and pressed; about 25 percent fiber, 5 percent rubbed; weak thick platy structure; very friable; mostly herbaceous fibers; moderately acid; clear smooth boundary.

Oe—7 to 41 inches; hemic material, very dark brown (10YR 2/2) broken face, dark reddish brown (5YR 3/2) rubbed, and dark reddish brown (5YR 3/3) pressed; about 60 percent fiber, about 30 percent rubbed; weak thick platy structure; very friable; mostly herbaceous fibers; moderately acid; abrupt smooth boundary.

Cg—41 to 60 inches; dark grayish brown (2.5Y 4/2) loam; massive; friable; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of organic material: 16 to 51 inches
Depth to mineral soil: 16 to 51 inches
Other features: An A horizon in some pedons

Organic material:
Content of fiber—35 to 65 percent unrubbed; 15 to 45 percent rubbed

Oa horizon:
Hue—5YR, 7.5YR, or 10YR
Value—2 or 3
Chroma—1 to 3
Content of fiber—15 to 35 percent unrubbed; 0 to 10 percent rubbed

Oe horizon:
Hue—5YR, 7.5YR, or 10YR
Value—2 or 3
Chroma—1 to 3
Content of fiber—35 to 65 percent unrubbed; 15 to 45 percent rubbed

Cg horizon:
Hue—2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, clay loam, sandy loam, or silt loam

Talmoon Series

Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 0 to 2 percent
Taxonomic class: Fine-loamy, mixed, frigid Mollic Ochraqualfs

Typical Pedon

Talmoon muck, 2,400 feet south and 600 feet west of the northeast corner of sec. 28, T. 150 N., R. 30 W.

Oa—0 to 4 inches; sapric material, black (10YR 2/1) broken face, rubbed, and pressed; about 15 percent fiber, less than 1 percent rubbed; weak thin platy structure; very friable; mostly herbaceous fibers; about 10 percent mineral material; slightly acid; abrupt smooth boundary.

A—4 to 9 inches; black (2.5Y 2/0) loam, dark gray (2.5Y 4/0) dry; weak fine granular structure; friable; slightly acid; abrupt wavy boundary.

Eg—9 to 14 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/4) mottles; weak thin platy structure; very friable; slightly acid; abrupt wavy boundary.

Btg1—14 to 18 inches; dark gray (5Y 4/1) loam; few medium prominent yellowish brown (10YR 5/6) mottles; weak fine angular blocky structure; friable; few distinct dark olive gray (5Y 3/2) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Btg2—18 to 24 inches; olive gray (5Y 5/2) clay loam; few medium prominent yellowish brown (10YR 5/6) mottles; weak fine angular blocky structure; friable; few distinct olive gray (5Y 4/2) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Cg—24 to 60 inches; light olive gray (5Y 6/2) loam; few coarse prominent yellowish brown (10YR 5/6) mottles; massive; friable; common thin irregularly shaped carbonates in seams; about 3 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 44 inches
Content of rock fragments: 0 to 10 percent

Oa horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—sapric material

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

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

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

Cg horizon:
Hue—2.5Y or 5Y
Value—5 to 7
Chroma—1 or 2
Texture—loam, sandy clay loam, or clay loam

Tawas Series

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow in the

upper part; rapid in the lower part
Landform: Till-floored glacial lake plains and outwash plains
Parent material: Highly decomposed woody organic material overlying sandy lacustrine or outwash sediments
Slope range: 0 to 1 percent
Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Tawas muck, 1,800 feet north and 300 feet east of the southwest corner of sec. 14, T. 151 N., R. 32 W.

Oa1—0 to 6 inches; sapric material, very dark brown (10YR 2/2) broken face, rubbed, and pressed; about 20 percent herbaceous fiber, less than 5 percent rubbed; weak fine granular structure; very friable; about 25 percent woody fragments more than 2 millimeters in size; slightly acid; abrupt wavy boundary.

Oa2—6 to 33 inches; sapric material, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 15 percent herbaceous fiber, less than 5 percent rubbed; weak thick platy structure; very friable; about 35 percent woody fragments more than 2 millimeters in size; neutral; abrupt smooth boundary.

Cg—33 to 60 inches; dark grayish brown (2.5Y 4/2) sand; single grain; loose; about 12 percent gravel; neutral.

Range in Characteristics

Thickness of organic material: 16 to 51 inches
Depth to mineral soil: 16 to 51 inches

Sapric material:
Content of fiber—15 to 35 percent unrubbed; 0 to 10 percent rubbed
Hue—5YR, 7.5YR, or 10YR
Value—2 or 3
Chroma—1 to 3

Cg horizon:
Hue—5Y, 2.5Y, or 10YR
Value—4 to 6
Chroma—1 to 3
Texture—sand, fine sand, loamy sand, coarse sand, loamy coarse sand, or loamy fine sand
Content of rock fragments—0 to 15 percent gravel

Warba Series

Drainage class: Well drained
Permeability: Moderately slow
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 1 to 12 percent
Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Warba fine sandy loam, 1 to 6 percent slopes, about 100 feet south and 50 feet west of the northeast corner of sec. 2, T. 146 N., R. 32 W.

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

E—2 to 12 inches; brown (10YR 5/3) fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; about 5 percent gravel; strongly acid; clear irregular boundary.

E/B—12 to 16 inches; tongues and interfingerings of brown (10YR 5/3) fine sandy loam (E) penetrating dark yellowish brown (10YR 4/4) loam (Bt); weak fine angular blocky structure; friable; about 5 percent gravel; strongly acid; clear wavy boundary.

B/E—16 to 22 inches; dark yellowish brown (10YR 4/4) clay loam (Bt); penetrated by interfingerings of brown (10YR 5/3) fine sandy loam (E); moderate medium angular blocky structure; friable; common distinct dark brown (10YR 4/3) clay films on faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.

Bt—22 to 35 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine angular blocky structure; firm; common distinct dark brown (10YR 3/3) clay films on faces of peds; about 5 percent gravel; moderately acid; clear wavy boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; very friable; common medium irregularly shaped carbonates in seams and soft masses; about 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 32 to 51 inches
Content of rock fragments: 2 to 12 percent gravel

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

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 or 3
Texture—very fine sandy loam or fine sandy loam

E/B and B/E horizons:
Colors—similar to those of the E and B horizons
Textures—similar to those of the E and B horizons

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

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

Waskish Series

Drainage class: Very poorly drained
Permeability: Rapid
Landform: Till-floored glacial lake plains
Parent material: Slightly decomposed herbaceous organic material
Slope range: 0 to 1 percent
Taxonomic class: Dysic, frigid Typic Sphagnofibrists

Typical Pedon

Waskish peat, 1,250 feet north and 200 feet east of the southwest corner of sec. 7, T. 155 N., R. 31 W.

Oi1—0 to 3 inches; fibric material, very pale brown (10YR 7/3) broken face, very pale brown (10YR 8/4) rubbed and pressed; about 90 percent fiber, about 85 percent rubbed; massive; very friable; primarily sphagnum fibers; about 10 percent woody fragments; about 7 percent mineral material; extremely acid; clear wavy boundary.

Oi2—3 to 16 inches; fibric material, brown (7.5YR 4/4) broken face, dark reddish brown (5YR 3/3) rubbed, and dark reddish brown (5YR 3/4) pressed; about 90 percent fiber, about 85 percent rubbed; weak thick platy structure; very friable; primarily sphagnum fibers; about 15 percent woody fragments; about 6 percent mineral material; few layers of sapric material; extremely acid; abrupt smooth boundary.

Oi3—16 to 84 inches; fibric material, reddish brown (5YR 4/4) broken face, light yellowish brown (10YR 6/4) rubbed, and brown (7.5YR 5/4) pressed; about 95 percent fiber, about 90 percent rubbed; weak medium and thick platy structure; very friable; primarily sphagnum fibers; about 5 percent woody fragments; about 3 percent mineral material; few thin layers of sapric material; extremely acid.

Range in Characteristics

Thickness of organic material: More than 60 inches
Reaction: Extremely acid
Organic material:
Content of fiber—90 to 100 percent unrubbed; 60 to 95 percent rubbed
Hue—10YR, 7.5YR, or 5YR
Value—3 to 7
Chroma—2 to 4

Wykeham Series

Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines and till plains
Parent material: Calcareous till
Slope range: 1 to 3 percent
Taxonomic class: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Wykeham fine sandy loam, 2,000 feet south and 100 feet east of the northwest corner of sec. 25, T. 150 N., R. 33 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; about 2 percent gravel; moderately acid; clear smooth boundary.

E—8 to 16 inches; brown (10YR 5/3) fine sandy loam, very pale brown (10YR 7/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; about 2 percent gravel; moderately acid; clear smooth boundary.

B/E—16 to 23 inches; dark yellowish brown (10YR 4/4) loam (Bt); penetrated by tongues and interfingerings of grayish brown (10YR 5/2) fine sandy loam (E); few fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few faint dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Bt—23 to 32 inches; dark brown (10YR 4/3) loam; common medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; common faint dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; common medium faint grayish brown (2.5Y 5/2) and few fine faint yellowish brown (2.5Y 5/6) mottles; massive; very friable; common medium irregularly shaped carbonates in seams and soft masses; about 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Content of rock fragments: 2 to 10 percent gravel
Other features: An E/B horizon in some pedons

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

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

B/E horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

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

C horizon:
Hue—2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—sandy loam or fine sandy loam

Zimmerman Series

Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and beach ridges
Parent material: Sandy sediments
Slope range: 1 to 12 percent
Taxonomic class: Mixed, frigid Alfic Udipsamments

Typical Pedon

Zimmerman loamy fine sand, 1 to 6 percent slopes, 1,000 feet south and 500 feet east of the northwest corner of sec. 20, T. 150 N., R. 32 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loamy fine sand, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; moderately acid; abrupt wavy boundary.

E—3 to 16 inches; brown (10YR 5/3) fine sand, light brownish gray (10YR 6/2) dry; single grain; loose; moderately acid; clear wavy boundary.

Bw—16 to 35 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; slightly acid; clear wavy boundary.

E′—35 to 40 inches; pale brown (10YR 6/3) fine sand; single grain; loose; slightly acid; clear wavy boundary.

E&Bt—40 to 60 inches; very pale brown (10YR 7/3) fine sand (E); single grain; loose; several lamellae of dark yellowish brown (10YR 4/4) fine sandy loam (Bt), which are ¼ inch to 1½ inches thick and have a combined thickness of 4 inches; weak fine subangular blocky structure; very friable; common faint dark brown (7.5YR 4/4) clay bridges between sand grains; moderately acid.

Range in Characteristics

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

E horizon:
Hue—10YR
Value—4 to 7
Chroma—2 to 4
Texture—fine sand or loamy fine sand

Bw horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 5
Texture—fine sand or loamy fine sand

E&Bt horizon:
Hue—7.5YR or 10YR
Value—4 to 7 (E); 3 to 5 (Bt)
Chroma—2 to 4 (E); 3 to 6 (Bt)
Texture—fine sand (E); bands of loamy fine sand, loamy very fine sand, or fine sandy loam (Bt) that range in thickness from 1/16 inch to 3 inches and that have a total thickness of less than 6 inches

Taxonomic Units in the Chippewa National Forest

Aeric Glossaqualfs

Drainage class: Somewhat poorly drained
Permeability: Moderately rapid or moderate in the upper part; moderate to slow in the lower part
Landform: Moraines
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic class: Aeric Glossaqualfs

Sample Pedon Description

Sample pedon location: Sec. 31, T. 149 N., R. 27 W.

Oe—1 inch to 0; a mixture of slightly decomposed and partly decomposed plant material.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; many roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 5 inches; gray (10YR 5/1) fine sandy loam, light gray (10YR 6/1) dry; moderate medium subangular blocky structure; friable; many roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw1—5 to 9 inches; brown (10YR 5/3) fine sandy loam; moderate medium subangular blocky structure; friable; few roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw2—9 to 13 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium prominent strong brown (7.5YR 5/6) and common fine faint yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; friable; few roots; about 2 percent gravel; moderately acid; clear wavy boundary.

E/B—13 to 24 inches; about 60 percent gray (10YR 6/1) fine sandy loam (E); about 40 percent dark brown (10YR 4/3) clay loam (Bt); common medium prominent strong brown (7.5YR 5/8) and common medium distinct brown (10YR 5/3) mottles; strong medium subangular blocky structure; firm; few roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; moderately acid; clear smooth boundary.

Btg—24 to 30 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common fine prominent strong brown (7.5YR 5/8) mottles; strong medium subangular blocky structure; firm; very few roots; many faint dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; moderately acid; clear smooth boundary.

BC—30 to 35 inches; dark yellowish brown (10YR 4/6) clay loam; common medium prominent yellowish red (5YR 5/8) and common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; very few roots; about 2 percent gravel; neutral; clear smooth boundary.

C—35 to 60 inches; dark brown (10YR 3/3) silty clay loam; common medium distinct yellowish brown (10YR 5/4) and common fine distinct grayish brown (10YR 5/2) mottles; massive; firm; about 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Content of gravel: 1 to 15 percent
Other features: A B/E horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam, sandy loam, loamy sand, loamy fine sand, or very fine sandy loam

E horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 to 6
Chroma—1 to 3
Texture—fine sandy loam, sandy loam, loamy sand, loamy fine sand, or very fine sandy loam

Bw horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 to 6
Chroma—3 to 5
Texture—fine sandy loam, sandy loam, loamy sand, loamy fine sand, or very fine sandy loam

E/B horizon:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

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

BC horizon:
Hue—2.5Y, 10YR, or 7.5YR
Value—3 to 6
Chroma—2 to 6
Texture—clay loam, loam, sandy clay loam, fine sandy loam, sandy loam, loamy sand, or loamy fine sand

C or Cg horizon:
Hue—2.5Y, 10YR, or 7.5YR
Value—3 to 6
Chroma—2 to 4
Texture—silty clay loam, clay loam, loam, sandy clay loam, fine sandy loam, sandy loam, loamy sand, or loamy fine sand

Alfic Udipsamments

Drainage class: Somewhat excessively drained

Permeability: Rapid
Landform: Outwash plains and moraines
Parent material: Sandy sediments
Slope range: 0 to 8 percent
Taxonomic class: Alfic Udipsamments

Sample Pedon Description

Sample pedon location: Sec. 9, T. 147 N., R. 27 W.

Oi—2 inches to 0; partially decomposed forest litter.

A—0 to 1 inch; black (10YR 2/1) loamy sand; weak fine granular structure; very friable; many roots; strongly acid; abrupt smooth boundary.

E—1 to 3 inches; grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) loamy sand; weak coarse subangular blocky structure parting to weak very fine granular; very friable; many roots; strongly acid; abrupt wavy boundary.

Bw1—3 to 7 inches; yellowish brown (10YR 5/4) loamy fine sand; weak very fine granular structure; very friable; many roots; strongly acid; clear wavy boundary.

Bw2—7 to 17 inches; brown (10YR 5/3) fine sand; single grain; loose; common roots; moderately acid; gradual wavy boundary.

E′—17 to 26 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; common roots; moderately acid; clear wavy boundary.

E&Bt—26 to 58 inches; light brownish gray (10YR 6/2) and brown (10YR 5/3) fine sand and sand (E); single grain; loose; dark brown (7.5YR 4/4), yellowish brown (10YR 5/4), and brown (10YR 5/3) fine sandy loam and loamy sand (Bt); massive; firm; many thin clay bridges between sand grains; slightly acid; clear wavy boundary.

C—58 to 60 inches; light brownish gray (10YR 6/2 and 2.5Y 6/2) sand; single grain; loose; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 48 to more than 60 inches
Content of gravel: 0 to 15 percent

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy sand, sand, loamy fine sand, or fine sand

E or E′ horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 or 3
Texture—sand, loamy sand, fine sand, or loamy fine sand

Bw horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—sand, loamy sand, fine sand, loamy fine sand, or coarse sand

Bt horizon:
Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 to 6
Texture—fine sandy loam, sandy loam, loamy sand, or loamy fine sand
Thickness—less than 6 inches

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

Aqualfs

Drainage class: Somewhat poorly drained and poorly drained
Permeability: Moderately rapid or moderate in the upper part; moderate or moderately slow in the lower part
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Aqualfs

Sample Pedon Description

Sample pedon location: Sec. 13, T. 148 N., R. 27 W.

Oe—1 inch to 0; a mixture of slightly decomposed and partly decomposed plant material.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; many roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E1—2 to 6 inches; light gray (10YR 7/1) loamy fine sand; moderate medium granular structure; friable; many roots; about 2 percent gravel; moderately acid; clear wavy boundary.

E2—6 to 12 inches; pale brown (10YR 6/3) loamy fine sand; common medium prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; few roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw—12 to 17 inches; dark yellowish brown (10YR 4/4) fine sandy loam; common medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Btg—17 to 31 inches; dark grayish brown (10YR 4/2) clay loam; common distinct pale brown (10YR 6/3) mottles; moderate medium subangular blocky structure; firm; many faint dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; slightly acid; gradual smooth boundary.

BCg—31 to 37 inches; brown (10YR 5/3) clay loam; many prominent medium yellowish brown (10YR 5/8) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; about 2 percent gravel; slightly acid; gradual smooth boundary.

Cg—37 to 60 inches; light brownish gray (10YR 6/2) clay loam; common medium prominent strong brown (7.5YR 5/6) and few fine distinct dark gray (10YR 4/1) mottles; massive; firm; about 2 percent gravel; slightly acid.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Content of gravel: 1 to 15 percent

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

E horizon:
Hue—10YR or 2.5Y
Value—4 to 7
Chroma—1 to 3
Texture—very fine sandy loam, loamy fine sand, loamy very fine sand, fine sandy loam, sandy loam, loam, or loamy sand

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

B/E horizon (if it occurs):
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

E/B horizon (if it occurs):
Colors—similar to those of the E and B horizons
Textures—similar to those of the E and B horizons

Btg horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, loam, sandy loam, fine sandy loam, sandy clay loam, clay, or sandy clay

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

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

Aquic Eutroboralfs

Drainage class: Moderately well drained
Permeability: Moderate in the upper part; moderate to slow in the lower part
Landform: Moraines and outwash plains
Parent material: Till
Slope range: 0 to 8 percent
Taxonomic class: Aquic Eutroboralfs

Sample Pedon Description

Sample pedon location: NW¼NE¼ sec. 30, T. 142 N., R. 30 W.

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

E—2 to 4 inches; grayish brown (10YR 5/2) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

Bw—4 to 8 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; very friable; common coarse roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

Bt1—8 to 16 inches; light yellowish brown (10YR 5/4) sandy loam; many medium prominent yellowish red (5YR 5/8) and light gray (10YR 7/1) mottles; weak fine subangular blocky structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt2—16 to 26 inches; yellowish brown (10YR 5/4) loam; many medium prominent yellowish red (5YR 5/8) and light gray (10YR 7/1) mottles; weak medium subangular blocky structure; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few prominent light gray silt coatings on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt3—26 to 47 inches; yellowish brown (10YR 5/4) loam; common medium prominent strong brown (7.5YR 5/8) and light gray (10YR 7/1) mottles; moderate medium subangular blocky structure; firm; common prominent light brownish gray (2.5Y 6/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

C—47 to 60 inches; yellowish brown (10YR 5/6) sandy loam; common fine prominent yellowish red (5YR 5/8) and light gray (5Y 7/1) mottles; massive; firm; about 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 15 to more than 60 inches
Content of gravel: 0 to 10 percent
Other features: A BC horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam, sandy loam, very fine sandy loam, loam, clay loam, loamy fine sand, loamy sand, or loamy very fine sand

E horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 to 6
Chroma—2 or 3
Texture—fine sandy loam, sandy loam, very fine sandy loam, loam, clay loam, or loamy very fine sand

Bw horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—fine sandy loam, sandy loam, very fine sandy loam, loamy sand, loamy fine sand, loam, sand, or fine sand

Bt horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—fine sandy loam, sandy loam, very fine sandy loam, loam, sandy clay loam, clay, clay loam, or sandy clay

C or Cg horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 to 6
Chroma—2 to 6
Texture—fine sandy loam, sandy loam, very fine sandy loam, loam, sandy clay loam, clay loam, sandy clay, or loamy very fine sand

Arenic Eutroboralfs

Drainage class: Well drained
Permeability: Rapid in the upper part; moderately slow or slow in the lower part
Landform: Moraines
Parent material: Sandy sediments overlying till
Slope range: 0 to 8 percent
Taxonomic class: Arenic Eutroboralfs

Sample Pedon Description

Sample pedon location: Sec. 30, T. 145 N., R. 31 W.

Oi—2 inches to 0; slightly decomposed forest litter.

A—0 to 1 inch; very dark gray (10YR 3/1) loamy fine sand, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; many fine roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E—1 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common fine roots; moderately acid; clear wavy boundary.

Bw1—6 to 10 inches; dark brown (10YR 4/3) loamy fine sand; single grain; loose; very friable; common roots; about 2 percent gravel; moderately acid; clear smooth boundary.

Bw2—10 to 20 inches; brown (10YR 5/3) loamy fine sand; single grain; loose; common fine roots; about 5 percent gravel; moderately acid; clear smooth boundary.

Bw3—20 to 30 inches; yellowish brown (10YR 5/4 and 5/6) sand; single grain; loose; few fine roots; slightly acid; abrupt wavy boundary.

2Bt—30 to 36 inches; dark yellowish brown (10YR 3/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; few distinct yellowish brown (10YR 5/4) clay films on faces of peds and in root channels; about 2 percent gravel; neutral; abrupt wavy boundary.

2C—36 to 60 inches; light olive brown (2.5Y 5/4 and 5/3) silty clay loam; massive; friable; few very fine roots; about 2 percent gravel; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Ap or A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—loamy fine sand, loamy sand, sand, or fine sand
Content of gravel—0 to 5 percent

E horizon:
Hue—10YR
Value—4 or 5
Chroma—2 or 3
Texture—loamy fine sand, loamy sand, sand, fine sand, coarse sand, or loamy coarse sand
Content of gravel—0 to 5 percent

Bw horizon:
Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 to 6
Texture—loamy fine sand, fine sand, loamy sand, sand, coarse sand, or loamy coarse sand
Content of gravel—0 to 5 percent

2Bt horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—3 to 5
Chroma—3 or 4
Texture—sandy loam, clay loam, silty clay loam, loam, fine sandy loam, clay, or silty clay
Content of gravel—1 to 15 percent

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 or 4
Texture—sandy loam, clay loam, silty clay loam, loam, or fine sandy loam
Content of gravel—1 to 15 percent

Glossic Eutroboralfs

Drainage class: Well drained
Permeability: Moderately rapid to moderately slow
Landform: Moraines
Parent material: Till
Slope range: 8 to 20 percent
Taxonomic class: Glossic Eutroboralfs

Sample Pedon Description

Sample pedon location: Sec. 19, T. 142 N., R. 25 W.

A—0 to 1 inch; very dark gray (10YR 3/1) very fine sandy loam; weak very fine granular structure; friable; many fine roots; about 3 percent gravel; strongly acid; abrupt clear boundary.

E—1 to 6 inches; pale brown (10YR 6/3) very fine sandy loam; weak thin platy structure; friable; common fine roots; about 3 percent gravel; strongly acid; clear smooth boundary.

Bw—6 to 18 inches; yellowish brown (10YR 5/4) very fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; moderately acid; clear wavy boundary.

E/B—18 to 23 inches; about 60 percent pale brown (10YR 6/3) very fine sandy loam (E); about 40 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); moderate fine subangular blocky structure; friable; few fine roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

B/E—23 to 26 inches; about 60 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); about 40 percent pale brown (10YR 6/3) very fine sandy loam (E); moderate fine subangular blocky structure; friable; few roots; about 3 percent gravel; moderately acid; clear smooth boundary.

Bt—26 to 48 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate fine subangular blocky structure; friable; common distinct dark brown (7.5YR 3/4) clay films on faces of peds; about 5 percent gravel; slightly acid; clear smooth boundary.

BC—48 to 56 inches; brown (10YR 5/3) sandy loam; few fine prominent strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; friable; about 5 percent gravel; neutral; gradual smooth boundary.

C—56 to 60 inches; dark brown (7.5YR 4/4) sandy loam; massive; friable; about 5 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Content of gravel: 1 to 15 percent

Ap or A horizon:
Hue—10YR
Value—2 to 4
Chroma—1 or 2
Texture—very fine sandy loam, silt loam, fine sandy loam, or sandy loam

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

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

B/E and E/B horizons:
Colors—similar to those of the B and E horizons
Textures—similar to those of the B and E horizons

Bt horizon:
Hue—10YR, 2.5Y, or 7.5YR
Value—4 or 5

Chroma—3 to 6
Texture—sandy loam, fine sandy loam, clay loam, or loam

BC horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—2 to 4
Texture—sandy loam, fine sandy loam, loam, clay loam, loamy sand, or loamy fine sand

C horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—2 to 4
Texture—sandy loam, fine sandy loam, loam, clay loam, loamy sand, or loamy fine sand

Histosols

Drainage class: Very poorly drained
Permeability: Moderately slow to rapid
Landform: Outwash plains and moraines
Parent material: Organic material
Slope range: 0 to 2 percent
Taxonomic class: Histosols

Sample Pedon Description

Sample pedon location: Sec. 19, T. 148 N., R. 30 W.

Oe1—0 to 17 inches; mucky peat, black (10YR 2/1) broken face, rubbed, and pressed; about 55 percent fiber, about 20 percent rubbed; weak medium subangular blocky structure; very strongly acid; abrupt smooth boundary.

Oe2—17 to 32 inches; mucky peat, very dark gray (10YR 3/1) broken face, rubbed, and pressed; about 30 percent fiber, about 15 percent rubbed; weak medium subangular blocky structure; moderately acid; abrupt smooth boundary.

Oa1—32 to 45 inches; muck, dark brown (7.5YR 4/2) broken face, rubbed, and pressed; about 25 percent fiber, about 5 percent rubbed; weak medium subangular blocky structure; neutral; abrupt smooth boundary.

Oa2—45 to 60 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; about 15 percent fiber, about 1 percent rubbed; weak medium subangular blocky structure; neutral.

Range in Characteristics

Kind of organic material: Muck, mucky peat, peat
Thickness of organic material: 16 to more than 51 inches
Content of fiber: 15 to 85 percent unrubbed; 0 to 50 percent rubbed
Reaction: Extremely acid to moderately alkaline

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

Humaquepts

Drainage class: Poorly drained and very poorly drained
Permeability: Rapid to moderate
Landform: Outwash plains
Parent material: Loamy or sandy sediments
Slope range: 0 to 2 percent
Taxonomic class: Humaquepts

Sample Pedon Description

Sample pedon location: Sec. 14, T. 146 N., R. 31 W.

Oa—4 inches to 0; dark reddish brown (5YR 3/2) muck; about 30 percent fiber, about 5 percent rubbed; weak medium platy structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

A—0 to 4 inches; dark gray (N 4/0) and gray (5Y 5/1) fine sandy loam; weak fine granular structure; very friable; common fine roots; moderately acid; abrupt smooth boundary.

Bg1—4 to 10 inches; light brownish gray (2.5Y 6/2) loamy fine sand; weak fine subangular blocky structure; very friable; few fine roots; moderately acid; clear smooth boundary.

Bg2—10 to 29 inches; light olive gray (5Y 6/2) fine sand; common fine prominent strong brown (7.5YR 5/8) mottles; weak very fine subangular blocky structure; very friable; about 5 percent gravel; slightly acid; clear smooth boundary.

Cg—29 to 60 inches; gray (5Y 6/1) fine sandy loam; common fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; about 5 percent gravel; neutral.

Range in Characteristics

Thickness of organic material: 3 to 12 inches
Depth to carbonates: 24 to more than 60 inches
Content of gravel: 0 to 15 percent

Oa horizon:
Hue—5YR, 7.5YR, or 10YR
Value—1 to 4
Chroma—1 to 3
Texture—muck, mucky peat, or peat

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

sandy loam, loamy sand, loamy fine sand, loam, or sand

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

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

Psammentic Eutroboralfs

Drainage Class: Well drained and somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy sediments
Slope range: 0 to 20 percent
Taxonomic class: Psammentic Eutroboralfs

Sample Pedon Description

Sample pedon location: Sec. 16, T. 147 N., R. 27 W.

Oe—2 inches to 0; moderately decomposed forest litter.

E—0 to 2 inches; very dark grayish brown (10YR 3/2) loamy sand; weak medium platy structure; very friable; many very fine and fine roots; about 1 percent gravel; moderately acid; abrupt smooth boundary.

Bw1—2 to 12 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; very friable; many very fine and fine roots; about 1 percent gravel; moderately acid; clear smooth boundary.

Bw2—12 to 26 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; common fine roots; about 5 percent gravel and 3 percent cobbles; moderately acid; clear wavy boundary.

Bt—26 to 34 inches; dark yellowish brown (10YR 4/4) gravelly loamy coarse sand; weak coarse subangular blocky structure parting to single grain; friable; few roots; few distinct dark brown (7.5YR 4/4) clay films on and between sand grains; about 10 percent gravel and 10 percent cobbles; strongly acid; clear wavy boundary.

BC—34 to 48 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 4 percent gravel and 2 percent cobbles; moderately acid; gradual smooth boundary.

C1—48 to 58 inches; pale brown (10YR 6/3) coarse sand that has a very thin band of yellowish brown (10YR 5/4) loamy sand; single grain; loose; about 2 percent gravel; slightly acid; gradual smooth boundary.

C2—58 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 2 percent gravel; neutral.

Range in Characteristics

A or Ap horizon (if it occurs):
Hue—10YR
Value—2 to 4
Chroma—1 to 3
Texture—loamy sand, loamy fine sand, sand, or fine sand
Content of gravel and cobbles—0 to 15 percent

E horizon:
Hue—10YR or 7.5YR
Value—3 to 6
Chroma—2 or 3
Texture—loamy sand, loamy fine sand, sand, or fine sand
Content of gravel and cobbles—0 to 15 percent

Bw horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 5
Texture—loamy sand, loamy fine sand, sand, fine sand, coarse sand, loamy coarse sand, or the gravelly and cobbly analogs of those textures
Content of gravel and cobbles—2 to 25 percent

Bt horizon:
Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 to 6
Texture—loamy sand, loamy fine sand, loamy coarse sand, or the gravelly and cobbly analogs of those textures
Content of gravel and cobbles—2 to 25 percent

BC horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—sand, coarse sand, fine sand, or the gravelly and cobbly analogs of those textures
Content of gravel and cobbles—2 to 25 percent

C horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—2 to 4

Texture—sand, coarse sand, fine sand, or the gravelly analogs of those textures
Content of gravel and cobbles—2 to 25 percent

Typic Borohemists

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Landform: Outwash plains and moraines
Parent material: Moderately decomposed organic material
Slope range: 0 to 2 percent
Taxonomic class: Typic Borohemists

Sample Pedon Description

Sample pedon location: Sec. 5, T. 144 N., R. 30 W.

Oe1—0 to 4 inches; dark reddish brown (5YR 2/2) mucky peat; about 45 percent fiber, about 20 percent rubbed; weak thick platy structure; very friable; very strongly acid; abrupt smooth boundary.
Oe2—4 to 8 inches; dark reddish brown (5YR 3/2) mucky peat, dark brown (7.5YR 3/4) pressed; about 65 percent fiber, about 25 percent rubbed; weak thick platy structure; very friable; extremely acid; abrupt smooth boundary.
Oe3—8 to 10 inches; dark reddish brown (5YR 2/2) mucky peat; about 45 percent fiber, about 20 percent rubbed; weak thick platy structure; very friable; extremely acid; clear smooth boundary.
Oe4—10 to 29 inches; dark reddish brown (5YR 2/2) mucky peat; about 40 percent fiber, about 15 percent rubbed; massive; very friable; about 15 percent woody fragments more than 2 millimeters in size; very strongly acid; clear smooth boundary.
Oe5—29 to 60 inches; dark reddish brown (5YR 3/2 and 3/3) mucky peat; about 60 percent fiber, about 15 percent rubbed; massive; very friable; very strongly acid.

Range in Characteristics

Organic material:
Kind—mucky peat
Thickness—16 to more than 51 inches
Content of fiber—20 to 80 percent unrubbed; 15 to 45 percent rubbed
Content of woody fragments more than 2 millimeters in size—0 to 15 percent
Reaction—extremely acid to moderately alkaline

Oe horizon:
Hue—5YR, 7.5YR, or 10YR
Value—2 to 4
Chroma—2 or 3

Typic Borosaprists

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Outwash plains, moraines, and flood plains
Parent material: Moderately decomposed organic material
Slope range: 0 to 2 percent
Taxonomic class: Typic Borosaprists

Sample Pedon Description

Sample pedon location: Sec. 2, T. 149 N., R. 31 W.

Oa1—0 to 20 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; about 35 percent fiber, about 5 percent rubbed; weak fine subangular blocky structure; strongly acid; clear smooth boundary.
Oa2—20 to 42 inches; muck, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 30 percent fiber, about 5 percent rubbed; massive; slightly acid; gradual smooth boundary.
Oa3—42 to 60 inches; muck, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 20 percent fiber, about 5 percent rubbed; massive; slightly acid.

Range in Characteristics

Organic material:
Kind—muck
Thickness—16 to more than 51 inches
Content of fiber—10 to 45 percent unrubbed; 0 to 10 percent rubbed
Content of wood fragments more than 2 millimeters in size—0 to 15 percent
Reaction—strongly acid to moderately alkaline

Surface tier:
Hue—7.5YR or 10YR
Value—2 or 3
Chroma—1 to 3

Subsurface tier:
Hue—7.5YR or 10YR
Value—2 or 3
Chroma—1 or 2

Typic Ochraqualfs

Drainage class: Very poorly drained to somewhat poorly drained
Permeability: Moderate to slow
Landform: Moraines and outwash plains
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic class: Typic Ochraqualfs

Sample Pedon Description

Sample pedon location: Sec. 2, T. 143 N., R. 28 W.

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

E—3 to 15 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; friable; many fine roots; slightly alkaline; abrupt smooth boundary.

Btg1—15 to 29 inches; pale olive (5Y 6/2) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; weak very fine subangular blocky structure; friable; many fine roots; few distinct grayish brown (2.5Y 5/2) clay films on faces of peds; about 2 percent gravel; moderately alkaline; clear smooth boundary.

Btg2—29 to 37 inches; light brownish gray (2.5Y 6/2) clay loam; common medium distinct light olive brown (2.5Y 5/4) mottles; weak thin platy structure parting to weak very fine subangular blocky; friable; few fine roots; few faint grayish brown (2.5Y 5/2) clay films on faces of peds; about 2 percent gravel; moderately alkaline; clear smooth boundary.

BCg—37 to 48 inches; light olive gray (5Y 6/2) silty clay loam; moderate medium platy structure; firm; few fine roots; strong effervescence; about 2 percent gravel; moderately alkaline; clear smooth boundary.

Cg—48 to 60 inches; gray (5Y 6/1) silt loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Content of gravel: 0 to 20 percent

Ap or A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 to 4
Chroma—0 to 2
Texture—loam, fine sandy loam, silt loam, sandy loam, loamy sand, loamy fine sand, loamy very fine sand, clay loam, very fine sandy loam, or the gravelly analogs of those textures

E or Eg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—loam, fine sandy loam, silt loam, sandy loam, loamy sand, loamy fine sand, loamy very fine sand, very fine sandy loam, or the gravelly analogs of those textures

Btg horizon:
Hue—10YR, 5Y, or 2.5Y
Value—3 to 6
Chroma—1 or 2
Texture—loam, sandy loam, clay loam, fine sandy loam, very fine sandy loam, clay, or the gravelly analogs of those textures

BCg horizon:
Hue—10YR, 5Y, or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, sandy loam, fine sandy loam, loamy fine sand, loamy sand, silt loam, very fine sandy loam, silty clay loam, or the gravelly analogs of those textures

Cg horizon:
Hue—10YR, 5Y, or 2.5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam, sandy loam, fine sandy loam, loamy fine sand, loamy sand, silt loam, very fine sandy loam, silty clay loam, or the gravelly analogs of those textures

Typic Udipsamments

Drainage class: Somewhat excessively drained or excessively drained
Permeability: Rapid
Landform: Moraines and outwash plains
Parent material: Sandy sediments
Slope range: 0 to 8 percent
Taxonomic class: Typic Udipsamments

Sample Pedon Description

Sample pedon location: Sec. 14, T. 146 N., R. 29 W.

A—0 to 2 inches; dark brown (10YR 3/3) loamy sand; weak medium granular structure; very friable; many roots; very strongly acid; abrupt smooth boundary.

E—2 to 6 inches; pale brown (10YR 6/3) loamy sand; weak fine subangular blocky structure; very friable; many roots; moderately acid; clear wavy boundary.

Bw—6 to 16 inches; yellowish brown (10YR 5/6) loamy sand; weak medium subangular blocky structure; very friable; many roots; moderately acid; gradual smooth boundary.

BC—16 to 22 inches; very pale brown (10YR 7/4) sand; single grain; loose; few roots; neutral; gradual smooth boundary.

C—22 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few roots; slightly acid.

Range in Characteristics

Content of gravel: 0 to 35 percent

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of those textures

E horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 or 3
Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of those textures

Bw horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of those textures

BC horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 to 6
Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly analogs of those textures
Content of gravel—0 to 35 percent

C horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 to 6
Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly analogs of those textures

Udipsamments

Drainage class: Somewhat excessively drained or excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy sediments
Slope range: 0 to 8 percent
Taxonomic class: Udipsamments

Sample Pedon Description

Sample pedon location: Sec. 23, T. 146 N., R. 35 W.

A—0 to 1 inch; very dark gray (10YR 3/1) fine sand; weak medium granular structure; very friable; many roots; very strongly acid; abrupt smooth boundary.
E—1 to 4 inches; dark gray (10YR 4/1) fine sand; weak fine subangular blocky structure; very friable; many roots; moderately acid; clear wavy boundary.
Bw—4 to 8 inches; dark yellowish brown (10YR 4/4) fine sand; weak medium subangular blocky structure; very friable; many roots; moderately acid; gradual smooth boundary.
BC—8 to 18 inches; yellowish brown (10YR 5/6) fine sand; single grain; loose; few roots; neutral; gradual smooth boundary.
C—18 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few roots; slightly acid.

Range in Characteristics

Content of gravel: 0 to 35 percent

Ap or A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of those textures

E horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—1 to 3
Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of those textures

Bw horizon:
Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of those textures

BC horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 to 6
Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly analogs of those textures
Content of gravel—0 to 35 percent

C horizon:
Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 to 6
Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly analogs of those textures

2C horizon (if it occurs):

Location in the profile—at a depth of more than 48 inches

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

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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. Climate and plant and animal life are the active factors of soil formation. 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.

Parent Material

The parent material in most of the survey area formed during the most recent period of glaciation, when a series of depositions covered the survey area with glacial till. In some areas the till was modified and reworked by meltwater and proglacial lakes as the glaciers receded.

In the northern part of the county, the parent material commonly is sand and loamy sand and is interspersed with gravel and small stones throughout. The area was covered by calcareous, loamy glacial till that was mostly submerged under the waters of glacial Lake Agassiz. Lacustrine silt and clay were deposited in basins, and lacustrine sand was deposited on sandbars and deltas and in interbeach areas. Several gently sloping beach ridges formed as the lake receded.

In the poorly drained environment of the lake plain, vegetative production exceeds decomposition. In many areas, organic matter has accumulated on top of the mineral deposits. The organic matter consists of undecomposed to well decomposed woody and herbaceous fibers. The differences in thickness and acidity of these deposits account for many of the differences in the soils in this area.

In the rest of the county, the parent material consists primarily of glacial till and outwash sediment, which were deposited by glacial meltwater. The glacial till ranges in texture from fine sandy loam to loam. In the southern part of the county, till that consists of calcareous sandy loam is exposed. This area is characterized by gently rolling topography and commonly has a concentration of cobbles on the surface. Till that consists of calcareous loam is exposed across the middle of the southern part of the county. This area is characterized by hilly topography that is incised by deep trenches. Till that consists of a mixture of calcareous fine sandy loam and loam extends north from the middle of the southern part of the county to the lake plain. This area is characterized by nearly level to rolling topography and has a concentration of stones on the surface in some places.

Coarse textured outwash sediment was deposited on the broad outwash plain in the southern part of the county. This outwash sediment consists mostly of medium and coarse grained sand that has scattered pockets of gravel and cobbles. Stratified deposits of fine sand and silt are intermingled with glacial till in basins, drainageways, and scattered upland areas and in adjacent areas.

Climate

Climate has influenced the formation of the soils in Beltrami County. The parent material of many of the soils originated during a period of continental glaciers. The climate warmed, and it stabilized at present temperatures about 5,000 years ago.

Climate affects the physical, chemical, and biological characteristics of the soil. Beltrami County has a cool, subhumid climate that has wide variations in temperature from summer to winter. The shrinking and swelling associated with freezing and thawing break up parent materials. Warmer temperatures increase the biological activity in the soil and thus accelerate soil development. Precipitation transports and deposits particles across the soil surface and downward through the profile. The depth at which clay, lime, gypsum, and other materials accumulate is largely dependent on the amount of precipitation.

Plants and Animals

The vegetation in Beltrami County can be divided into three broad categories. These are wet-prairie, bog, and forest types. Wet-prairie vegetation is characteristic of the northwestern part of the county. Bog vegetation is in low-lying areas throughout the county. It is the dominant vegetative type on the lake plain. Forest vegetation is most common in the southern part of the county.

Wet-prairie vegetation consists of grasses and forbs. Common wet-prairie species include redtop, switchgrass, prairie cordgrass, northern reedgrass, and an assortment of lilies, gentians, asters, goldenrods, mints, and other wildflowers. In the prairie environment, there is a large annual accumulation of plant matter, which is quickly broken down and incorporated into the soil by bacteria and other micro-organisms. The organic matter stains the surface layer of the soil, and the soil becomes progressively darker as the content of organic matter increases.

Bog vegetation is the dominant vegetative type on the lake plain. A number of plant communities grow in the bogs, ranging from sedges and reeds to dense forests. The forested bogs include areas of prairie and mixed stands of black spruce, tamarack, and whitecedar. Common understory species are leatherleaf, bog rosemary, Labrador tea, swamp laurel, and cotton grass. The forest floor is commonly covered by sphagnum, hypnum, and other mosses. The nonforested bogs are dominated by grasses, sedges, reeds, and moss, and they commonly have a shrub layer of willow, alder, and cranberry. Decomposing vegetation is the parent material for the organic soils that form in the bog. The type of vegetation plays a major role in determining the degree of decomposition, which affects water movement, aeration, and fertility in the soils.

Forest vegetation consists of pine forests, which grow on the droughtier sites, and mixed hardwood forests, which are in areas of the more clayey soils. The pine forests have an overstory of red pine, jack pine, and white pine. The understory ranges from a sparse covering of grass and a few forbs to a dense shrub layer, which commonly includes hazel, juneberry, gooseberry, willow, and blueberry. In the hardwood forests, common trees include sugar maple, quaking aspen, American basswood, paper birch, and northern red oak. The shrub layer includes hazel, alder, willow, chokecherry, and redosier dogwood, and the forest floor is covered by a wide variety of forbs, sedges, and grasses. The pine and hardwood forests stabilize the soil and increase the eluviation or leaching of minerals and soil particles downward through the profile. Some materials, such as clay, calcium carbonate, and gypsum, are concentrated at certain depths. Other materials may be completely leached out of the soil.

Animals have the greatest impact on soil development through the microbial decomposition and mineralization of organic matter and through the process of soil mixing by insects and burrowing mammals. Human activities also have altered many of the soils in Beltrami County. Tillage has partially altered the original structure of the surface soil and has mixed the dark surface layer with the lighter colored subsoil. Applications of fertilizer and manure have increased the fertility of some soils. The suppression of wildfires over the years has altered the nutrient cycle in some soil systems.

Relief

Relief influences soil formation through its effect on drainage, vegetation, temperature, and erosion. Relief is the most important factor in the differentiation of soils that formed in the same parent material.

The relief in Beltrami County ranges from nearly level to steep. In level areas, precipitation moves down through the soil and does not run off the surface. This process can result in permanent or seasonal saturation of the soil in areas where the water table is close to the surface. Saturation of the soil causes mottling and reduces the rate of decomposition of organic matter. In level areas where the water table is deeper, the amount of leaching is greater because there is more water percolating through the profile. Drainage is better in steeper areas because some precipitation runs off the soil surface. Soils in these areas generally have brighter colors and shallower development. Drainage characteristics also affect the type of vegetation that can grow in different landscape positions. Plants that require more moisture grow in level areas, and other species grow higher up the slope.

Time

Soil characteristics are influenced by the length of time involved in the soil-forming process. Time is necessary for the other factors to influence the formation of the soils. Geologically, all of the soils in Beltrami County are young. The soil-forming process has been active for only 10,000 to 20,000 years. Because of the relatively short time of development, the soils in the county have a thinner profile than soils that developed over a longer period of time.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

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, 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.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

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.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

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.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 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.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil 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.

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.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

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.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock 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 50 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.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low 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.)

Mucky peat. Partially decomposed organic soil material that has accumulated under excess moisture. It is intermediate between muck and peat. (See Hemic 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.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

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.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid 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.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

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
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

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.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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 in areas outside the Chippewa National Forest are:

Nearly level	0 to 2 percent
Gently sloping	1 to 6 percent
Rolling	6 to 12 percent
Steep	12 to 25 percent

The slope classes in the Chippewa National Forest are:

Nearly level	0 to 1 percent
Gently undulating	1 to 3 percent
Undulating	1 to 8 percent
Gently rolling	4 to 12 percent
Rolling	8 to 16 percent
Hilly	10 to 25 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

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.

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 soil blowing 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.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

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.

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.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Bemidji, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	13.4	-9.4	2.0	43	-40	0	0.57	0.17	0.88	3	8.8
February----	21.6	-3.5	9.1	49	-36	0	.45	.13	.71	2	5.6
March-------	33.2	9.7	21.5	58	-30	0	.79	.32	1.17	3	7.5
April-------	50.2	27.6	38.9	80	2	17	1.89	.79	2.81	5	3.4
May---------	64.9	39.7	52.3	88	19	169	2.74	1.14	4.10	7	.2
June--------	74.1	50.5	62.3	92	33	369	3.77	1.98	5.33	8	.0
July--------	79.4	55.6	67.5	96	41	543	3.53	1.94	4.93	7	.0
August------	76.7	53.3	65.0	94	36	465	3.44	1.72	4.92	7	.0
September---	65.4	43.2	54.3	89	25	159	2.51	1.04	3.74	6	.0
October-----	54.2	33.3	43.8	82	13	43	1.67	.56	2.58	4	.8
November----	34.9	17.7	26.3	64	-16	0	.75	.30	1.12	3	5.0
December----	20.0	.2	10.1	44	-33	0	.75	.30	1.12	3	7.3
Yearly:											
Average---	49.0	27.6	37.8	---	---	---	---	---	---	---	---
Extreme---	---	---	---	97	-42	---	---	---	---	---	---
Total-----	---	---	---	---	---	1,765	22.86	18.23	27.23	58	38.6

* 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 (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Bemidji, 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 19	May 26	June 4
2 years in 10 later than--	May 14	May 21	May 31
5 years in 10 later than--	May 6	May 13	May 23
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 23	Sept. 14	Sept. 2
2 years in 10 earlier than--	Sept. 28	Sept. 17	Sept. 7
5 years in 10 earlier than--	Oct. 7	Sept. 24	Sept. 17

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Bemidji, 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	133	115	96
8 years in 10	141	121	103
5 years in 10	154	133	116
2 years in 10	167	146	130
1 year in 10	174	152	137

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
32B	Nebish sandy loam, 1 to 6 percent slopes	26,000	1.3
32C	Nebish fine sandy loam, 6 to 12 percent slopes	13,000	0.7
32D	Nebish fine sandy loam, 12 to 25 percent slopes	1,000	0.1
48	Hiwood loamy fine sand	12,000	0.6
72	Shooker loam	58,500	3.0
77	Garnes loam	2,500	0.1
116	Redby loamy fine sand	22,000	1.1
117	Cormant loamy fine sand	46,000	2.4
121	Wykeham fine sandy loam	14,000	0.7
125	Beltrami fine sandy loam	22,000	1.1
147	Spooner silt loam	4,000	0.2
158B	Zimmerman loamy fine sand, 1 to 6 percent slopes	10,500	0.5
158C	Zimmerman loamy fine sand, 6 to 12 percent slopes	3,000	0.2
167	Baudette silt loam	5,150	0.3
191	Epoufette sandy loam	7,000	0.4
199B	Sol cobbly sandy loam, 1 to 6 percent slopes	10,300	0.5
199C	Sol cobbly sandy loam, 6 to 12 percent slopes	3,000	0.2
202	Meehan loamy sand	11,000	0.6
205	Karlstad loamy sand	13,500	0.7
240B	Warba fine sandy loam, 1 to 6 percent slopes	1,500	0.1
240C	Warba fine sandy loam, 6 to 12 percent slopes	500	*
242B	Marquette loamy sand, 1 to 6 percent slopes	4,000	0.2
242C	Marquette loamy sand, 6 to 12 percent slopes	5,000	0.3
243	Stuntz fine sandy loam	1,500	0.1
267B	Snellman fine sandy loam, 1 to 6 percent slopes	21,000	1.1
267C	Snellman fine sandy loam, 6 to 12 percent slopes	7,100	0.4
267D	Snellman fine sandy loam, 12 to 25 percent slopes	1,280	0.1
272	Bemidji loamy sand	2,500	0.1
280	Pelan sandy loam	3,660	0.2
328B	Sartell loamy fine sand, 1 to 6 percent slopes	2,830	0.1
404	Chilgren loam	26,400	1.4
432	Strandquist loam	13,000	0.7
439	Rockwell fine sandy loam	1,015	0.1
458B	Menahga loamy sand, 1 to 6 percent slopes	13,000	0.7
458C	Menahga loamy sand, 6 to 12 percent slopes	3,000	0.2
458D	Menahga loamy sand, 12 to 25 percent slopes	520	*
481	Kratka fine sandy loam	28,900	1.5
482	Grygla loamy fine sand	29,400	1.5
496B	Andrusia loamy sand, 1 to 6 percent slopes	11,000	0.6
496C	Andrusia loamy sand, 6 to 12 percent slopes	6,000	0.3
496D	Andrusia loamy sand, 12 to 25 percent slopes	5,500	0.3
503B	Balmlake fine sandy loam, 1 to 6 percent slopes	7,330	0.4
503C	Balmlake fine sandy loam, 6 to 12 percent slopes	2,330	0.1
503D	Balmlake fine sandy loam, 12 to 25 percent slopes	665	*
505B	Debs silt loam, 1 to 6 percent slopes	7,660	0.4
505C	Debs silt loam, 6 to 12 percent slopes	1,750	0.1
514	Tacoosh muck	7,160	0.4
534	Mooselake mucky peat	22,000	1.1
538	Waskish peat	4,000	0.2
540	Seelyeville muck	65,000	3.3
541	Rifle mucky peat	62,000	3.2
543	Markey muck	58,500	3.0
544	Cathro muck	76,500	3.8
545	Rondeau muck	4,660	0.2
546	Lupton muck	16,500	0.8
547	Deerwood muck	21,000	1.1
549	Greenwood peat	54,000	2.8
560	Greenwood-Lobo complex	26,500	1.4
561	Bullwinkle muck	114,500	5.8
563	Northwood muck	26,400	1.4
565	Eckvoll loamy fine sand	26,500	1.4
582	Roliss loam	2,660	0.1
607	Pengilly very fine sandy loam	9,000	0.5

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
616	Effie silt loam	12,000	0.6
620B	Cutaway loamy fine sand, 1 to 6 percent slopes	11,000	0.6
620C	Cutaway loamy fine sand, 6 to 12 percent slopes	2,500	0.1
621	Morph fine sandy loam	7,800	0.4
624	Rosy sandy loam	8,800	0.4
625	Sandwick loamy fine sand	12,000	0.6
626B	Suomi loam, 1 to 6 percent slopes	14,000	0.7
626C	Suomi loam, 6 to 12 percent slopes	6,160	0.3
626D	Suomi loam, 12 to 25 percent slopes	3,830	0.2
627	Tawas muck	39,900	2.0
628	Talmoon muck	3,160	0.2
653	Smiley muck	37,900	1.9
702	Bullwinkle-Cathro complex	26,000	1.3
709B	Lengby sandy loam, 1 to 6 percent slopes	8,360	0.4
709C	Lengby sandy loam, 6 to 12 percent slopes	4,830	0.2
709D	Lengby sandy loam, 12 to 25 percent slopes	1,000	0.1
712	Rosewood fine sandy loam	3,660	0.2
765	Smiley loam	18,500	0.9
799	Seelyeville and Bowstring soils	8,800	0.4
867B	Graycalm-Menahga complex, 1 to 6 percent slopes	35,900	1.8
867C	Graycalm-Menahga complex, 6 to 12 percent slopes	6,660	0.3
1029	Pits, gravel	1,500	0.1
1085B	Urban land-Graycalm complex, 1 to 6 percent slopes	3,000	0.2
1085C	Urban land-Graycalm complex, 6 to 12 percent slopes	350	*
1086	Urban land-Cormant complex	500	*
1804	Hamre muck, ponded	3,000	0.2
1807	Cathro muck, ponded	800	*
1808	Markey muck, ponded	3,500	0.2
1878	Hamre muck	48,000	2.5
1922	Chilgren sandy loam, very stony	2,500	0.1
1923	Garnes fine sandy loam, very stony	600	*
1924	Grygla loamy fine sand, very stony	6,500	0.3
1925	Eckvoll loamy fine sand, very stony	4,800	0.2
1935	Epoufette muck	2,330	0.1
1939	Northwood muck, very stony	2,160	0.1
1959	Nary cobbly fine sandy loam	6,560	0.3
1991	Stuntz loam	3,660	0.2
1993B	Snellman-Wykeham complex, 1 to 6 percent slopes	1,830	0.1
H87	Suomi-Aeric Glossaqualfs, loamy association, nearly level and undulating	5,400	0.3
H88	Suomi-Aeric Glossaqualfs, loamy association, gently undulating to hilly	260	*
H94	Typic Ochraqualfs, ponded	80	*
J5	Alfic Udipsamments, nearly level and undulating	1,480	0.1
J6	Graycalm-Typic Udipsamments association, nearly level and undulating	2,490	0.1
J7	Warba-Stuntz association, nearly level and undulating	40,160	2.1
J8	Glossic Eutroboralfs, loamy, rolling and hilly	3,300	0.2
J9	Aeric Glossaqualfs, clayey subsoil	2,140	0.1
J10	Aqualfs	1,490	0.1
J11	Warba-Stuntz-Arenic Eutroboralfs association, nearly level and undulating	2,400	0.1
J12	Warba-Histosols association, nearly level to gently rolling	10	*
J19	Aquic Eutroboralfs, loamy, nearly level and undulating	2,400	0.1
N77	Udipsamments, nearly level and undulating	2,660	0.1
N78	Psammentic Eutroboralfs, sandy, nearly level and undulating	15,510	0.8
N79	Psammentic Eutroboralfs, sandy, rolling and hilly	1,250	0.1
N80	Cutaway-Hiwood association, nearly level and undulating	220	*
N84	Humaquepts	400	*
O92	Hiwood-Zimmerman association, nearly level to hilly	400	*
O94	Redby fine sand	850	*
O97	Humaquepts, sandy	10	*
X01	Histosols, depressional	3,990	0.2
X02	Typic Borohemists, acid	4,660	0.2
X03	Typic Borohemists, nonacid-Typic Borosaprists association	20	*

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
X04	Typic Borosaprists-Bowstring association	7,100	0.4
X05	Typic Borohemists, nonacid	51,900	2.7
	Water areas more than 40 acres in size	351,000	17.9
	Total	1,955,600	100.0

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
32B	Nebish sandy loam, 1 to 6 percent slopes
72	Shooker loam (where drained)
77	Garnes loam
121	Wykeham fine sandy loam
125	Beltrami fine sandy loam
147	Spooner silt loam (where drained)
167	Baudette silt loam
240B	Warba fine sandy loam, 1 to 6 percent slopes
243	Stuntz fine sandy loam (where drained)
267B	Snellman fine sandy loam, 1 to 6 percent slopes
404	Chilgren loam (where drained)
439	Rockwell fine sandy loam (where drained)
481	Kratka fine sandy loam (where drained)
503B	Balmlake fine sandy loam, 1 to 6 percent slopes
505B	Debs silt loam, 1 to 6 percent slopes
582	Roliss loam
616	Effie silt loam (where drained)
621	Morph fine sandy loam (where drained)
624	Rosy sandy loam
626B	Suomi loam, 1 to 6 percent slopes
709B	Lengby sandy loam, 1 to 6 percent slopes
765	Smiley loam
1991	Stuntz loam (where drained)
1993B	Snellman-Wykeham complex, 1 to 6 percent slopes

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	Corn silage	Oats	Barley	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Tons	Bu	Bu	Tons	AUM*
32B------------- Nebish	IIe	30	13	75	55	4.0	6.0
32C------------- Nebish	IIIe	25	11	70	50	3.7	5.5
32D------------- Nebish	VIe	---	---	---	---	3.0	4.5
48-------------- Hiwood	IVs	20	6	40	25	2.5	3.8
72-------------- Shooker	IIw	20	8	50	30	2.5	3.7
77-------------- Garnes	IIe	33	12	75	55	4.0	6.0
116------------- Redby	IIIw	25	10	55	40	3.0	4.5
117------------- Cormant	IVw	20	8	50	30	2.0	3.0
121------------- Wykeham	IIe	33	14	80	60	4.5	6.8
125------------- Beltrami	IIe	33	14	80	60	4.5	6.8
147------------- Spooner	IIw	28	12	70	45	4.0	6.0
158B------------ Zimmerman	IVs	20	6	38	25	1.7	2.6
158C------------ Zimmerman	VIs	---	---	---	---	1.4	2.1
167------------- Baudette	IIe	33	14	80	60	4.5	6.8
191------------- Epoufette	IIIw	25	9	55	35	2.5	3.8
199B------------ Sol	IVs	25	10	60	40	3.0	4.5
199C------------ Sol	VIs	---	---	---	---	2.8	4.2
202------------- Meehan	IVw	20	8	50	30	2.0	3.0
205------------- Karlstad	IVs	30	8	45	40	2.5	3.3

See footnotes 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	Corn silage	Oats	Barley	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Tons	Bu	Bu	Tons	AUM*
240B------------ Warba	IIe	30	13	75	55	4.0	6.0
240C------------ Warba	IIIe	25	11	70	50	3.7	5.5
242B------------ Marquette	IVs	20	7	35	25	2.0	3.0
242C------------ Marquette	IVs	15	6	30	20	1.6	2.4
243------------- Stuntz	IIw	28	12	70	45	4.0	6.0
267B------------ Snellman	IIe	30	13	75	55	4.0	6.0
267C------------ Snellman	IIIe	25	11	70	50	3.7	5.5
267D------------ Snellman	VIe	---	---	---	---	3.0	4.5
272------------- Bemidji	IIIs	20	8	55	35	2.5	3.8
280------------- Pelan	IIIe	30	8	55	30	3.0	4.5
328B------------ Sartell	IVs	15	6	35	20	2.0	3.0
404------------- Chilgren	IIw	33	10	75	55	4.0	6.0
432------------- Strandquist	IIIw	25	8	50	30	2.5	3.8
439------------- Rockwell	IIw	30	9	65	45	3.5	5.3
458B, 458C------ Menahga	IVs	20	6	40	25	2.5	3.8
458D------------ Menahga	VIs	---	---	---	---	2.0	3.0
481------------- Kratka	IIIw	30	10	65	40	3.5	5.3
482------------- Grygla	IVw	25	8	50	30	2.5	3.8
496B------------ Andrusia	IIIs	20	8	55	40	3.0	4.5
496C------------ Andrusia	IIIe	15	7	50	35	2.5	3.8

See footnotes 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	Corn silage	Oats	Barley	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Tons	Bu	Bu	Tons	AUM*
496D------------ Andrusia	VIe	---	---	---	---	2.0	3.0
503B------------ Balmlake	IIe	25	8	60	45	3.5	5.3
503C------------ Balmlake	IIIe	20	8	55	40	3.0	4.5
503D------------ Balmlake	VIe	---	---	---	---	2.5	3.8
505B------------ Debs	IIe	30	13	75	55	4.5	6.8
505C------------ Debs	IIIe	25	12	70	50	4.0	6.0
514------------- Tacoosh	VIw	---	---	---	---	---	---
534------------- Mooselake	VIw	---	---	---	---	---	---
538------------- Waskish	VIIw	---	---	---	---	---	---
540------------- Seelyeville	VIw	---	---	---	---	---	---
541------------- Rifle	VIw	---	---	---	---	---	---
543------------- Markey	VIw	---	---	---	---	---	---
544------------- Cathro	VIw	---	---	---	---	---	---
545------------- Rondeau	VIw	---	---	---	---	---	---
546------------- Lupton	VIIw	---	---	---	---	---	---
547------------- Deerwood	VIw	---	---	---	---	---	---
549------------- Greenwood	VIIw	---	---	---	---	---	---
560------------- Greenwood-Lobo	VIIw	---	---	---	---	---	---
561------------- Bullwinkle	VIw	---	---	---	---	---	---
563------------- Northwood	VIw	---	---	---	---	---	---

See footnotes 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	Corn silage	Oats	Barley	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Tons	Bu	Bu	Tons	AUM*
565------------- Eckvoll	IIIs	25	8	60	40	2.5	3.8
582------------- Roliss	IIw	33	11	75	50	3.7	5.5
607------------- Pengilly	VIIw	---	---	---	---	---	---
616------------- Effie	IIw	28	12	70	45	4.0	6.0
620B------------ Cutaway	IIIs	25	8	55	35	2.5	3.7
620C------------ Cutaway	IIIe	20	7	45	30	2.5	3.8
621------------- Morph	IIw	20	8	50	30	2.5	3.8
624------------- Rosy	IIe	25	11	70	45	4.0	6.0
625------------- Sandwick	IIIw	25	10	55	40	3.0	4.5
626B------------ Suomi	IIe	30	13	75	55	4.0	6.0
626C------------ Suomi	IIIe	25	10	70	50	3.6	5.4
626D------------ Suomi	VIe	---	---	---	---	3.0	4.5
627------------- Tawas	VIw	---	---	---	---	---	---
628------------- Talmoon	VIw	---	---	---	---	---	---
653------------- Smiley	IIIw	25	10	60	35	3.0	4.5
702------------- Bullwinkle-Cathro	VIw	---	---	---	---	---	---
709B------------ Lengby	IIe	28	8	70	45	3.5	5.3
709C------------ Lengby	IIIe	23	8	65	40	3.0	4.5
709D------------ Lengby	VIe	---	---	---	---	2.5	3.8
712------------- Rosewood	IIIw	30	8	65	45	2.5	3.8

See footnotes 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	Corn silage	Oats	Barley	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Tons	Bu	Bu	Tons	AUM*
765------------- Smiley	IIw	33	11	70	55	4.0	6.0
799------------- Seelyeville and Bowstring	VIw	---	---	---	---	---	---
867B------------ Graycalm-Menahga	IVs	20	7	40	25	2.5	3.8
867C:							
Graycalm-------	VIs	---	---	---	---	---	---
Menahga--------	IVs	15	6	35	26	2.0	3.0
1029. Pits							
1085B, 1085C. Urban land-Graycalm							
1086. Urban land-Cormant							
1804------------ Hamre	VIIIw	---	---	---	---	---	---
1807------------ Cathro	VIIIw	---	---	---	---	---	---
1808------------ Markey	VIIIw	---	---	---	---	---	---
1878------------ Hamre	IIIw	20	8	40	30	2.5	3.8
1922------------ Chilgren	VIw	---	---	---	---	3.0	4.5
1923------------ Garnes	VIs	---	---	---	---	3.0	4.5
1924------------ Grygla	VIw	---	---	---	---	2.5	3.8
1925------------ Eckvoll	VIs	---	---	---	---	2.5	3.8
1935------------ Epoufette	VIw	---	---	---	---	---	---
1939------------ Northwood	VIw	---	---	---	---	---	---
1959------------ Nary	IIIs	23	11	60	45	3.0	4.5

See footnotes 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	Corn silage	Oats	Barley	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Tons	Bu	Bu	Tons	AUM*
1991------------ Stuntz	IIw	25	11	65	45	3.0	4.5
1993B----------- Snellman-Wykeham	IIe	30	14	75	55	4.1	6.2

* 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 the 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: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
32B, 32C--------	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	76	89	White spruce, eastern white pine, balsam fir.
Nebish						Paper birch---------	67	77	
						American basswood---	75	73	
						Sugar maple---------	59	37	
						Northern red oak----	65	59	
						Balsam fir----------	65	129	
						White spruce--------	60	118	
						Eastern white pine--	55	106	
						Red pine------------	55	88	
						Jack pine-----------	65	94	
32D-------------	6R	Moderate	Moderate	Slight	Slight	Quaking aspen-------	76	89	White spruce, eastern white pine, balsam fir.
Nebish						Paper birch---------	67	77	
						American basswood---	75	73	
						Sugar maple---------	59	37	
						Northern red oak----	65	59	
						Balsam fir----------	65	129	
						White spruce--------	60	118	
						Eastern white pine--	55	106	
						Red pine------------	55	88	
						Jack pine-----------	65	94	
48--------------	8W	Slight	Moderate	Moderate	Moderate	Red pine------------	66	117	Red pine, jack pine, white spruce.
Hiwood						Eastern white pine--	45	75	
						Jack pine-----------	63	91	
						White spruce--------	50	96	
						Balsam fir----------	59	116	
						Black spruce--------	52	---	
						Quaking aspen-------	71	82	
72--------------	6W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	72	84	White spruce, black spruce, eastern white pine, balsam fir.
Shooker						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						American basswood---	65	59	
						Black ash-----------	65	40	
						American elm--------	---	---	
						White spruce--------	60	118	
77--------------	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	80	94	Red pine, eastern white pine, white spruce.
Garnes						Red pine------------	60	107	
						Eastern white pine--	55	106	
						Jack pine-----------	65	94	
						White spruce--------	60	118	
						Sugar maple---------	55	35	
						Paper birch---------	70	81	
						Balsam fir----------	60	118	
						Bur oak-------------	40	---	
116-------------	7W	Slight	Moderate	Moderate	Moderate	Quaking aspen-------	76	89	Red pine, jack pine, white spruce.
Redby						Jack pine-----------	67	96	
						Red pine------------	49	73	
						White spruce--------	60	118	
						Black spruce--------	50	63	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
117------------- Cormant	6W	Slight	Moderate	Moderate	Moderate	Quaking aspen-------	75	87	Black spruce, eastern white pine, white spruce.
						Black ash-----------	50	32	
						Balsam fir----------	50	96	
121------------- Wykeham	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	84	99	Eastern white pine, jack pine, northern red oak, white spruce.
						Sugar maple---------	60	38	
						American basswood---	70	66	
						White spruce--------	60	118	
						Red pine------------	60	101	
						Eastern white pine--	60	121	
						Northern red oak----	70	66	
125------------- Beltrami	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	80	94	Jack pine, white spruce, eastern white pine.
						Red pine------------	60	101	
						Eastern white pine--	55	106	
						Jack pine-----------	65	94	
						White spruce--------	60	118	
						American basswood---	70	66	
						Northern red oak----	65	59	
						Sugar maple---------	60	38	
147------------- Spooner	8W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	85	101	White spruce, black spruce, balsam fir.
						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						Black ash-----------	65	40	
						American elm--------	---	---	
						White spruce--------	60	118	
158B, 158C------ Zimmerman	8S	Slight	Slight	Moderate	Slight	Red pine------------	62	107	Red pine, eastern white pine, jack pine.
						Jack pine-----------	66	96	
						Paper birch---------	65	73	
						Quaking aspen-------	75	87	
						Balsam fir----------	65	129	
						Northern red oak----	53	39	
						Eastern white pine--	76	169	
						White spruce--------	65	129	
167------------- Baudette	7L	Slight	Severe	Slight	Slight	Quaking aspen-------	85	101	Balsam fir, white spruce, eastern white pine, red pine.
						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						Black ash-----------	65	40	
						American elm--------	---	---	
						White spruce--------	60	118	
						Bur oak-------------	63	---	
						American basswood---	67	---	
191------------- Epoufette	5W	Slight	Severe	Moderate	Severe	Quaking aspen-------	64	71	Black spruce, white spruce, balsam fir.
						Black ash-----------	---	---	
						Balsam fir----------	---	---	
						American elm--------	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
199B, 199C------ Sol	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	72	84	White spruce, eastern white pine, northern red oak, balsam fir, red pine.
						American basswood---	65	59	
						Sugar maple---------	55	35	
						Northern red oak----	55	42	
						Paper birch---------	69	80	
						Balsam fir----------	55	107	
						Red pine------------	50	75	
						White spruce--------	60	118	
						Eastern white pine--	50	90	
						American elm--------	65	---	
						Jack pine-----------	55	77	
202------------- Meehan	6W	Slight	Moderate	Slight	Moderate	Quaking aspen-------	79	93	Eastern white pine, jack pine, white spruce, balsam fir, red pine.
						Jack pine-----------	60	96	
						Red pine------------	65	115	
						Paper birch---------	60	65	
						Balsam fir----------	59	116	
						Eastern white pine--	55	106	
205------------- Karlstad	5L	Slight	Moderate	Moderate	Slight	Red pine------------	55	88	Red pine, white spruce, jack pine, balsam fir.
						Quaking aspen-------	70	81	
						Eastern white pine--	55	106	
						Jack pine-----------	60	85	
						Bur oak-------------	36	---	
240B, 240C------ Warba	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	76	89	White spruce, balsam fir, eastern white pine, northern red oak.
						Paper birch---------	74	88	
						American basswood---	70	66	
						Sugar maple---------	60	38	
						Northern red oak----	67	61	
						Balsam fir----------	60	118	
						Eastern white pine--	55	106	
						Red pine------------	68	123	
						White spruce--------	63	125	
						Bigtooth aspen------	81	96	
242B, 242C------ Marquette	6F	Slight	Slight	Moderate	Slight	Red pine------------	55	88	Red pine, white spruce, jack pine.
						Quaking aspen-------	63	70	
						Eastern white pine--	55	106	
						Jack pine-----------	65	94	
						Paper birch---------	---	---	
						White spruce--------	50	96	
						Bur oak-------------	---	---	
243------------- Stuntz	7W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	80	94	White spruce, eastern white pine, balsam fir.
						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						American basswood---	65	59	
						American elm--------	---	---	
						Sugar maple---------	55	35	
						White spruce--------	60	118	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
267B, 267C------ Snellman	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	70	81	Red pine, northern red oak, eastern white pine, jack pine, balsam fir.
						Paper birch---------	60	65	
						Northern red oak----	60	51	
						Sugar maple---------	55	35	
						Bur oak-------------	50	34	
						Red pine------------	50	75	
						Eastern white pine--	50	70	
						Jack pine-----------	55	77	
						American basswood---	70	66	
						White spruce--------	60	118	
267D------------ Snellman	6R	Moderate	Moderate	Slight	Slight	Quaking aspen-------	70	81	Red pine, northern red oak, eastern white pine, jack pine, balsam fir.
						Paper birch---------	60	65	
						Northern red oak----	60	51	
						Sugar maple---------	55	35	
						Bur oak-------------	50	34	
						Red pine------------	50	75	
						Eastern white pine--	50	70	
						Jack pine-----------	55	77	
						American basswood---	70	66	
						White spruce--------	60	118	
272------------- Bemidji	8W	Slight	Moderate	Moderate	Moderate	Red pine------------	65	115	Red pine, eastern white pine, jack pine, white spruce, balsam fir.
						White spruce--------	60	118	
						Quaking aspen-------	70	86	
						Eastern white pine--	60	121	
						Paper birch---------	60	65	
						Northern red oak----	60	51	
						Jack pine-----------	55	77	
280------------- Pelan	6L	Slight	Moderate	Slight	Slight	Red pine------------	55	88	Red pine, white spruce, jack pine.
						Jack pine-----------	60	85	
						White spruce--------	60	118	
						Eastern white pine--	55	106	
328B------------ Sartell	7S	Slight	Moderate	Moderate	Slight	Red pine------------	59	99	Red pine, jack pine, white spruce.
						Eastern white pine--	61	124	
						Jack pine-----------	64	93	
404------------- Chilgren	6W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	75	87	White spruce, black spruce, balsam fir.
						White spruce--------	55	107	
						Black ash-----------	45	29	
						Balsam fir----------	50	96	
						Bur oak-------------	38	---	
458B, 458C------ Menahga	7S	Slight	Moderate	Moderate	Slight	Jack pine-----------	65	94	Red pine, white spruce, eastern white pine, jack pine.
						Red pine------------	63	104	
						Eastern white pine--	57	112	
						Quaking aspen-------	66	75	
						Bigtooth aspen------	76	---	
						Paper birch---------	70	81	
						Balsam fir----------	68	135	
						Northern red oak----	55	42	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
458D------------ Menahga	8R	Moderate	Moderate	Moderate	Slight	Red pine------------	63	104	Red pine, white spruce, eastern white pine, jack pine.
						Jack pine-----------	65	94	
						Eastern white pine--	57	112	
						Quaking aspen-------	66	75	
						Bigtooth aspen------	76	---	
						Paper birch---------	70	81	
						Balsam fir----------	68	35	
						Northern red oak----	55	42	
482------------- Grygla	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	76	89	White spruce, black spruce, eastern white pine, balsam fir.
						Jack pine-----------	50	68	
496B, 496C------ Andrusia	7S	Slight	Moderate	Moderate	Slight	Red pine------------	63	109	Red pine, jack pine, white spruce.
						Jack pine-----------	66	96	
						White spruce--------	60	118	
						Paper birch---------	60	65	
496D------------ Andrusia	7R	Moderate	Moderate	Moderate	Slight	Red pine------------	63	109	Red pine, jack pine, white spruce.
						Jack pine-----------	66	96	
						White spruce--------	60	118	
						Paper birch---------	60	65	
503B, 503C------ Balmlake	7L	Slight	Moderate	Slight	Slight	Red pine------------	60	101	Red pine, northern red oak, white oak, jack pine.
						Northern red oak----	60	51	
						Paper birch---------	65	73	
						Sugar maple---------	55	35	
						American basswood---	65	59	
						Quaking aspen-------	80	94	
						White oak-----------	---	---	
						Jack pine-----------	---	---	
503D------------ Balmlake	7R	Moderate	Moderate	Slight	Slight	Red pine------------	60	101	Red pine, northern red oak, white oak, jack pine.
						Northern red oak----	60	51	
						Paper birch---------	65	73	
						Sugar maple---------	55	35	
						American basswood---	65	59	
						Quaking aspen-------	80	94	
						White oak-----------	---	---	
						Jack pine-----------	---	---	
505B, 505C------ Debs	6L	Slight	Severe	Slight	Slight	Quaking aspen-------	73	85	Eastern white pine, white spruce, balsam fir.
						Paper birch---------	65	73	
						American basswood---	75	73	
						White spruce--------	60	118	
						Sugar maple---------	60	38	
534------------- Mooselake	2W	Slight	Severe	Severe	Severe	Black spruce--------	40	52	Black spruce, balsam fir, northern whitecedar.
						Black ash-----------	55	35	
						Northern whitecedar-	30	42	
						Balsam fir----------	50	96	
						Tamarack------------	49	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
538-------------- Waskish	2W	Slight	Severe	Severe	Severe	Black spruce--------	25	35	Black spruce, tamarack.
						Tamarack------------	30	---	
546-------------- Lupton	2W	Slight	Severe	Severe	Severe	Black spruce--------	40	50	Black spruce, balsam fir, northern whitecedar, tamarack.
						Black ash-----------	56	36	
						Northern whitecedar-	29	41	
						Balsam fir----------	39	69	
						Tamarack------------	49	---	
549-------------- Greenwood	4W	Slight	Severe	Severe	Severe	Black spruce--------	39	51	Black spruce, tamarack.
						Tamarack------------	46	---	
560:									
Greenwood-------	4W	Slight	Severe	Severe	Severe	Black spruce--------	39	51	Black spruce, tamarack.
						Tamarack------------	46	---	
Lobo------------	2W	Slight	Severe	Severe	Severe	Black spruce--------	25	35	Black spruce, tamarack.
						Tamarack------------	30	---	
561-------------- Bullwinkle	3W	Slight	Severe	Moderate	Severe	Black spruce--------	33	44	Black spruce, tamarack, balsam fir, northern whitecedar.
						Tamarack------------	37	---	
						Northern whitecedar-	35	51	
						Balsam fir----------	30	49	
565-------------- Eckvoll	6L	Slight	Severe	Moderate	Moderate	Quaking aspen-------	74	86	Red pine, northern red oak, white spruce, balsam fir.
						Bur oak-------------	45	30	
						American basswood---	60	51	
607-------------- Pengilly	3W	Slight	Severe	Moderate	Severe	Black ash-----------	70	38	Black spruce, tamarack, balsam fir.
						American elm--------	---	---	
						Quaking aspen-------	70	81	
						Red maple-----------	---	---	
						Paper birch---------	60	65	
						Balsam fir----------	55	101	
						Silver maple--------	75	---	
						Swamp white oak-----	60	---	
616-------------- Effie	7W	Slight	Severe	Moderate	Moderate	Quaking aspen-------	87	99	White spruce, black spruce, balsam fir.
						Balsam fir----------	60	118	
						Paper birch---------	65	73	
						Eastern white pine--	55	106	
						White spruce--------	60	118	
						Black ash-----------	65	40	
						Balsam poplar-------	90	107	
620B, 620C------- Cutaway	6S	Slight	Moderate	Moderate	Slight	Quaking aspen-------	75	87	White spruce, red pine, eastern white pine, jack pine, balsam fir.
						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						Red pine------------	62	107	
						Jack pine-----------	65	94	
						Eastern white pine--	55	106	
						White spruce--------	60	118	
						Northern red oak----	60	51	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
621------------- Morph	7W	Slight	Severe	Slight	Moderate	Quaking aspen-------	80	94	White spruce, balsam fir, black spruce.
						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						Black ash-----------	65	40	
						White spruce--------	60	118	
624------------- Rosy	7L	Slight	Moderate	Slight	Slight	Quaking aspen-------	81	96	White spruce, eastern white pine, northern red oak, balsam fir.
						Balsam fir----------	60	118	
						Paper birch---------	65	73	
						American basswood---	65	59	
						Sugar maple---------	65	40	
						Northern red oak----	55	42	
						Eastern white pine--	55	106	
						White spruce--------	55	107	
						Red pine------------	60	101	
625------------- Sandwick	8W	Slight	Moderate	Slight	Moderate	Quaking aspen-------	80	94	White spruce, eastern white pine, balsam fir.
						Paper birch---------	65	73	
						Balsam fir----------	73	146	
						Eastern white pine--	55	106	
						Black ash-----------	65	40	
626B, 626C------ Suomi	7W	Slight	Moderate	Slight	Moderate	Quaking aspen-------	85	101	White spruce, eastern white pine, northern red oak, balsam fir.
						Paper birch---------	70	81	
						American basswood---	70	66	
						Sugar maple---------	55	35	
						Northern red oak----	65	59	
						Balsam fir----------	65	129	
						Eastern white pine--	55	106	
						White spruce--------	60	118	
						Red pine------------	54	---	
626D------------ Suomi	7R	Moderate	Moderate	Slight	Moderate	Quaking aspen-------	85	101	White spruce, eastern white pine, northern red oak, balsam fir.
						Paper birch---------	70	81	
						American basswood---	70	66	
						Sugar maple---------	55	35	
						Northern red oak----	65	59	
						Balsam fir----------	65	129	
						Eastern white pine--	55	106	
						White spruce--------	60	118	
						Red pine------------	54	---	
627------------- Tawas	3W	Slight	Severe	Severe	Severe	Black spruce--------	40	46	Balsam fir, black spruce, tamarack, northern whitecedar.
						Northern whitecedar-	24	35	
						Balsam fir----------	50	96	
						Black ash-----------	55	35	
						Tamarack------------	47	---	
628------------- Talmoon	3W	Slight	Severe	Severe	Severe	Black ash-----------	60	38	Balsam fir, black spruce, tamarack, northern whitecedar.
						Balsam fir----------	55	107	
						American elm--------	---	---	
						Black spruce--------	40	52	
						Tamarack------------	50	---	
						Northern whitecedar-	35	51	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
702:									
Bullwinkle	3W	Slight	Severe	Moderate	Severe	Black spruce	33	50	Black spruce, tamarack, balsam fir, northern whitecedar.
						Tamarack	37	---	
						Northern whitecedar	35	51	
						Balsam fir	30	49	
Cathro.									
709B, 709C Lengby	7L	Slight	Moderate	Slight	Slight	Quaking aspen	80	94	Quaking aspen, eastern white pine, white spruce, red pine, jack pine.
						Paper birch	---	---	
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
709D Lengby	7R	Moderate	Moderate	Slight	Slight	Quaking aspen	80	94	Quaking aspen, eastern white pine, white spruce, red pine, jack pine.
						Paper birch	---	---	
						White oak	---	---	
						American basswood	---	---	
						Sugar maple	---	---	
867B, 867C:									
Graycalm	7A	Slight	Slight	Slight	Slight	Red pine	61	104	Red pine, eastern white pine, white spruce, jack pine, balsam fir.
						Jack pine	63	91	
						Quaking aspen	65	73	
						Eastern white pine	55	106	
						White spruce	53	103	
						Paper birch	60	65	
						Northern red oak	55	42	
						Balsam fir	58	113	
Menahga	8S	Slight	Moderate	Moderate	Slight	Red pine	63	109	Red pine, white spruce, eastern white pine, jack pine.
						Jack pine	65	94	
						Eastern white pine	57	112	
						Quaking aspen	66	75	
						Bigtooth aspen	76	---	
						Paper birch	70	81	
						Balsam fir	68	135	
						Northern red oak	55	42	
1922 Chilgren	6W	Slight	Severe	Moderate	Moderate	Quaking aspen	75	87	White spruce, black spruce, balsam fir.
						White spruce	55	107	
						Black ash	45	29	
						Balsam fir	50	96	
						Bur oak	38	---	
1923 Garnes	7L	Slight	Severe	Slight	Slight	Red pine	60	101	Red pine, eastern white pine, white spruce, balsam fir.
						Eastern white pine	55	106	
						Jack pine	65	94	
						White spruce	60	118	
						Quaking aspen	80	94	
						Sugar maple	55	35	
						Paper birch	70	81	
						Balsam fir	60	118	
						Bur oak	40	---	

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	Volume*	
1924------------ Grygla	6X	Slight	Severe	Moderate	Moderate	Quaking aspen-------	76	89	White spruce, black spruce, eastern white pine.
						Jack pine-----------	50	68	
1925------------ Eckvoll	6L	Slight	Severe	Slight	Moderate	Quaking aspen-------	74	86	Red pine, white spruce, balsam fir.
						Bur oak-------------	45	30	
						American basswood---	60	51	
1935------------ Epoufette	2W	Slight	Severe	Severe	Severe	Black spruce--------	45	32	Black spruce, tamarack, balsam fir, northern whitecedar.
						Northern whitecedar-	---	---	
						Balsam fir----------	---	---	
						Black ash-----------	---	---	
1959------------ Nary	7L	Slight	Moderate	Slight	Slight	Quaking aspen-------	84	99	White spruce, eastern white pine, balsam fir.
						American basswood---	---	---	
						Northern red oak----	65	59	
						Sugar maple---------	---	---	
						American elm--------	---	---	
1991------------ Stuntz	7W	Slight	Severe	Slight	Moderate	Quaking aspen-------	80	94	White spruce, eastern white pine, balsam fir.
						Paper birch---------	65	73	
						Balsam fir----------	60	118	
						American basswood---	65	59	
						American elm--------	---	---	
						Sugar maple---------	55	35	
						White spruce--------	60	118	
1993B:									
Snellman-------	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	70	81	Red pine, eastern white pine, balsam fir.
						Paper birch---------	60	65	
						Northern red oak----	60	51	
						Sugar maple---------	55	35	
						Bur oak-------------	50	34	
						Red pine------------	50	75	
						Eastern white pine--	50	70	
						Jack pine-----------	55	77	
						American basswood---	70	66	
						White spruce--------	60	118	
Wykeham--------	6L	Slight	Moderate	Slight	Slight	Quaking aspen-------	84	99	Eastern white pine, red pine, white spruce.
						Sugar maple---------	60	38	
						American basswood---	70	66	
						White spruce--------	60	118	
						Red pine------------	60	101	
						Eastern white pine--	60	121	
						Northern red oak----	70	66	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--FORESTRY EQUIPMENT USE

(Only the soils suitable for the production of commercial trees are listed)

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Ratings for the most limiting season(s): Log landings	Ratings for the most limiting season(s): Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Ratings for preferred operating season(s): Log landings	Ratings for preferred operating season(s): Haul roads
32B, Nebish	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall.	Slight	Moderate: low strength.	Moderate: low strength.
					Winter	Slight	Slight	Slight.
32C, Nebish	Spring	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.	Summer, fall.	Slight	Moderate: low strength, slope.	Moderate: low strength.
					Winter	Slight	Moderate: slope.	Slight.
32D, Nebish	Spring	Moderate: low strength, slope.	Severe: slope.	Moderate: low strength, slope.	Summer, fall.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope.
					Winter	Moderate: slope.	Severe: slope.	Moderate: slope.
48, Hiwood	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
72, Shooker	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, low strength.
					Winter*	Slight	Slight	Slight.
77, Garnes	Spring	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
116, Redby	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
117, Cormant	Spring	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Log landings	Haul roads
121 Wykeham	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
125 Beltrami	Spring	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall.	Slight	Moderate: low strength.	Moderate: low strength.
					Winter	Slight	Slight	Slight.
147 Spooner	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.
158B Zimmerman	---	---	---	---	All	Slight	Slight	Slight.
158C Zimmerman	---	---	---	---	All	Slight	Moderate: slope.	Slight.
167 Baudette	Spring	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
191 Epoufette	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.
199B Sol	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
199C Sol	Spring	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.	Summer, fall, winter.	Slight	Moderate: slope.	Slight.
202 Meehan	Spring	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter	Slight	Slight	Slight.
205 Karlstad	---	---	---	---	All	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Ratings for the most limiting season(s): Log landings	Ratings for the most limiting season(s): Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Ratings for preferred operating season(s): Log landings	Ratings for preferred operating season(s): Haul roads
240B----------------- Warba	Spring----	Moderate: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall.	Slight--------	Severe: low strength.	Severe: low strength.
					Winter---	Slight--------	Slight--------	Slight.
240C----------------- Warba	Spring----	Moderate: low strength.	Severe: low strength, slope.	Severe: low strength.	Summer, fall.	Slight--------	Severe: low strength, slope.	Severe: low strength.
					Winter---	Slight--------	Moderate: slope.	Slight.
242B----------------- Marquette	---	---	---	---	All------	Slight--------	Slight--------	Slight.
242C----------------- Marquette	---	---	---	---	All------	Slight--------	Moderate: slope.	Slight.
243------------------ Stuntz	Spring----	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall.	Slight--------	Severe: low strength.	Severe: low strength.
					Winter---	Slight--------	Slight--------	Slight.
267B----------------- Snellman	Spring----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight--------	Slight--------	Slight.
267C----------------- Snellman	Spring----	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.	Slight--------	Moderate: slope.	Slight.
267D----------------- Snellman	Spring----	Moderate: low strength, slope.	Severe: slope.	Moderate: low strength, slope.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
272------------------ Bemidji	Spring----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight--------	Slight--------	Slight.
280------------------ Pelan	Spring----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight--------	Slight--------	Slight.
328B----------------- Sartell	---	---	---	---	All------	Slight--------	Slight--------	Slight.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Log landings	Haul roads
404 Chilgren	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.
458B Menahga	---	---	---	---	All	Slight	Slight	Slight.
458C Menahga	---	---	---	---	All	Slight	Moderate: slope.	Slight.
458D Menahga	---	---	---	---	All	Moderate: slope.	Severe: slope.	Moderate: slope.
482 Grygla	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.
496B Andrusia	---	---	---	---	All	Slight	Slight	Slight.
496C Andrusia	---	---	---	---	All	Slight	Moderate: slope.	Slight.
496D Andrusia	---	---	---	---	All	Moderate: slope.	Severe: slope.	Moderate: slope.
503B Balmlake	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
503C Balmlake	Spring	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Moderate: low strength, slope.	Slight.
503D Balmlake	Spring	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope.
505B Debs	Spring	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Log landings	Haul roads
505C----------------- Debs	Spring----	Severe: low strength.	Severe: low strength, slope.	Severe: low strength.	Summer, fall, winter.	Slight--------	Moderate: slope.	Slight.
534----------------- Mooselake	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
538----------------- Waskish	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
546----------------- Lupton	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
549----------------- Greenwood	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
560----------------- Greenwood-Lobo	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
561----------------- Bullwinkle	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
565----------------- Eckvoll	Spring----	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight--------	Slight--------	Slight.
607----------------- Pengilly	Spring, summer, fall.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter*--	Slight--------	Slight--------	Slight.
616----------------- Effie	Spring----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Severe: low strength.	Severe: low strength.
					Winter*--	Slight--------	Slight--------	Slight.
620B---------------- Cutaway	---	---	---	---	All------	Slight--------	Slight--------	Slight.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Ratings for the most limiting season(s): Log landings	Ratings for the most limiting season(s): Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Ratings for preferred operating season(s): Log landings	Ratings for preferred operating season(s): Haul roads
620C Cutaway	---	---	---	---	All	Slight	Moderate: slope.	Slight.
621 Morph	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.
624 Rosy	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
625 Sandwick	Spring	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
					Winter*	Slight	Slight	Slight.
626B Suomi	Spring	Moderate: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall.	Slight	Severe: low strength.	Severe: low strength.
					Winter	Slight	Slight	Slight.
626C Suomi	Spring	Moderate: low strength.	Severe: low strength, slope.	Severe: low strength.	Summer, fall.	Slight	Severe: low strength, slope.	Severe: low strength.
					Winter	Slight	Moderate: slope.	Slight.
626D Suomi	Spring	Moderate: slope, low strength.	Severe: slope, low strength.	Severe: low strength.	Summer, fall.	Moderate: slope.	Severe: slope, low strength.	Severe: low strength, slope.
					Winter	Moderate: slope.	Severe: slope.	Moderate: slope.
627 Tawas	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*	Slight	Slight	Slight.
628 Talmoon	Spring	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall.	Moderate: wetness.	Severe: low strength.	Severe: low strength.
					Winter*	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Log landings	Haul roads
702:								
Bullwinkle	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*	Slight	Slight	Slight.
Cathro.								
709B Lengby	Spring	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall.	Slight	Moderate: low strength.	Moderate: low strength.
					Winter	Slight	Slight	Slight.
709C Lengby	Spring	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall.	Slight	Moderate: slope, low strength.	Moderate: low strength.
					Winter	Slight	Slight	Slight.
709D Lengby	Spring	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall.	Moderate: slope.	Severe: slope.	Moderate: slope, low strength.
					Winter	Slight	Slight	Slight.
867B Graycalm-Menahga	---	---	---	---	All	Slight	Slight	Slight.
867C Graycalm-Menahga	---	---	---	---	All	Slight	Moderate: slope.	Slight.
1922 Chilgren	Spring	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness, too stony.	Moderate: wetness, too stony.
					Winter*	Slight	Moderate: too stony.	Moderate: too stony.
1923 Garnes	Spring	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Moderate: too stony.	Moderate: too stony.

See footnote at end of table.

TABLE 8.--FORESTRY EQUIPMENT USE--Continued

Soil name and map symbol	Most limiting season(s)	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)	Ratings for preferred operating season(s): Logging areas and skid trails	Log landings	Haul roads
1924---------------- Grygla	Spring----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Summer, fall.	Moderate: wetness.	Moderate: wetness, too stony.	Moderate: wetness, too stony.
					Winter*--	Slight--------	Moderate: too stony.	Moderate: too stony.
1925---------------- Eckvoll	Spring----	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight--------	Moderate: too stony.	Moderate: too stony.
1935---------------- Epoufette	Spring, summer, fall.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter*--	Slight--------	Slight--------	Slight.
1959---------------- Nary	Spring----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight--------	Slight--------	Slight.
1991---------------- Stuntz	Spring----	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall.	Slight--------	Severe: low strength.	Severe: low strength.
					Winter---	Slight--------	Slight--------	Slight.
1993B--------------- Snellman-Wykeham	Spring----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight--------	Slight--------	Slight.

* The rating is severe if the soil cannot support equipment because it is not adequately frozen.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(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. Only the soils suited to windbreaks and environmental plantings are listed)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
32B, 32C, 32D. Nebish	---	Amur maple, redosier dogwood, Siberian peashrub, lilac.	Northern whitecedar, white spruce, eastern redcedar, Manchurian crabapple, blue spruce.	Eastern white pine, green ash, red pine.	---
48. 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.	---
72. Shooker	---	Lilac, Siberian peashrub, American cranberrybush, redosier dogwood.	White spruce, northern whitecedar, blue spruce, Norway spruce.	Golden willow, eastern white pine, green ash.	Silver maple.
77. 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.
121. Wykeham	---	Lilac, redosier dogwood, blue spruce, Siberian peashrub, American cranberrybush.	White spruce	Norway spruce, eastern white pine, jack pine, red pine, green ash.	Eastern cottonwood.
125. Beltrami	---	Redosier dogwood, lilac, American cranberrybush, Siberian peashrub.	White spruce, blue spruce, eastern redcedar.	Norway spruce, eastern white pine, green ash, red pine, jack pine.	---

TABLE 9.--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
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.
158B, 158C Zimmerman	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Jack pine, red pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
167 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.	---
191 Epoufette	---	Common ninebark, American plum, lilac, Siberian peashrub, silver buffaloberry, common chokecherry, redosier dogwood, American cranberrybush, arrowwood.	Blue spruce, northern whitecedar, white spruce, Amur maple, hackberry, radiant crabapple, Manchurian crabapple, Scotch pine.	Eastern white green ash, golden willow.	Silver maple, cottonwood, white willow.
199B, 199C Sol	Peking cotoneaster, Nanking cherry.	American cranberrybush, American plum, lilac, Amur maple, common chokecherry, Siberian peashrub, arrowwood, silver buffaloberry.	Eastern redcedar, hackberry, Russian-olive, blue spruce, Siberian crabapple, white spruce, Manchurian crabapple, northern whitecedar, nannyberry viburnum.	Eastern white pine, green ash, Siberian elm, red pine, silver maple.	---
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	Lilac	Common chokecherry, Siberian peashrub, eastern redcedar.	White spruce, bur oak, Russian-olive, blue spruce.	Golden willow	Eastern cottonwood.

TABLE 9.--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
240B, 240C: Warba	---	Siberian peashrub, Amur maple, redosier dogwood, lilac.	Northern whitecedar, Manchurian crabapple, eastern redcedar, white spruce, blue spruce.	Green ash, eastern white pine, red pine.	---
242B, 242C: 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.	---
243: Stuntz	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, white spruce, blue spruce.	Norway spruce, red pine, jack pine, eastern white pine, green ash.	---
267B, 267C, 267D: Snellman	Peking cotoneaster	American cranberrybush, American plum, lilac, Amur maple, common chokecherry, Siberian peashrub, arrowwood, silver buffaloberry.	Eastern redcedar, hackberry, Russian-olive, blue spruce, Siberian crabapple, white spruce, Manchurian crabapple, northern whitecedar, nannyberry viburnum.	Eastern white pine, green ash, Siberian elm, red pine, silver maple.	---
272: Bemidji	Peking cotoneaster	Common chokecherry, Amur maple, lilac, Siberian peashrub, silver buffaloberry, Siberian crabapple, American cranberrybush, late lilac, American plum.	Eastern redcedar, red pine, hackberry, white spruce, blue spruce, Russian-olive, Manchurian crabapple, Roselow sargent crabapple.	Green ash, eastern white pine, Siberian elm, Scotch pine, Norway spruce.	---
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.	---
328B: Sartell	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, Russian-olive, green ash.	Eastern white pine, Siberian elm.	---

TABLE 9.--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
404-------------- Chilgren	---	Redosier dogwood, Siberian peashrub, American plum, common chokecherry, lilac.	White spruce, Manchurian crabapple, blue spruce.	Golden willow-----	Eastern cottonwood, Carolina poplar.
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.
439-------------- Rockwell	---	Common chokecherry, Siberian peashrub, lilac, eastern redcedar.	Bur oak, Russian-olive, white spruce, blue spruce.	Siberian elm, golden willow.	Eastern cottonwood.
458B, 458C, 458D-- 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.
496B, 496C, 496D-- Andrusia	---	Siberian peashrub, Amur maple, American cranberrybush, lilac.	Blue spruce, red pine, eastern redcedar, white spruce.	Eastern white pine, green ash, Norway spruce, jack pine.	---
503B, 503C, 503D-- Balmlake	---	Siberian peashrub, Amur maple, lilac.	White spruce, red pine, eastern redcedar, blue spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, green ash, Norway spruce.	---
505B, 505C-------- Debs	---	Siberian peashrub, Amur maple, redosier dogwood, lilac.	White spruce, eastern redcedar, blue spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, green ash, red pine.	---

TABLE 9.--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
540 Seelyeville	Common ninebark	---	---	Golden willow, white willow.	Imperial Carolina poplar.
563 Northwood	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.	---
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.
620B, 620C Cutaway	---	Siberian peashrub, American cranberrybush, Amur maple, lilac.	Blue spruce, red pine, eastern redcedar, white spruce.	Eastern white pine, green ash, Norway spruce, jack pine.	---
621 Morph	---	Lilac, Siberian peashrub, American cranberrybush, redosier dogwood.	White spruce, northern whitecedar, blue spruce, Norway spruce.	Golden willow, eastern white pine, green ash.	Silver maple.
624 Rosy	---	Redosier dogwood, American cranberrybush, lilac, Siberian peashrub.	White spruce, eastern redcedar, blue spruce.	Norway spruce, eastern white pine, green ash, red pine, jack pine.	---
625 Sandwick	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, white spruce, blue spruce.	Norway spruce, red pine, jack pine, eastern white pine, green ash.	---
626B, 626C, 626D Suomi	---	Amur maple, American cranberrybush, Siberian peashrub, lilac, northern whitecedar.	White spruce, Manchurian crabapple, eastern redcedar.	Jack pine, green ash, eastern white pine.	---
653 Smiley	---	Redosier dogwood, black spruce.	Tamarack, black ash.	White willow, golden willow.	---

TABLE 9.--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
709B, 709C, 709D-- Lengby	Peking cotoneaster	Lilac, Siberian crabapple, American cranberrybush, Siberian peashrub, American plum, silver buffaloberry, Amur maple, common chokecherry.	Blue spruce, northern whitecedar, eastern redcedar, Russian-olive, hackberry, red pine, Manchurian crabapple, bur oak, white spruce.	Siberian elm, green ash, jack pine, eastern white pine.	---
712---------------- Rosewood	---	Common chokecherry, Siberian peashrub, eastern redcedar, lilac.	Blue spruce, Russian-olive, white spruce, bur oak.	Golden willow, Siberian elm.	Eastern cottonwood.
765---------------- Smiley	Redosier dogwood, honeysuckle, sargent crabapple, lilac.	Late lilac, Siberian peashrub, nannyberry viburnum, silver buffaloberry, American plum, gray dogwood, common chokecherry, eastern redcedar.	Black Hills spruce, white spruce, Manchurian crabapple, blue spruce, ponderosa pine, green ash, hackberry, Russian-olive.	Golden willow-----	Siberian elm, eastern cottonwood, Siouxland cottonwood.
867B, 867C:					
Graycalm----------	---	Lilac, Siberian peashrub, eastern redcedar, Manchurian crabapple, Siberian crabapple.	Jack pine, red pine, green ash, Russian-olive.	Siberian elm, eastern white pine.	---
Menahga-----------	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
1085B, 1085C: Urban land.					
Graycalm----------	---	Lilac, Siberian peashrub, eastern redcedar, Manchurian crabapple, Siberian crabapple.	Jack pine, red pine, green ash, Russian-olive.	Siberian elm, eastern white pine.	---
1086: Urban land.					

TABLE 9.--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
1086:					
Cormant----------	---	Siberian peashrub, redosier dogwood, American plum, lilac, common chokecherry.	White spruce, blue spruce, Manchurian crabapple.	Golden willow-----	Carolina poplar, eastern cottonwood.
1878-------------- Hamre	Common ninebark---	---	---	Golden willow, white willow.	Imperial Carolina poplar.
1922-------------- 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.
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.	---
1925-------------- 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.	---
1959-------------- Nary	---	Lilac, redosier dogwood, blue spruce, Siberian peashrub, American cranberrybush.	White spruce, eastern redcedar.	Norway spruce, eastern white pine, jack pine, red pine, green ash.	---
1991-------------- Stuntz	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, white spruce, blue spruce.	Norway spruce, red pine, jack pine, eastern white pine, green ash.	---
1993B:					
Snellman---------	Peking cotoneaster	American cranberrybush, American plum, lilac, Amur maple, common chokecherry, Siberian peashrub, arrowwood, silver buffaloberry.	Eastern redcedar, hackberry, Russian-olive, blue spruce, Siberian crabapple, white spruce, Manchurian crabapple, northern whitecedar, nannyberry viburnum.	Eastern white pine, green ash, Siberian elm, red pine, silver maple.	---

TABLE 9.--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
1993B:					
Wykeham----------	---	Lilac, redosier dogwood, blue spruce, Siberian peashrub, American cranberrybush.	White spruce------	Norway spruce, eastern white pine, jack pine, red pine, green ash.	Eastern cottonwood.

TABLE 10.--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
32B Nebish	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
32C Nebish	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
32D Nebish	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
48 Hiwood	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: slope, too sandy, wetness.	Moderate: too sandy.	Moderate: droughty.
72 Shooker	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
77 Garnes	Slight	Slight	Moderate: small stones.	Slight	Slight.
116 Redby	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: slope, 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.
121 Wykeham	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
125 Beltrami	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones, wetness.	Slight	Slight.
147 Spooner	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
158B Zimmerman	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
158C Zimmerman	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
167 Baudette	Slight	Slight	Moderate: slope.	Slight	Slight.
191 Epoufette	Severe: wetness.	Severe: wetness.	Severe: small stones, wetness.	Severe: wetness.	Severe: wetness.
199B Sol	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.	Severe: large stones.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
199C----- Sol	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope.	Moderate: large stones.	Severe: large stones.
202----- Meehan	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
205----- Karlstad	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
240B----- Warba	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
240C----- Warba	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
242B----- Marquette	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Severe: droughty.
242C----- Marquette	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Severe: droughty.
243----- Stuntz	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
267B----- Snellman	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones.
267C----- Snellman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: large stones, slope.
267D----- Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
272----- Bemidji	Moderate: small stones, wetness, too sandy.	Moderate: wetness, too sandy, small stones.	Severe: small stones.	Moderate: too sandy.	Moderate: small stones, large stones, droughty.
280----- Pelan	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
328B----- Sartell	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
404----- Chilgren	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
432----- Strandquist	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
439----- Rockwell	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
458B------------------ Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
458C------------------ Menahga	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
458D------------------ Menahga	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
481------------------- Kratka	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
482------------------- Grygla	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
496B------------------ Andrusia	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
496C------------------ Andrusia	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
496D------------------ Andrusia	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
503B------------------ Balmlake	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
503C------------------ Balmlake	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
503D------------------ Balmlake	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
505B------------------ Debs	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
505C------------------ Debs	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
514------------------- Tacoosh	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
534------------------- Mooselake	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
538------------------- Waskish	Severe: wetness, excess humus, too acid.	Severe: wetness, excess humus, too acid.	Severe: excess humus, wetness, too acid.	Severe: wetness, excess humus.	Severe: too acid, wetness, excess humus.
540------------------- Seelyeville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
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.
545------------------- Rondeau	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.
547------------------- Deerwood	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
549------------------- Greenwood	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
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.
561------------------- Bullwinkle	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: slope, small stones.	Moderate: too sandy.	Slight.
582------------------- Roliss	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
607------------------- Pengilly	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
616------------------- Effie	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
620B------------------ Cutaway	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
620C------------------ Cutaway	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
621------------------- Morph	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
624------------------- Rosy	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
625------------------- Sandwick	Severe: wetness.	Moderate: wetness, too sandy, percs slowly.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
626B------------------ Suomi	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Severe: erodes easily.	Moderate: wetness.
626C------------------ Suomi	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
626D------------------ Suomi	Severe: slope, wetness.	Severe: slope.	Severe: slope, wetness.	Severe: erodes easily.	Severe: slope.
627------------------- Tawas	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
628------------------- Talmoon	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
653------------------- Smiley	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
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.
709B------------------ Lengby	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
709C------------------ Lengby	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
709D------------------ Lengby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
712------------------- Rosewood	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
765------------------- Smiley	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
799:					
Seelyeville----------	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
Bowstring------------	Severe: flooding, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, flooding.	Severe: wetness, excess humus.	Severe: wetness, flooding, excess humus.
867B:					
Graycalm-------------	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Severe: droughty.
Menahga--------------	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
867C:					
Graycalm-------------	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
Menahga--------------	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
1029. Pits					
1085B:					
Urban land.					
Graycalm-------------	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Severe: droughty.
1085C:					
Urban land.					
Graycalm-------------	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
1086:					
Urban land.					
Cormant--------------	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1804 Hamre	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
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.
1878 Hamre	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1922 Chilgren	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
1923 Garnes	Slight	Slight	Moderate: large stones, small 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, slope.	Moderate: too sandy.	Moderate: large stones.
1935 Epoufette	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1939 Northwood	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1959 Nary	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Slight	Moderate: large stones.
1991 Stuntz	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
1993B:					
Snellman	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones.
Wykeham	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.

TABLE 11.--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 herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
32B---------------- Nebish	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
32C---------------- Nebish	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
32D---------------- Nebish	Poor	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
48----------------- Hiwood	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor.
72----------------- Shooker	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
77----------------- 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.
121---------------- Wykeham	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
125---------------- Beltrami	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
147---------------- Spooner	Good	Fair	Good	Good	Good	Fair	Fair	Good	Good	Fair.
158B, 158C--------- Zimmerman	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
167---------------- Baudette	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
191---------------- Epoufette	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
199B, 199C--------- Sol	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very 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.
240B--------------- Warba	Good	Good	Good	Good	Poor	Very poor.	Very poor.	Good	Good	Very poor.
240C--------------- Warba	Fair	Good	Good	Good	Poor	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
242B, 242C--------- Marquette	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
243---------------- Stuntz	Fair	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair.
267B--------------- Snellman	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
267C--------------- Snellman	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
267D--------------- Snellman	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
272---------------- Bemidji	Fair	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Poor.
280---------------- Pelan	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor.
328B--------------- Sartell	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
404---------------- Chilgren	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Fair.
432---------------- Strandquist	Fair	Fair	Fair	Fair	Poor	Good	Good	Good	Fair	Good.
439---------------- Rockwell	Fair	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
458B, 458C--------- Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
458D--------------- Menahga	Very 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.
496B, 496C, 496D--- Andrusia	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
503B, 503C--------- Balmlake	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
503D--------------- Balmlake	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
505B--------------- Debs	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
505C--------------- Debs	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
514---------------- Tacoosh	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
534: Mooselake	Very poor.	Poor	Poor	Poor	Fair	Good	Good	Poor	Poor	Good.
538: Waskish	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very 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	Fair	Fair	Good	Good	Poor	Fair	Good.
545: Rondeau	Poor	Poor	Poor	Very poor.	Very poor.	Good	Good	Poor	Very poor.	Good.
546: Lupton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
547: Deerwood	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very 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.
561: Bullwinkle	Very poor.	Poor	Poor	Poor	Fair	Good	Good	Poor	Fair	Good.
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.
582: Roliss	Good	Good	Good	Fair	---	Good	Fair	Good	Fair	Fair.
607: Pengilly	Poor	Poor	Fair	Fair	Fair	Fair	Good	Poor	Poor	Good.
616: Effie	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
620B, 620C: Cutaway	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
621: Morph	Fair	Fair	Good	Fair	Fair	Good	Fair	Fair	Fair	Fair.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
624 Rosy	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
625 Sandwick	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
626B, 626C Suomi	Fair	Good	Fair	Good	Good	Poor	Very poor.	Fair	Good	Poor.
626D Suomi	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
627 Tawas	Poor	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
628 Talmoon	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
653 Smiley	Fair	Fair	Poor	Poor	Poor	Good	Poor	Poor	Poor	Fair.
702:										
Bullwinkle	Very poor.	Poor	Poor	Poor	Fair	Good	Good	Poor	Fair	Good.
Cathro	Poor	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
709B, 709C Lengby	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
709D Lengby	Fair	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.
712 Rosewood	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
765 Smiley	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	---	Good.
799:										
Seelyeville	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Bowstring	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
867B, 867C:										
Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
1029. Pits										
1085B, 1085C: Urban land.										
Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.

TABLE 11.--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
1086: Urban land.										
Cormant	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
1804 Hamre	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
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.
1878 Hamre	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
1922 Chilgren	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Fair.
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.
1935 Epoufette	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Fair.
1939 Northwood	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
1959 Nary	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
1991 Stuntz	Fair	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair.
1993B:										
Snellman	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
Wykeham	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.

TABLE 12.--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
32B Nebish	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Slight.
32C Nebish	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
32D Nebish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
48 Hiwood	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: droughty.
72 Shooker	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
77 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.
121 Wykeham	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.
125 Beltrami	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
147 Spooner	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
158B Zimmerman	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
158C Zimmerman	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
167 Baudette	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
191 Epoufette	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.

TABLE 12.--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
199B-------------- Sol	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Severe: large stones.
199C-------------- Sol	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, slope, frost action.	Severe: large stones.
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.
240B-------------- Warba	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
240C-------------- Warba	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
242B-------------- Marquette	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
242C-------------- Marquette	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
243--------------- Stuntz	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
267B-------------- Snellman	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Moderate: large stones.
267C-------------- Snellman	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: shrink-swell, slope, frost action.	Moderate: large stones, slope.
267D-------------- Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
272--------------- Bemidji	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: small stones, large stones, droughty.
280--------------- Pelan	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Moderate: droughty.
328B-------------- Sartell	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
404--------------- Chilgren	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
432--------------- Strandquist	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.

TABLE 12.--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
439: Rockwell	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
458B: Menahga	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
458C: Menahga	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
458D: Menahga	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
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.
496B: Andrusia	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
496C: Andrusia	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
496D: Andrusia	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
503B: Balmlake	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
503C: Balmlake	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
503D: Balmlake	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
505B: Debs	Severe: cutbanks cave.	Slight	Slight	Slight	Severe: frost action.	Slight.
505C: Debs	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
514: Tacoosh	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
534: Mooselake	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
538: Waskish	Severe: excess humus, wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, frost action.	Severe: too acid, wetness, excess humus.

TABLE 12.--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
540: Seelyeville	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: ponding, excess humus.
541: Rifle	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	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.
544: Cathro	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
545: Rondeau	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	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.
547: Deerwood	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, 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.
561: 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.
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.

TABLE 12.--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
582 Roliss	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
607 Pengilly	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
616 Effie	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
620B Cutaway	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
620C Cutaway	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
621 Morph	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
624 Rosy	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Slight.
625 Sandwick	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Moderate: wetness, droughty.
626B Suomi	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
626C Suomi	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
626D Suomi	Severe: wetness, slope.	Severe: wetness, shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
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.
628 Talmoon	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding, excess humus.
653 Smiley	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.

TABLE 12.--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
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.
709B-------------- Lengby	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
709C-------------- Lengby	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
709D-------------- Lengby	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
712--------------- Rosewood	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
765--------------- Smiley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
799:						
Seelyeville------	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
Bowstring--------	Severe: cutbanks cave, excess humus, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, wetness, flooding.	Severe: wetness, flooding, excess humus.
867B:						
Graycalm---------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
Menahga----------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
867C:						
Graycalm---------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Menahga----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
1029. Pits						
1085B: Urban land.						

TABLE 12.--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
1085B:						
Graycalm	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
1085C:						
Urban land.						
Graycalm	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
1086:						
Urban land.						
Cormant	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
1804 Hamre	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
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.
1878 Hamre	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1922 Chilgren	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
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.
1935 Epoufette	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
1939 Northwood	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1959 Nary	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Moderate: large stones.

TABLE 12.--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
1991-------------- Stuntz	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
1993B:						
Snellman---------	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Moderate: large stones.
Wykeham----------	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," 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
32B Nebish	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
32C Nebish	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
32D Nebish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
48 Hiwood	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
72 Shooker	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
77 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.
121 Wykeham	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
125 Beltrami	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
147 Spooner	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
158B Zimmerman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
158C Zimmerman	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
167 Baudette	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.

TABLE 13.--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
191----------------- Epoufette	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
199B---------------- Sol	Severe: percs slowly.	Severe: seepage.	Slight-----------	Slight-----------	Good.
199C---------------- Sol	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
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.
240B---------------- Warba	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
240C---------------- Warba	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
242B---------------- Marquette	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
242C---------------- Marquette	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
243----------------- Stuntz	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
267B---------------- Snellman	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
267C---------------- Snellman	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
267D---------------- Snellman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
272----------------- Bemidji	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
280----------------- Pelan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.

TABLE 13.--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
328B: Sartell	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
404: Chilgren	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
432: Strandquist	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
439: Rockwell	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
458B: Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
458C: Menahga	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
458D: Menahga	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
481: Kratka	Severe: wetness, percs slowly, poor filter.	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.
496B: Andrusia	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
496C: Andrusia	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
496D: Andrusia	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
503B: Balmlake	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too sandy.	Slight	Poor: too sandy.
503C: Balmlake	Moderate: percs slowly, slope.	Severe: slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
503D: Balmlake	Severe: slope.	Severe: slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.

TABLE 13.--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
505B----------------- Debs	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too sandy.	Slight-----------	Good.
505C----------------- Debs	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too sandy.	Moderate: slope.	Fair: slope.
514------------------ Tacoosh	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
534------------------ Mooselake	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
538------------------ Waskish	Severe: wetness, poor filter.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus, too acid.
540------------------ Seelyeville	Severe: subsides, ponding.	Severe: seepage, excess humus.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding, excess humus.
541------------------ Rifle	Severe: 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.
545------------------ Rondeau	Severe: subsides, ponding.	Severe: seepage, excess humus.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
546------------------ Lupton	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
547------------------ Deerwood	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
549------------------ Greenwood	Severe: wetness, subsides.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.

TABLE 13.--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
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.
561 Bullwinkle	Severe: wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: 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.
582 Roliss	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
607 Pengilly	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
616 Effie	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
620B Cutaway	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
620C Cutaway	Severe: percs slowly, poor filter.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
621 Morph	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
624 Rosy	Severe: wetness.	Severe: wetness.	Severe: wetness, too sandy.	Severe: wetness.	Poor: too sandy.
625 Sandwick	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
626B Suomi	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.

TABLE 13.--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
626C: Suomi	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
626D: Suomi	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: wetness, slope, too clayey.	Severe: wetness, slope.	Poor: too clayey, hard to pack, slope.
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.
628: Talmoon	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
653: Smiley	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
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.
709B: Lengby	Moderate: percs slowly.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
709C: Lengby	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
709D: Lengby	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
712: Rosewood	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
765: Smiley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
799:					
Seelyeville	Severe: subsides, flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.

TABLE 13.--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
799:					
Bowstring----------	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, excess humus.
867B:					
Graycalm-----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Menahga------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
867C:					
Graycalm-----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Menahga------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1029. Pits					
1085B: Urban land.					
Graycalm-----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1085C: Urban land.					
Graycalm-----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1086: Urban land.					
Cormant------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
1804---------------- Hamre	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1807---------------- Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.

TABLE 13.--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
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.
1878---------------- Hamre	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1922---------------- Chilgren	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
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.
1935---------------- Epoufette	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
1939---------------- Northwood	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
1959---------------- Nary	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1991---------------- Stuntz	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
1993B:					
Snellman-----------	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
Wykeham------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.

TABLE 14.--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
32B Nebish	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
32C Nebish	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
32D Nebish	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
48 Hiwood	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
72 Shooker	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
77 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.
121 Wykeham	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
125 Beltrami	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
147 Spooner	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
158B, 158C Zimmerman	Good	Probable	Improbable: too sandy.	Poor: too sandy.
167 Baudette	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
191 Epoufette	Poor: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
199B, 199C Sol	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, large stones, area reclaim.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
202: Meehan	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
205: Karlstad	Fair: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
240B: Warba	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
240C: Warba	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
242B, 242C: Marquette	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
243: Stuntz	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
267B: Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
267C: Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
267D: Snellman	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
272: Bemidji	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
280: Pelan	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
328B: Sartell	Good	Probable	Improbable: too sandy.	Poor: too sandy.
404: Chilgren	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
432: Strandquist	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
439: Rockwell	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
458B, 458C: Menahga	Good	Probable	Improbable: too sandy.	Poor: too sandy.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
458D: Menahga	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
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: too sandy, wetness.
496B, 496C: Andrusia	Good	Probable	Improbable: too sandy.	Poor: too sandy, small stones.
496D: Andrusia	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, small stones, slope.
503B, 503C: Balmlake	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
503D: Balmlake	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
505B: Debs	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
505C: Debs	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
514: Tacoosh	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
534: Mooselake	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
538: Waskish	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
540: Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
541: Rifle	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
543: Markey	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
544: Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
545: Rondeau	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
546: Lupton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
547: Deerwood	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, small stones, 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.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
561: Bullwinkle	Poor: wetness.	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: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
582: Roliss	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
607: Pengilly	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
616: Effie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
620B, 620C: Cutaway	Fair: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
621: Morph	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
624: Rosy	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
625: Sandwick	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
626B, 626C: Suomi	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
626D: Suomi	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
627: Tawas	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
628: Talmoon	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
653: Smiley	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
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.
709B, 709C: Lengby	Good	Probable	Improbable: too sandy.	Poor: too sandy.
709D: Lengby	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
712: Rosewood	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
765: Smiley	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
799:				
Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Bowstring	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
867B, 867C:				
Graycalm	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Menahga	Good	Probable	Improbable: too sandy.	Poor: too sandy.
1029. Pits				
1085B, 1085C: Urban land.				

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1085B, 1085C: Graycalm	Good	Probable	Improbable: too sandy.	Poor: too sandy.
1086: Urban land.				
Cormant	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
1804 Hamre	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
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.
1878 Hamre	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1922 Chilgren	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1923 Garnes	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1924 Grygla	Fair: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
1925 Eckvoll	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
1935 Epoufette	Poor: wetness.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
1939 Northwood	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1959 Nary	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1991 Stuntz	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1993B: Snellman	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1993B:				
Wykeham--------------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.

TABLE 15.--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-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
32B-----Nebish	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Soil blowing---	Favorable.
32C, 32D-----Nebish	Severe: slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
48-----Hiwood	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Droughty.
72-----Shooker	Moderate: seepage.	Severe: piping, wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
77-----Garnes	Moderate: seepage.	Severe: piping.	Frost action---	Wetness--------	Wetness--------	Rooting depth.
116-----Redby	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
117-----Cormant	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
121-----Wykeham	Moderate: seepage.	Moderate: wetness.	Favorable------	Wetness, soil blowing.	Wetness, soil blowing.	Rooting depth.
125-----Beltrami	Moderate: seepage.	Severe: piping.	Frost action---	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.
147-----Spooner	Moderate: seepage.	Severe: piping, wetness.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
158B-----Zimmerman	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
158C-----Zimmerman	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
167-----Baudette	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
191-----Epoufette	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
199B-----Sol	Moderate: slope.	Moderate: thin layer, piping.	Deep to water	Slope, rooting depth.	Favorable------	Rooting depth.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
199C Sol	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.
202 Meehan	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
205 Karlstad	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty, fast intake.	Large stones, wetness, too sandy.	Large stones, droughty.
240B Warba	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.
240C Warba	Severe: slope.	Moderate: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
242B Marquette	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
242C Marquette	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
243 Stuntz	Slight	Moderate: wetness.	Frost action	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.
267B Snellman	Moderate: seepage, slope.	Slight	Deep to water	Slope, soil blowing, rooting depth.	Soil blowing	Rooting depth.
267C, 267D Snellman	Severe: slope.	Slight	Deep to water	Slope, soil blowing, rooting depth.	Slope, soil blowing.	Slope, rooting depth.
272 Bemidji	Severe: seepage.	Severe: piping.	Favorable	Wetness, droughty, fast intake.	Large stones, wetness, soil blowing.	Large stones, droughty, rooting depth.
280 Pelan	Severe: seepage.	Severe: piping.	Favorable	Wetness, droughty.	Wetness, soil blowing.	Droughty, rooting depth.
328B Sartell	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
404 Chilgren	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
432 Strandquist	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Wetness, erodes easily.	Wetness, erodes easily.
439 Rockwell	Severe: seepage.	Severe: piping, wetness.	Frost action	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
458B-------------- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
458C, 458D-------- Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
481--------------- Kratka	Severe: seepage.	Severe: piping, wetness.	Favorable------	Wetness, droughty.	Wetness, soil blowing.	Wetness, droughty, rooting depth.
482--------------- Grygla	Severe: seepage.	Severe: piping, wetness.	Frost action---	Wetness, soil blowing.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.
496B-------------- Andrusia	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
496C, 496D-------- Andrusia	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
503B-------------- Balmlake	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Erodes easily, too sandy.	Erodes easily.
503C, 503D-------- Balmlake	Severe: slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, erodes easily, too sandy.	Slope, erodes easily.
505B-------------- Debs	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
505C-------------- Debs	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
514--------------- Tacoosh	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
534--------------- Mooselake	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding--------	Ponding--------	Wetness.
538--------------- Waskish	Severe: seepage.	Severe: excess humus, wetness.	Frost action, too acid.	Wetness, too acid.	Wetness--------	Wetness.
540--------------- Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
541--------------- Rifle	Severe: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
543--------------- Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
544 Cathro	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
545 Rondeau	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing.	Wetness.
546 Lupton	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
547 Deerwood	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, cutbanks cave.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
549 Greenwood	Severe: seepage.	Severe: excess humus, wetness.	Frost action	Wetness	Wetness	Wetness.
560:						
Greenwood	Severe: seepage.	Severe: excess humus, wetness.	Frost action	Wetness	Wetness	Wetness.
Lobo	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness	Wetness	Wetness.
561 Bullwinkle	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
563 Northwood	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing, rooting depth.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.
565 Eckvoll	Severe: seepage.	Moderate: piping, wetness.	Frost action	Wetness, fast intake, soil blowing.	Erodes easily, wetness, soil blowing.	Erodes easily.
582 Roliss	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Wetness	Wetness.
607 Pengilly	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness, soil blowing.	Wetness.
616 Effie	Slight	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
620B Cutaway	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Erodes easily, too sandy.	Erodes easily, droughty.
620C Cutaway	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, erodes easily, too sandy.	Slope, erodes easily, droughty.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
621 Morph	Moderate: seepage.	Severe: piping, wetness.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.
624 Rosy	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
625 Sandwick	Severe: seepage.	Severe: wetness.	Favorable	Wetness, droughty, fast intake.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily, droughty.
626B Suomi	Moderate: slope.	Severe: hard to pack.	Percs slowly, slope.	Slope, wetness.	Erodes easily, wetness.	Wetness, erodes easily.
626C, 626D Suomi	Severe: slope.	Severe: hard to pack.	Percs slowly, slope.	Slope, wetness.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
627 Tawas	Severe: seepage.	Severe: seepage, piping, wetness.	Subsides, frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.
628 Talmoon	Slight	Severe: piping, ponding.	Ponding, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
653 Smiley	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
702:						
Bullwinkle	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
Cathro	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
709B Lengby	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, soil blowing.	Erodes easily, too sandy.	Erodes easily.
709C, 709D Lengby	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, soil blowing.	Slope, erodes easily, too sandy.	Slope, erodes easily.
712 Rosewood	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
765 Smiley	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Wetness	Wetness.
799:						
Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Ponding, flooding, subsides.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
799:						
Bowstring	Severe: seepage.	Severe: excess humus, wetness.	Flooding, subsides, frost action.	Wetness, flooding.	Wetness	Wetness.
867B:						
Graycalm	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
867C:						
Graycalm	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
1029. Pits						
1085B: Urban land.						
Graycalm	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
1085C: Urban land.						
Graycalm	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
1086: Urban land.						
Cormant	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
1804 Hamre	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1807 Cathro	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1808 Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1878 Hamre	Moderate: seepage.	Severe: piping, ponding.	Ponding, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1922 Chilgren	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
1923 Garnes	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Wetness	Rooting depth.
1924 Grygla	Severe: seepage.	Severe: piping, wetness.	Frost action	Wetness, rooting depth.	Erodes easily, wetness.	Wetness, erodes easily.
1925 Eckvoll	Severe: seepage.	Moderate: piping, wetness.	Frost action	Wetness, fast intake.	Erodes easily, wetness.	Erodes easily.
1935 Epoufette	Severe: seepage.	Severe: seepage, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy, soil blowing.	Wetness, droughty.
1939 Northwood	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, rooting depth.	Erodes easily, ponding.	Wetness, erodes easily, rooting depth.
1959 Nary	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Favorable	Wetness, rooting depth.	Wetness	Rooting depth.
1991 Stuntz	Slight	Moderate: wetness.	Frost action	Wetness	Wetness	Favorable.
1993B:						
Snellman	Moderate: seepage, slope.	Slight	Deep to water	Slope, soil blowing, rooting depth.	Soil blowing	Rooting depth.
Wykeham	Moderate: seepage.	Moderate: wetness.	Favorable	Wetness, soil blowing.	Wetness, soil blowing.	Rooting depth.

TABLE 16.--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: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
32B-------------- Nebish	0-9	Sandy loam-------	SM	A-4	0-3	95-100	85-100	75-85	35-50	20-35	NP-7
	9-24	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	85-100	70-95	55-80	30-50	10-20
	24-60	Loam, clay loam, sandy clay loam.	CL, ML, CL-ML	A-4, A-6	0-3	95-100	85-100	70-95	50-80	20-40	5-20
32C-------------- Nebish	0-8	Fine sandy loam	SM	A-4	0-3	95-100	85-100	75-85	35-50	20-35	NP-7
	8-26	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	85-100	70-95	55-80	30-50	10-20
	26-60	Loam, clay loam, sandy clay loam.	CL, ML, CL-ML	A-4, A-6	0-3	95-100	85-100	70-95	50-80	20-40	5-20
32D-------------- Nebish	0-8	Fine sandy loam	SM	A-4	0-3	95-100	85-100	75-85	35-50	20-35	NP-7
	8-25	Clay loam, loam	CL, ML	A-6, A-7	0-3	95-100	85-100	70-95	55-80	30-50	10-20
	25-60	Loam, clay loam, sandy clay loam.	CL, ML, CL-ML	A-4, A-6	0-3	95-100	85-100	70-95	50-80	20-40	5-20
48--------------- Hiwood	0-6	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-95	5-25	---	NP
	6-26	Sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	95-100	80-95	5-20	---	NP
	26-60	Sand, fine sand	SP-SM, SP	A-3, A-2	0	100	95-100	80-95	1-12	---	NP
72--------------- Shooker	0-9	Loam-------------	ML, CL-ML, CL	A-4, A-6	0-3	95-100	90-98	80-95	50-75	20-40	4-14
	9-28	Loam, clay loam, sandy clay loam.	ML, CL, CL-ML	A-6, A-4	0-3	95-100	90-98	70-95	50-70	20-40	3-20
	28-60	Loam, fine sandy loam, sandy loam.	ML, CL, SC, SM	A-4, A-6	0-3	95-100	90-98	70-95	40-65	20-40	2-20
77--------------- Garnes	0-7	Loam-------------	ML, CL-ML	A-4	0-3	95-100	85-100	60-90	50-65	20-35	1-10
	7-20	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
	20-60	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
	3-8	Fine sand, sand	SM, SP-SM	A-3, A-2	0	100	95-100	80-95	5-20	---	NP
	8-60	Fine sand, sand	SP, SP-SM	A-3, A-2	0	100	95-100	80-95	2-12	---	NP
117-------------- Cormant	0-8	Loamy fine sand	SM, SP-SM	A-2, A-4, A-3	0	100	100	80-100	5-40	---	NP
	8-60	Fine sand, sand, loamy fine sand.	SP, SP-SM, SM	A-2, A-3	0	100	100	70-100	1-20	---	NP
121-------------- Wykeham	0-8	Fine sandy loam	SM, SC-SM	A-4	0-5	90-100	85-100	65-80	40-50	25-30	2-5
	8-16	Fine sandy loam, loamy sand, sandy loam.	SM, SC-SM	A-4, A-2	0-5	85-100	70-95	65-80	25-50	<20	1-5
	16-32	Loam, sandy clay loam, sandy loam.	SC, CL	A-6	0-5	90-100	85-95	70-80	35-60	30-35	10-15
	32-60	Fine sandy loam, sandy loam.	SC-SM, SC	A-4	0-5	85-95	85-95	65-80	35-50	20-25	5-10
125-------------- Beltrami	0-5	Fine sandy loam	SM, SC-SM	A-4	0-3	95-100	85-95	60-90	35-50	<20	NP-5
	5-10	Fine sandy loam, loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-4	0-3	95-100	85-95	60-90	35-65	<25	NP-7
	10-26	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0-3	95-100	85-98	75-95	50-85	20-45	10-30
	26-60	Loam, clay loam	CL-ML, CL	A-4, A-6	1-3	95-100	85-95	70-95	50-80	20-40	5-20

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
147 Spooner	0-4	Silt loam	ML	A-4, A-6	0	100	100	90-100	50-80	25-40	1-14
	4-7	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
	7-25	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	60-85	20-40	5-15
	25-60	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
158B Zimmerman	0-16	Loamy fine sand	SM	A-2	0	100	100	95-100	15-30	<20	NP
	16-60	Fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	95-100	5-20	<20	NP
158C Zimmerman	0-12	Loamy fine sand	SM	A-2	0	100	100	95-100	15-30	<20	NP
	12-60	Fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	95-100	5-20	<20	NP
167 Baudette	0-4	Silt loam	ML	A-4	0	100	100	95-100	60-90	20-40	1-10
	4-8	Very fine sandy loam, fine sandy loam, silt loam.	SM, ML	A-4	0	100	100	75-100	40-90	<40	NP-10
	8-35	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
	35-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML	A-4	0	100	100	95-100	70-100	20-40	1-10
191 Epoufette	0-4	Sandy loam	SM, SC-SM	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	4-13	Loamy sand, sand, gravelly loamy sand.	SM, SP, SP-SM	A-2, A-3	0-5	95-100	65-95	50-75	0-30	---	NP
	13-18	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
	18-60	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
199B Sol	0-4	Cobbly sandy loam	SM, SC, SC-SM	A-2-4, A-4	5-35	95-100	90-100	55-70	25-40	<25	2-8
	4-13	Loamy sand, cobbly loamy sand, loamy fine sand.	SM, SC-SM	A-2-4	2-15	95-100	90-100	50-65	20-35	<20	NP-7
	13-52	Loam, sandy clay loam.	SC, CL	A-4, A-6	2-10	95-100	90-100	80-90	35-65	25-40	8-18
	52-60	Fine sandy loam, sandy loam.	SM, SC, CL, ML	A-2-4, A-4	2-10	95-100	90-100	70-85	30-60	<25	2-10
199C Sol	0-3	Cobbly sandy loam	SM, SC, SC-SM	A-2-4, A-4	5-35	95-100	90-100	55-70	25-40	<25	2-8
	3-10	Loamy sand, cobbly loamy sand, loamy fine sand.	SM, SC-SM	A-2-4	2-15	95-100	90-100	50-65	20-35	<20	NP-7
	10-18	Loam, sandy clay loam.	SC, CL	A-4, A-6	2-10	95-100	90-100	80-90	35-65	25-40	8-18
	18-60	Fine sandy loam, sandy loam.	SM, SC, CL, ML	A-2-4, A-4	2-10	95-100	90-100	70-85	30-60	<25	2-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
202-------------- Meehan	0-5	Loamy sand-------	SM	A-2, A-1	0	90-100	75-100	40-90	15-30	---	NP
	5-30	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
	30-60	Sand, coarse sand	SP, SP-SM	A-1, A-3, A-2	0	90-100	75-100	40-90	0-5	---	NP
205-------------- Karlstad	0-7	Loamy sand-------	SM, SP-SM	A-2, A-3	0-5	95-100	95-100	75-95	5-35	<25	NP-4
	7-12	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	<25	NP-10
	12-18	Gravelly coarse sandy loam, gravelly sandy loam, gravelly fine sandy loam.	SC, SM, SC-SM, SP-SM	A-2, A-1, A-3	0-25	65-95	20-85	15-70	5-35	<25	NP-10
	18-60	Stratified gravelly coarse sand to loamy fine sand.	SP, SP-SM	A-1, A-2, A-3	0-25	60-100	50-100	20-80	2-12	---	NP
240B------------- Warba	0-16	Fine sandy loam	ML, SM	A-4	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	16-35	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	35-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0-3	90-100	85-100	70-80	55-75	30-50	10-25
240C------------- Warba	0-16	Fine sandy loam	ML, SM	A-4	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	16-44	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	44-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0-3	90-100	85-100	70-80	55-75	30-50	10-25
242B------------- Marquette	0-13	Loamy sand-------	SP-SM, SM, SC-SM	A-2	0-5	90-100	85-100	50-75	10-35	<20	NP-5
	13-18	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
	18-60	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
242C------------- Marquette	0-12	Loamy sand-------	SP-SM, SM, SC-SM	A-2	0-5	90-100	85-100	50-75	10-35	<20	NP-5
	12-17	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
	17-60	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

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
243-------------- Stuntz	0-16	Fine sandy loam	ML, SM, CL-ML, SC-SM	A-4	0-3	98-100	95-100	85-95	45-75	<25	NP-6
	16-35	Sandy clay loam, clay loam, loam.	CL	A-7, A-6	0-3	95-100	85-97	70-85	50-80	30-50	15-25
	35-60	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0-5	90-100	85-97	65-85	50-75	30-50	10-20
267B------------- Snellman	0-3	Fine sandy loam	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	3-12	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	12-29	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	29-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
267C------------- Snellman	0-3	Fine sandy loam	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	3-14	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	14-30	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	30-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
267D------------- Snellman	0-3	Fine sandy loam	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	3-10	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	10-30	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	30-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
272-------------- Bemidji	0-4	Loamy sand-------	SM	A-2-4	5-10	90-100	70-90	65-85	15-35	<20	NP-2
	4-26	Cobbly loamy sand, cobbly sand, cobbly fine sand.	SM, SP-SM	A-2-4, A-3	10-30	90-100	70-90	65-85	5-35	<20	NP-2
	26-44	Fine sandy loam, sandy loam, sandy clay loam.	SC, CL, CL-ML, SC-SM	A-4	0-5	90-100	80-95	75-95	40-65	20-30	4-10
	44-60	Fine sandy loam, sandy loam.	SC, CL, CL-ML, SC-SM	A-4	0-5	90-100	75-95	75-90	35-60	15-25	4-10
280-------------- Pelan	0-3	Sandy loam-------	SM, SC-SM	A-2, A-4	2-4	95-100	75-100	60-90	30-50	<20	NP-5
	3-12	Sand, loamy sand	SP-SM, SM	A-2-4	2-4	95-100	75-100	60-90	10-30	<20	NP
	12-17	Gravelly sandy loam, gravelly sandy clay loam.	SM, GM, SC, GC	A-2, A-1	2-4	45-85	35-65	20-45	12-35	20-30	NP-10
	17-24	Stratified gravelly coarse sand to fine sandy loam.	SP-SM, SP, GP, GP-GM	A-1, A-3, A-2	2-4	40-85	40-80	20-60	1-10	---	NP
	24-60	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
328B------------- Sartell	0-6	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	90-100	7-20	---	NP
	6-40	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	90-100	7-20	---	NP
	40-60	Fine sand--------	SP, SP-SM	A-3, A-2	0	100	100	85-95	1-12	---	NP

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
404-------------- Chilgren	0-3	Loam------------	ML, CL, CL-ML	A-6, A-4	0-3	90-100	85-100	65-90	55-80	20-40	3-15
	3-11	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
	11-18	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
	18-60	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
432-------------- Strandquist	0-9	Loam------------	CL-ML, CL, SC-SM, SC	A-4, A-6	1-2	95-100	95-100	75-90	45-70	20-40	5-20
	9-32	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
	32-60	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
439-------------- Rockwell	0-9	Fine sandy loam	ML, SM, SC-SM, CL-ML	A-4	0	100	95-100	70-85	40-55	15-25	1-7
	9-17	Fine sandy loam, sandy loam, loam.	SM, ML, SC-SM, CL-ML	A-4	0	100	95-100	60-85	35-55	15-25	1-7
	17-26	Fine sand, sand, loamy fine sand.	SM	A-2	0	100	95-100	65-80	20-35	---	NP
	26-60	Silt loam, loam, clay loam.	CL, CL-ML, SC, SC-SM	A-6, A-4	0-1	95-100	90-100	70-90	40-85	15-40	5-20
458B------------- Menahga	0-3	Loamy sand-------	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	3-30	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	30-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
458C------------- Menahga	0-3	Loamy sand-------	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	3-24	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	24-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
458D------------- Menahga	0-3	Loamy sand-------	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	3-27	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	27-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
481-------------- Kratka	0-10	Fine sandy loam	SM, SC-SM	A-4	0	95-100	90-100	50-80	36-50	<25	2-6
	10-28	Loamy sand, sand, loamy fine sand.	SP-SM	A-3, A-2	0	95-100	90-100	50-80	5-10	---	NP
	28-60	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	0-7	Loamy fine sand	SM, SC-SM	A-2	0	100	100	85-95	15-35	<25	NP-7
	7-25	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
	25-60	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

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
496B------------- Andrusia	0-3	Loamy sand-------	SP-SM, SM	A-2, A-3	0-5	80-100	75-100	55-70	5-35	<20	NP
	3-29	Loamy sand, fine sand, sand.	SP-SM, SM	A-2, A-3	0-5	80-100	70-100	50-65	5-20	---	NP
	29-39	Fine sandy loam, sandy loam, coarse sandy loam.	SC, SM, SC-SM	A-4, A-2	0-5	80-100	65-100	60-75	30-45	20-30	2-10
	39-60	Sand, coarse sand, gravelly sand.	SP, SW	A-2, A-3	0-5	80-100	60-100	50-65	0-5	---	NP
496C------------- Andrusia	0-3	Loamy sand-------	SP-SM, SM	A-2, A-3	0-5	80-100	75-100	55-70	5-35	<20	NP
	3-31	Loamy sand, fine sand, sand.	SP-SM, SM	A-2, A-3	0-5	80-100	70-100	50-65	5-20	---	NP
	31-43	Fine sandy loam, sandy loam, coarse sandy loam.	SC, SM, SC-SM	A-4, A-2	0-5	80-100	65-100	60-75	30-45	20-30	2-10
	43-60	Sand, coarse sand, gravelly sand.	SP, SW	A-2, A-3	0-5	80-100	60-100	50-65	0-5	---	NP
496D------------- Andrusia	0-3	Loamy sand-------	SP-SM, SM	A-2, A-3	0-5	80-100	75-100	55-70	5-35	<20	NP
	3-24	Loamy sand, fine sand, sand.	SP-SM, SM	A-2, A-3	0-5	80-100	70-100	50-65	5-20	---	NP
	24-32	Fine sandy loam, sandy loam, coarse sandy loam.	SC, SM, SC-SM	A-4, A-2	0-5	80-100	65-100	60-75	30-45	20-30	2-10
	32-60	Sand, coarse sand, gravelly sand.	SP, SW	A-2, A-3	0-5	80-100	60-100	50-65	0-5	---	NP
503B------------- Balmlake	0-3	Fine sandy loam	SM, SC, SC-SM	A-2, A-4	0	100	95-100	60-85	30-50	<25	2-10
	3-11	Very fine sand, loamy fine sand, fine sandy loam.	SM	A-2, A-4	0	100	95-100	60-85	25-50	<25	NP-4
	11-24	Fine sandy loam, sandy loam, loam.	SM, CL, SC, ML	A-4	0	100	95-100	60-90	35-65	20-30	2-10
	24-60	Stratified fine sand to silt loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	95-100	65-90	30-80	<25	NP-5
503C------------- Balmlake	0-3	Fine sandy loam	SM, SC, SC-SM	A-2, A-4	0	100	95-100	60-85	30-50	<25	2-10
	3-14	Very fine sand, loamy fine sand, fine sandy loam.	SM	A-2, A-4	0	100	95-100	60-85	25-50	<25	NP-4
	14-22	Fine sandy loam, sandy loam, loam.	SM, CL, SC, ML	A-4	0	100	95-100	60-90	35-65	20-30	2-10
	22-60	Stratified fine sand to silt loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	95-100	65-90	30-80	<25	NP-5

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
503D------------- Balmlake	0-3	Fine sandy loam	SM, SC, SC-SM	A-2, A-4	0	100	95-100	60-85	30-50	<25	2-10
	3-11	Very fine sand, loamy fine sand, fine sandy loam.	SM	A-2, A-4	0	100	95-100	60-85	25-50	<25	NP-4
	11-21	Fine sandy loam, sandy loam, loam.	SM, CL, SC, ML	A-4	0	100	95-100	60-90	35-65	20-30	2-10
	21-60	Stratified fine sand to silt loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	95-100	65-90	30-80	<25	NP-5
505B------------- Debs	0-4	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	60-90	20-30	NP-7
	4-12	Fine sandy loam, very fine sandy loam, silt loam.	ML, SM	A-4	0	100	100	85-100	40-70	<20	NP-4
	12-24	Silt loam, silty clay loam, clay loam.	ML, CL	A-4, A-6	0	100	100	95-100	75-95	20-40	8-20
	24-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML, SM	A-4	0	100	100	95-100	40-75	<20	NP-4
505C------------- Debs	0-2	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	60-90	20-30	NP-7
	2-10	Fine sandy loam, very fine sandy loam, silt loam.	ML, SM	A-4	0	100	100	85-100	40-70	<20	NP-4
	10-23	Silt loam, silty clay loam, clay loam.	ML, CL	A-4, A-6	0	100	100	95-100	75-95	20-40	8-20
	23-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML, SM	A-4	0	100	100	95-100	40-75	<20	NP-4
514-------------- Tacoosh	0-7	Muck-------------	PT	A-8	0-10	---	---	---	---	---	---
	7-41	Mucky peat-------	PT	A-8	0-10	---	---	---	---	---	---
	41-60	Sandy loam, loam, clay loam.	SM, ML, CL-ML, CL	A-2, A-4, A-6	0-10	85-100	85-95	65-95	25-75	15-35	NP-20
534-------------- Mooselake	0-40	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
	40-60	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
538-------------- Waskish	0-60	Peat-------------	PT	A-8	0	---	---	---	---	---	---
540-------------- Seelyeville	0-10	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	10-60	Muck, mucky peat	PT	A-8	0	---	---	---	---	---	---
541-------------- Rifle	0-18	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
	18-60	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
543-------------- Markey	0-24	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	24-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3	0	100	85-100	60-75	0-20	---	NP
544-------------- Cathro	0-8	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	8-30	Sapric material	PT	A-8	0	---	---	---	---	---	---
	30-60	Sandy loam, loam, silt loam.	SM, ML, SC, CL	A-4	0-5	80-100	65-100	60-100	35-90	<25	3-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
545----------- Rondeau	0-18	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	18-60	Marl-------------	OH, MH	A-8, A-5, A-7	0	100	95-100	80-90	60-80	50-90	NP-20
546----------- Lupton	0-25	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	25-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
547----------- Deerwood	0-12	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	12-16	Fine sand, loamy sand, fine sandy loam.	SM, SP-SM	A-2, A-4	0-5	95-100	90-100	50-75	12-50	<20	NP-4
	16-60	Fine sand, sand, gravelly sand.	SM, SP, SP-SM	A-2, A-3, A-1	0-5	75-100	55-100	35-70	1-35	---	NP
549----------- Greenwood	0-4	Peat-------------	PT	A-8	0	---	---	---	---	---	---
	4-63	Hemic material---	PT	A-8	0	---	---	---	---	---	---
560:											
Greenwood-------	0-8	Peat-------------	PT	A-8	0	---	---	---	---	---	---
	8-60	Hemic material---	PT	A-8	0	---	---	---	---	---	---
Lobo------------	0-37	Peat-------------	PT	A-8	0	---	---	---	---	---	---
	37-84	Hemic material---	PT	A-8	0	---	---	---	---	---	---
561----------- Bullwinkle	0-17	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	17-41	Sapric material	PT	A-8	0	---	---	---	---	---	---
	41-45	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
	45-60	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
563----------- Northwood	0-9	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	9-14	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
	14-24	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
	24-60	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----------- Eckvoll	0-4	Loamy fine sand	SM, SC-SM	A-4, A-2	0-2	90-100	85-100	45-80	25-40	<20	NP-7
	4-25	Fine sand, sand, loamy sand.	SM, SP-SM	A-1, A-2, A-3	0-2	90-100	85-100	45-75	5-30	<20	NP-4
	25-32	Clay loam, sandy clay loam, loam.	SC, CL	A-4, A-6, A-7	0-5	90-100	85-100	65-95	45-75	25-50	7-25
	32-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	70-95	55-80	25-45	7-20
582----------- Roliss	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	80-100	80-100	60-90	20-40	5-20
	8-12	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	80-100	80-90	60-80	20-50	10-30
	12-60	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
607----------- Pengilly	0-4	Very fine sandy loam.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	90-100	60-95	30-65	<26	2-7
	4-60	Stratified loamy very fine sand to silt loam.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	90-100	60-95	30-75	<20	NP-7

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
616-------------- Effie	0-8	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0-2	95-100	90-100	85-100	60-90	20-40	3-15
	8-28	Clay loam, clay, silty clay loam.	CH, CL	A-7	0-2	95-100	95-100	85-100	70-90	45-70	25-45
	28-60	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
620B------------- Cutaway	0-3	Loamy fine sand	SM, SP-SM	A-2	0-3	100	85-100	55-90	10-25	---	NP
	3-28	Loamy sand, sand, coarse sand.	SM, SP-SM	A-2, A-3	0-3	100	85-100	50-80	5-20	---	NP
	28-45	Clay loam, loam, sandy loam.	CL, ML	A-7, A-6	0-4	95-100	85-95	75-85	60-80	30-45	10-20
	45-60	Loam, clay loam, sandy loam.	CL, ML	A-6, A-4	0-4	90-100	85-95	70-80	55-70	30-40	10-20
620C------------- Cutaway	0-3	Loamy fine sand	SM, SP-SM	A-2	0-3	100	85-100	55-90	10-25	---	NP
	3-28	Loamy sand, sand, coarse sand.	SM, SP-SM	A-2, A-3	0-3	100	85-100	50-80	5-20	---	NP
	28-55	Clay loam, loam, sandy loam.	CL, ML	A-7, A-6	0-4	95-100	85-95	75-85	60-80	30-45	10-20
	55-60	Loam, clay loam, sandy loam.	CL, ML	A-6, A-4	0-4	90-100	85-95	70-80	55-70	30-40	10-20
621-------------- Morph	0-13	Fine sandy loam	ML, CL-ML, SM, SC-SM	A-4, A-2	0	100	95-100	60-95	30-70	<25	NP-5
	13-35	Loam, fine sandy loam, clay loam.	ML, CL, SM, SC	A-4	0	100	95-100	60-100	35-90	20-30	3-9
	35-60	Stratified loamy sand to silty clay loam.	SM, SC, CL, ML	A-4, A-2	0	100	95-100	60-100	30-90	<25	2-8
624-------------- Rosy	0-15	Sandy loam-------	ML, SM, CL-ML, SC-SM	A-4	0	100	95-100	70-95	40-65	15-25	NP-6
	15-36	Loam, very fine sandy loam, fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0	100	95-100	70-95	40-75	20-40	3-15
	36-60	Stratified sand to silty clay loam.	SM, SC, ML, CL	A-4, A-2-4	0	95-100	95-100	60-95	30-75	<30	2-8
625-------------- Sandwick	0-8	Loamy fine sand	SM	A-2	0	95-100	85-100	65-90	15-30	---	NP
	8-22	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2	0	95-100	85-100	60-90	10-30	---	NP
	22-48	Loam, clay loam, sandy loam.	CL, ML	A-6, A-7	0-5	90-100	85-100	70-90	55-80	30-45	10-20
	48-60	Loam, clay loam, sandy loam.	CL, ML	A-6	0-5	90-100	85-100	70-90	50-80	30-40	10-20
626B------------- Suomi	0-6	Loam-------------	CL, ML, CL-ML	A-6, A-4	0-3	95-100	90-100	85-100	60-90	20-40	3-15
	6-23	Silty clay, clay, silty clay loam.	CH, CL	A-7	0-3	95-100	90-100	85-100	70-95	45-70	25-45
	23-60	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

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
626C-------------- 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
	8-28	Silty clay, clay, silty clay loam.	CH, CL	A-7	0-3	95-100	90-100	85-100	70-95	45-70	25-45
	28-60	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
626D-------------- Suomi	0-5	Loam-------------	CL, ML, CL-ML	A-6, A-4	0-3	95-100	90-100	85-100	60-90	20-40	3-15
	5-21	Silty clay, clay, silty clay loam.	CH, CL	A-7	0-3	95-100	90-100	85-100	70-95	45-70	25-45
	21-60	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	0-6	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	6-33	Sapric material, hemic material.	PT	A-8	0	---	---	---	---	---	---
	33-60	Fine sand, sand, loamy sand.	SP, SP-SM, SM	A-2-4, A-3	0	80-100	60-100	50-75	0-20	---	NP
628--------------- Talmoon	0-4	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	4-14	Very fine sandy loam, sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	95-100	85-100	60-95	35-75	23-35	6-15
	14-24	Clay loam, silty clay loam, loam.	CL, ML	A-6, A-7, A-4	0	95-100	85-100	70-100	50-95	30-50	9-20
	24-60	Loam, sandy clay loam, clay loam.	CL, CL-ML, SC, SC-SM	A-6, A-4, A-7	0	95-100	85-100	75-100	45-80	25-45	6-18
653--------------- Smiley	0-4	Muck-------------	PT	A-8	0-2	---	---	---	---	---	---
	4-11	Loam, fine sandy loam, sandy clay loam.	SC-SM, SM, ML, CL-ML	A-4, A-6	0-2	95-100	85-100	75-95	35-70	<35	2-12
	11-18	Clay loam, sandy clay loam, loam.	CL	A-6, A-7	0-2	95-100	85-100	70-95	50-80	25-50	10-25
	18-60	Loam, fine sandy loam, clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0-2	95-100	85-100	70-95	40-80	25-40	6-18
702:											
Bullwinkle-------	0-12	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	12-34	Sapric material	PT	A-8	0	---	---	---	---	---	---
	34-40	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
	40-60	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-----------	0-20	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	20-60	Sandy loam, loam, silt loam.	SM, ML, SC, CL	A-4	0-5	80-100	65-100	60-100	35-90	<25	3-10

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
709B------------- Lengby	0-5	Sandy loam-------	SM, SC-SM	A-4	0	100	95-100	70-85	35-50	<20	NP-5
	5-18	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2-4, A-3	0	100	95-100	65-80	5-30	---	NP
	18-28	Clay loam, loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	60-85	25-40	5-20
	28-41	Stratified silt loam to coarse sand.	SM, SC-SM	A-2-4, A-4	0-5	90-100	85-100	50-80	20-50	<25	NP-5
	41-60	Stratified sand to loamy very fine sand.	SM, SP-SM	A-2-4, A-1-b	0-3	90-100	85-100	35-75	10-35	---	NP
709C------------- Lengby	0-3	Sandy loam-------	SM, SC-SM	A-4	0	100	95-100	70-85	35-50	<20	NP-5
	3-11	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2-4, A-3	0	100	95-100	65-80	5-30	---	NP
	11-19	Clay loam, loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	60-85	25-40	5-20
	19-60	Stratified sand to loamy very fine sand.	SM, SP-SM	A-2-4, A-1-b	0-3	90-100	85-100	35-75	10-35	---	NP
709D------------- Lengby	0-3	Sandy loam-------	SM, SC-SM	A-4	0	100	95-100	70-85	35-50	<20	NP-5
	3-11	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2-4, A-3	0	100	95-100	65-80	5-30	---	NP
	11-19	Clay loam, loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	60-85	25-40	5-20
	19-60	Stratified sand to loamy very fine sand.	SM, SP-SM	A-2-4, A-1-b	0-3	90-100	85-100	35-75	10-35	---	NP
712-------------- Rosewood	0-7	Fine sandy loam	SM, SC, SC-SM	A-2, A-4	0	100	97-100	65-90	30-50	<30	NP-10
	7-18	Fine sandy loam, loamy fine sand, sandy loam.	SM, SC, SC-SM	A-2, A-4	0	100	95-100	60-85	25-45	<30	NP-10
	18-60	Fine sand, sand	SM, SP-SM	A-1, A-2, A-3	0	85-100	75-95	45-75	5-25	---	NP
765-------------- Smiley	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-2	95-100	85-100	75-95	50-80	<35	2-12
	8-13	Clay loam, sandy clay loam, loam.	CL	A-6, A-7	0-2	95-100	85-100	70-95	50-80	25-50	10-25
	13-60	Loam, fine sandy loam, clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0-2	95-100	85-100	70-95	40-80	25-40	6-18
799:											
Seelyeville-----	0-28	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	28-60	Muck, mucky peat	PT	A-8	0	---	---	---	---	---	---
Bowstring-------	0-35	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	35-43	Sand, fine sand, fine sandy loam.	SP-SM, SM, SC-SM	A-2	0	100	100	50-85	10-35	<20	NP-5
	43-60	Muck-------------	PT	A-8	0	---	---	---	---	---	---

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
867B:											
Graycalm	0-5	Loamy sand	SP-SM, SM	A-2, A-1	0	95-100	75-100	35-75	10-30	---	NP
	5-32	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	95-100	75-100	30-75	0-30	---	NP
	32-46	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-2, A-1, A-3	0	95-100	75-100	30-75	0-30	---	NP
	46-60	Sand, coarse sand	SP, SP-SM, SM	A-2, A-1, A-3	0	95-100	75-100	35-55	0-15	---	NP
Menahga	0-3	Loamy sand	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	3-36	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	36-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
867C:											
Graycalm	0-3	Loamy sand	SP-SM, SM	A-2, A-1	0	95-100	75-100	35-75	10-30	---	NP
	3-30	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	95-100	75-100	30-75	0-30	---	NP
	30-50	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-2, A-1, A-3	0	95-100	75-100	30-75	0-30	---	NP
	50-60	Sand, coarse sand	SP, SP-SM, SM	A-2, A-1, A-3	0	95-100	75-100	35-55	0-15	---	NP
Menahga	0-2	Loamy sand	SM, SP-SM	A-2	0	100	85-100	60-80	10-30	---	NP
	2-30	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
	30-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	100	80-100	30-75	0-10	---	NP
1029. Pits											
1085B, 1085C: Urban land.											
Graycalm	0-3	Loamy sand	SP-SM, SM	A-2, A-1	0	95-100	75-100	35-75	10-30	---	NP
	3-13	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	95-100	75-100	30-75	0-30	---	NP
	13-60	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-2, A-1, A-3	0	95-100	75-100	30-75	0-30	---	NP
1086: Urban land.											
Cormant	0-7	Loamy sand	SM, SP-SM	A-2, A-4, A-3	0	100	100	80-100	5-40	---	NP
	7-60	Fine sand, sand, loamy fine sand.	SP, SP-SM, SM	A-2, A-3	0	100	100	70-100	1-20	---	NP
1804 Hamre	0-8	Muck	PT	A-8	0	---	---	---	---	---	---
	8-18	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	90-100	80-100	70-100	50-90	25-45	6-20
	18-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	80-100	75-100	65-95	50-85	25-45	6-20

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
1807------------- Cathro	0-24	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	24-30	Sapric material	PT	A-8	0	---	---	---	---	---	---
	30-60	Sandy loam, loam, silt loam.	SM, ML, SC, CL	A-4	0-5	80-100	65-100	60-100	35-90	<25	3-10
1808------------- Markey	0-28	Muck-------------	PT	A-8	---	---	---	---	---	---	---
	28-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3	0	100	85-100	60-75	0-20	---	NP
1878------------- Hamre	0-9	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	9-13	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	90-100	80-100	70-100	50-90	25-45	6-20
	13-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-3	80-100	75-100	65-95	50-85	25-45	6-20
1922------------- Chilgren	0-3	Stony sandy loam	SM, SC-SM, SC	A-4, A-2	5-25	85-100	80-100	40-80	25-50	15-35	NP-10
	3-11	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
	11-18	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
	18-60	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
1923------------- Garnes	0-8	Stony sandy loam	ML, CL-ML, SM, SC-SM	A-4	5-25	85-100	80-100	55-90	35-65	20-35	1-10
	8-17	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
	17-60	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------------- Grygla	0-11	Stony loamy fine sand.	SM, SC-SM	A-2, A-1	5-25	85-100	80-100	45-85	15-35	<25	NP-7
	11-27	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	<20	NP-5
	27-60	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------------- Eckvoll	0-4	Stony loamy fine sand.	SM, SC-SM	A-2-4, A-1-b	5-15	90-100	80-100	45-80	20-35	<20	NP-7
	4-25	Fine sand, sand, loamy sand.	SM, SP-SM	A-1, A-2, A-3	0-2	90-100	85-100	45-75	5-30	<20	NP-4
	25-32	Clay loam, sandy clay loam, loam.	SC, CL	A-4, A-6, A-7	0-5	90-100	85-100	65-95	45-75	25-50	7-25
	32-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	70-95	55-80	25-45	7-20
1935------------- Epoufette	0-4	Muck-------------	PT	A-8	0	---	---	---	---	---	---
	4-8	Sandy loam, loamy sand, coarse sandy loam.	SM, SC-SM	A-2, A-4	0-5	95-100	65-95	50-75	15-40	<25	NP-7
	8-18	Loamy sand, sand, gravelly loamy sand.	SM, SP, SP-SM	A-2, A-3	0-5	95-100	65-95	50-75	0-30	---	NP
	18-30	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
	30-60	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

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1939------------- Northwood	0-11	Stony muck-------	PT	A-8	5-20	---	---	---	---	---	---
	11-15	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
	15-25	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
	25-60	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
1959------------- Nary	0-4	Cobbly fine sandy loam.	SM, SC-SM	A-2-4, A-4	15-25	90-100	85-95	60-85	25-40	<25	2-6
	4-14	Cobbly loamy sand, cobbly fine sandy loam, cobbly sandy loam.	SM, SC-SM	A-2-4	15-25	90-100	85-95	50-85	20-35	<25	NP-6
	14-45	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-4, A-6	0-1	95-100	90-100	70-95	40-70	25-40	8-16
	45-60	Fine sandy loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-4	0-1	95-100	90-100	60-85	35-55	20-30	2-7
1991------------- Stuntz	0-12	Loam-------------	CL-ML, CL	A-4, A-6	0-3	98-100	95-100	85-100	60-90	20-35	6-15
	12-60	Sandy clay loam, clay loam, loam.	CL	A-7, A-6	0-3	95-100	85-97	70-85	50-80	30-50	15-25
1993B:											
Snellman---------	0-5	Fine sandy loam	SM, SC-SM	A-4	0-10	90-100	85-100	65-80	40-50	25-30	2-5
	5-13	Loamy sand, sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2	0-10	88-100	85-100	65-80	30-50	<20	NP-5
	13-28	Sandy clay loam, sandy loam.	SC	A-6	0-10	90-100	85-95	70-80	35-50	25-40	10-20
	28-60	Sandy loam, fine sandy loam.	SC-SM, SC	A-4	0-10	85-95	85-95	65-80	35-50	<25	5-10
Wykeham----------	0-8	Fine sandy loam	SM, SC-SM	A-4	0-5	90-100	85-100	65-80	40-50	25-30	2-5
	8-14	Fine sandy loam, loamy sand, sandy loam.	SM, SC-SM	A-4, A-2	0-5	85-100	70-95	65-80	25-50	<20	1-5
	14-32	Loam, sandy clay loam, sandy loam.	SC, CL	A-6	0-5	90-100	85-95	70-80	35-60	30-35	10-15
	32-60	Fine sandy loam, sandy loam.	SC-SM, SC	A-4	0-5	85-95	85-95	65-80	35-50	20-25	5-10

TABLE 17.--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 K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
32B-------------- Nebish	0-9	5-18	1.35-1.50	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	1-2
	9-24	22-35	1.50-1.65	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	24-60	18-30	1.50-1.70	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.32			
32C-------------- Nebish	0-8	5-18	1.35-1.50	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	1-2
	8-26	22-35	1.50-1.65	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	26-60	18-30	1.50-1.70	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.32			
32D-------------- Nebish	0-8	5-18	1.35-1.50	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	1-2
	8-25	22-35	1.50-1.65	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	25-60	18-30	1.50-1.70	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.32			
48--------------- Hiwood	0-6	2-10	1.40-1.60	6.0-20	0.08-0.12	4.5-6.0	Low----------	0.17	5	2	.5-2
	6-26	1-10	1.55-1.70	6.0-20	0.07-0.10	5.1-6.0	Low----------	0.15			
	26-60	1-10	1.55-1.70	6.0-20	0.05-0.08	5.6-7.8	Low----------	0.15			
72--------------- Shooker	0-9	8-20	1.20-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	5	5	2-4
	9-28	18-35	1.40-1.60	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	28-60	12-27	1.40-1.65	0.6-2.0	0.11-0.19	7.4-8.4	Low----------	0.32			
77--------------- Garnes	0-7	7-28	1.30-1.50	0.6-2.0	0.18-0.20	6.1-7.8	Low----------	0.32	5	6	.5-2
	7-20	18-30	1.50-1.65	0.6-2.0	0.17-0.20	6.6-7.8	Moderate-----	0.32			
	20-60	10-27	1.60-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
116-------------- Redby	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
	3-8	1-8	1.55-1.70	6.0-20	0.07-0.10	5.1-7.3	Low----------	0.17			
	8-60	0-6	1.55-1.70	6.0-20	0.06-0.08	5.1-7.8	Low----------	0.17			
117-------------- Cormant	0-8	3-10	1.30-1.50	6.0-20	0.08-0.12	6.1-7.3	Low----------	0.17	5	2	2-10
	8-60	0-5	1.50-1.70	6.0-20	0.06-0.10	6.1-7.8	Low----------	0.17			
121-------------- Wykeham	0-8	5-18	1.30-1.55	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.20	5	3	2-6
	8-16	5-15	1.50-1.70	0.6-2.0	0.10-0.17	5.1-6.5	Low----------	0.28			
	16-32	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	32-60	10-18	1.55-1.75	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			
125-------------- Beltrami	0-5	5-12	1.35-1.50	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	2-4
	5-10	5-15	1.40-1.65	0.6-6.0	0.11-0.19	6.1-7.3	Low----------	0.32			
	10-26	18-35	1.50-1.65	0.6-2.0	0.15-0.19	6.1-7.8	Moderate-----	0.32			
	26-60	18-30	1.50-1.70	0.6-2.0	0.15-0.19	7.4-8.4	Low----------	0.32			
147-------------- Spooner	0-4	10-24	1.25-1.40	0.6-2.0	0.20-0.24	5.6-7.8	Low----------	0.37	5	5	1-4
	4-7	3-18	1.35-1.55	0.6-6.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	7-25	18-35	1.30-1.50	0.6-2.0	0.17-0.22	6.1-7.8	Low----------	0.37			
	25-60	5-32	1.40-1.60	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.37			
158B------------- Zimmerman	0-16	2-10	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low----------	0.17	5	2	.5-1
	16-60	2-10	1.50-1.70	6.0-20	0.06-0.10	6.1-7.3	Low----------	0.17			
158C------------- Zimmerman	0-12	2-10	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low----------	0.17	5	2	.5-1
	12-60	2-10	1.50-1.70	6.0-20	0.06-0.10	6.1-7.3	Low----------	0.17			
167-------------- Baudette	0-4	10-27	1.20-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37	5	6	1-4
	4-8	5-27	1.30-1.50	0.6-2.0	0.14-0.20	5.6-7.3	Low----------	0.37			
	8-35	18-35	1.25-1.45	0.6-2.0	0.17-0.24	5.6-7.8	Moderate-----	0.37			
	35-60	5-27	1.30-1.60	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	0.37			

TABLE 17.--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 K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
191-------------- Epoufette	0-4	5-15	1.35-1.50	2.0-6.0	0.09-0.14	6.1-7.3	Low-----------	0.17	4	3	4-6
	4-13	5-15	1.40-1.55	6.0-20	0.05-0.07	6.1-7.3	Low-----------	0.17			
	13-18	8-18	1.40-1.60	2.0-6.0	0.08-0.14	6.6-7.8	Low-----------	0.17			
	18-60	0-8	1.40-1.65	>20	0.01-0.03	7.4-8.4	Low-----------	0.10			
199B------------- Sol	0-4	4-16	1.50-1.65	0.6-2.0	0.12-0.20	5.1-6.0	Low-----------	0.20	5	8	1-3
	4-13	2-12	1.40-1.55	2.0-6.0	0.09-0.13	5.1-6.0	Low-----------	0.28			
	13-52	18-27	1.55-1.75	0.2-0.6	0.16-0.20	5.6-6.5	Moderate-----	0.28			
	52-60	5-18	1.55-1.75	0.2-0.6	0.11-0.16	7.4-7.8	Low-----------	0.37			
199C------------- Sol	0-3	4-16	1.50-1.65	0.6-2.0	0.12-0.20	5.1-6.0	Low-----------	0.20	5	8	1-3
	3-10	2-12	1.40-1.55	2.0-6.0	0.09-0.13	5.1-6.0	Low-----------	0.28			
	10-18	18-27	1.55-1.75	0.2-0.6	0.16-0.20	5.6-6.5	Moderate-----	0.28			
	18-60	5-18	1.55-1.75	0.2-0.6	0.11-0.16	7.4-7.8	Low-----------	0.37			
202-------------- Meehan	0-5	4-10	1.35-1.65	6.0-20	0.10-0.12	3.6-6.5	Low-----------	0.17	5	2	.5-3
	5-30	4-9	1.60-1.70	6.0-20	0.06-0.11	5.1-7.3	Low-----------	0.17			
	30-60	1-4	1.60-1.70	6.0-20	0.02-0.07	5.1-7.3	Low-----------	0.17			
205-------------- Karlstad	0-7	1-10	1.40-1.60	6.0-20	0.10-0.12	4.5-7.3	Low-----------	0.17	3	2	1-4
	7-12	5-18	1.35-1.60	2.0-6.0	0.13-0.18	6.1-7.3	Low-----------	0.24			
	12-18	5-18	1.50-1.70	2.0-6.0	0.12-0.16	6.1-7.8	Low-----------	0.10			
	18-60	1-5	1.50-1.70	>6.0	0.02-0.04	7.4-8.4	Low-----------	0.10			
240B------------- Warba	0-16	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----------	0.20	5	3	1-3
	16-35	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate-----	0.32			
	35-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate-----	0.32			
240C------------- Warba	0-16	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----------	0.20	5	3	1-3
	16-44	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate-----	0.32			
	44-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate-----	0.32			
242B------------- Marquette	0-13	1-10	1.40-1.60	6.0-20	0.10-0.14	5.6-7.3	Low-----------	0.17	2	2	1-3
	13-18	5-18	1.50-1.70	2.0-6.0	0.10-0.16	6.6-8.4	Low-----------	0.20			
	18-60	1-5	1.50-1.70	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
242C------------- Marquette	0-12	1-10	1.40-1.60	6.0-20	0.10-0.14	5.6-7.3	Low-----------	0.17	2	2	1-3
	12-17	5-18	1.50-1.70	2.0-6.0	0.10-0.16	6.6-8.4	Low-----------	0.20			
	17-60	1-5	1.50-1.70	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
243-------------- Stuntz	0-16	5-15	1.10-1.40	2.0-6.0	0.18-0.23	4.5-6.5	Low-----------	0.28	5	3	1-3
	16-35	20-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.8	Moderate-----	0.28			
	35-60	20-32	1.50-1.70	0.2-0.6	0.16-0.19	6.6-8.4	Low-----------	0.28			
267B------------- Snellman	0-3	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	1-3
	3-12	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low-----------	0.28			
	12-29	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	29-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
267C------------- Snellman	0-3	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	1-3
	3-14	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low-----------	0.28			
	14-30	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	30-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
267D------------- Snellman	0-3	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low-----------	0.20	5	3	1-3
	3-10	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low-----------	0.28			
	10-30	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	30-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low-----------	0.28			
272-------------- Bemidji	0-4	4-10	1.45-1.55	6.0-20	0.08-0.12	5.6-6.5	Low-----------	0.10	5	2	1-3
	4-26	4-10	1.50-1.60	6.0-20	0.04-0.08	5.6-6.5	Low-----------	0.10			
	26-44	12-18	1.60-1.75	0.2-0.6	0.10-0.12	6.1-7.3	Low-----------	0.32			
	44-60	8-16	1.60-1.75	0.2-2.0	0.14-0.16	7.4-8.4	Low-----------	0.32			

TABLE 17.--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 K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
280-------------- Pelan	0-3	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
	3-12	2-15	1.40-1.60	6.0-20	0.07-0.12	6.1-7.3	Low----------	0.17			
	12-17	15-25	1.50-1.65	6.0-20	0.10-0.16	6.1-7.8	Low----------	0.20			
	17-24	1-8	1.55-1.70	6.0-20	0.05-0.13	7.4-8.4	Low----------	0.20			
	24-60	8-18	1.40-1.75	0.6-2.0	0.14-0.18	7.4-8.4	Low----------	0.28			
328B------------- Sartell	0-6	4-10	1.25-1.40	6.0-20	0.10-0.12	5.1-6.0	Low----------	0.15	5	2	.5-2
	6-40	0-5	1.50-1.65	6.0-20	0.06-0.10	5.1-6.0	Low----------	0.15			
	40-60	0-5	1.50-1.65	6.0-20	0.05-0.09	5.6-7.3	Low----------	0.15			
404-------------- Chilgren	0-3	10-22	1.20-1.50	0.6-2.0	0.20-0.26	6.1-7.3	Low----------	0.28	5	5	1-3
	3-11	2-18	1.40-1.60	0.6-2.0	0.13-0.22	6.1-7.3	Low----------	0.28			
	11-18	18-35	1.30-1.70	0.6-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28			
	18-60	10-27	1.30-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.28			
432-------------- Strandquist	0-9	10-25	1.20-1.70	0.6-2.0	0.14-0.18	6.6-8.4	Moderate-----	0.32	3	4L	2-6
	9-32	1-8	1.50-1.70	6.0-20	0.03-0.05	7.4-8.4	Low----------	0.10			
	32-60	15-30	1.30-1.65	0.6-2.0	0.12-0.19	7.4-8.4	Moderate-----	0.37			
439-------------- Rockwell	0-9	10-20	1.25-1.45	2.0-6.0	0.16-0.18	7.4-8.4	Low----------	0.24	3	3	4-8
	9-17	5-30	1.35-1.50	2.0-6.0	0.15-0.17	7.9-8.4	Low----------	0.24			
	17-26	3-10	1.40-1.60	6.0-20	0.05-0.07	7.4-7.8	Low----------	0.24			
	26-60	15-30	1.40-1.60	0.2-2.0	0.18-0.22	7.4-7.8	Low----------	0.24			
458B------------- Menahga	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
	3-30	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low----------	0.15			
	30-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low----------	0.15			
458C------------- Menahga	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
	3-24	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low----------	0.15			
	24-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low----------	0.15			
458D------------- Menahga	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
	3-27	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low----------	0.15			
	27-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low----------	0.15			
481-------------- Kratka	0-10	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
	10-28	2-10	1.30-1.60	6.0-20	0.06-0.11	5.6-7.8	Low----------	0.17			
	28-60	10-35	1.50-1.80	0.2-2.0	0.11-0.19	7.4-8.4	Moderate-----	0.32			
482-------------- Grygla	0-7	2-15	1.40-1.60	6.0-20	0.13-0.15	6.1-7.3	Low----------	0.15	5	2	1-4
	7-25	1-10	1.50-1.70	6.0-20	0.06-0.11	6.6-7.8	Low----------	0.15			
	25-60	8-27	1.30-1.75	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			
496B------------- Andrusia	0-3	2-10	1.30-1.65	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	4	2	2-4
	3-29	1-5	1.45-1.70	6.0-20	0.07-0.10	5.6-7.3	Low----------	0.15			
	29-39	10-20	1.25-1.55	2.0-6.0	0.11-0.16	5.6-7.3	Low----------	0.20			
	39-60	1-5	1.45-1.70	6.0-20	0.04-0.09	7.4-8.4	Low----------	0.15			
496C------------- Andrusia	0-3	2-10	1.30-1.65	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	4	2	2-4
	3-31	1-5	1.45-1.70	6.0-20	0.07-0.10	5.6-7.3	Low----------	0.15			
	31-43	10-20	1.25-1.55	2.0-6.0	0.11-0.16	5.6-7.3	Low----------	0.20			
	43-60	1-5	1.45-1.70	6.0-20	0.04-0.09	7.4-8.4	Low----------	0.15			
496D------------- Andrusia	0-3	2-10	1.30-1.65	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	4	2	2-4
	3-24	1-5	1.45-1.70	6.0-20	0.07-0.10	5.6-7.3	Low----------	0.15			
	24-32	10-20	1.25-1.55	2.0-6.0	0.11-0.16	5.6-7.3	Low----------	0.20			
	32-60	1-5	1.45-1.70	6.0-20	0.04-0.09	7.4-8.4	Low----------	0.15			
503B------------- Balmlake	0-3	3-12	1.25-1.40	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.28	5	3	1-3
	3-11	3-12	1.30-1.50	2.0-6.0	0.10-0.17	5.1-6.5	Low----------	0.28			
	11-24	8-18	1.35-1.55	0.6-2.0	0.13-0.20	5.6-6.5	Low----------	0.37			
	24-60	6-14	1.30-1.65	0.6-2.0	0.10-0.22	7.4-8.4	Low----------	0.28			

TABLE 17.--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 K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
503C------------- Balmlake	0-3	3-12	1.25-1.40	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.28	5	3	1-3
	3-14	3-12	1.30-1.50	2.0-6.0	0.10-0.17	5.1-6.5	Low----------	0.28			
	14-22	8-18	1.35-1.55	0.6-2.0	0.13-0.20	5.6-6.5	Low----------	0.37			
	22-60	6-14	1.30-1.65	0.6-2.0	0.10-0.22	7.4-8.4	Low----------	0.28			
503D------------- Balmlake	0-3	3-12	1.25-1.40	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.28	5	3	1-3
	3-11	3-12	1.30-1.50	2.0-6.0	0.10-0.17	5.1-6.5	Low----------	0.28			
	11-21	8-18	1.35-1.55	0.6-2.0	0.13-0.20	5.6-6.5	Low----------	0.37			
	21-60	6-14	1.30-1.65	0.6-2.0	0.10-0.22	7.4-8.4	Low----------	0.28			
505B------------- Debs	0-4	8-16	1.20-1.40	0.6-2.0	0.18-0.24	6.1-7.3	Low----------	0.32	5	5	4-7
	4-12	3-12	1.20-1.50	2.0-6.0	0.15-0.20	6.1-7.3	Low----------	0.43			
	12-24	18-30	1.25-1.50	0.6-2.0	0.16-0.22	6.1-7.3	Moderate-----	0.43			
	24-60	5-12	1.30-1.60	0.6-2.0	0.14-0.22	7.4-8.4	Low----------	0.43			
505C------------- Debs	0-2	8-16	1.20-1.40	0.6-2.0	0.18-0.24	6.1-7.3	Low----------	0.32	5	5	4-7
	2-10	3-12	1.20-1.50	2.0-6.0	0.15-0.20	6.1-7.3	Low----------	0.43			
	10-23	18-30	1.25-1.50	0.6-2.0	0.16-0.22	6.1-7.3	Moderate-----	0.43			
	23-60	5-12	1.30-1.60	0.6-2.0	0.14-0.22	7.4-8.4	Low----------	0.43			
514-------------- Tacoosh	0-7	---	0.10-0.30	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	5	2	>75
	7-41	---	0.10-0.20	0.6-6.0	0.45-0.55	5.6-7.8	-------------	----			
	41-60	5-35	1.40-2.00	0.2-2.0	0.12-0.20	5.6-8.4	Low----------	0.28			
534-------------- Mooselake	0-40	---	0.05-0.30	0.6-6.0	0.35-0.55	4.5-7.3	-------------	----	5	5	>25
	40-60	---	0.10-0.20	0.6-6.0	0.40-0.50	4.5-7.3	-------------	----			
538-------------- Waskish	0-60	---	0.02-0.10	>6.0	0.55-0.65	<4.5	-------------	----	5	8	>90
540-------------- Seelyeville	0-10	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----	5	2	>25
	10-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----			
541-------------- Rifle	0-18	---	0.20-0.35	0.6-6.0	0.35-0.45	4.5-7.3	-------------	----	5	5	>75
	18-60	---	0.08-0.20	0.6-6.0	0.45-0.55	4.5-7.3	-------------	----			
543-------------- Markey	0-24	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	4	2	55-85
	24-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
544-------------- Cathro	0-8	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-------------	----	5	2	60-85
	8-30	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----			
	30-60	10-25	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.28			
545-------------- Rondeau	0-18	0-10	0.10-0.25	0.2-6.0	0.35-0.48	5.1-7.8	-------------	----	5	2	>25
	18-60	5-15	0.05-0.20	<0.2	0.20-0.22	7.4-8.4	-------------	----			
546-------------- Lupton	0-25	---	0.10-0.35	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----	5	2	70-90
	25-60	---	0.10-0.35	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----			
547-------------- Deerwood	0-12	---	0.10-0.30	0.6-6.0	0.35-0.45	5.6-7.8	-------------	----	3	2	50-90
	12-16	2-18	1.20-1.70	2.0-20	0.09-0.17	6.1-8.4	Low----------	0.17			
	16-60	0-10	1.50-1.70	6.0-20	0.02-0.07	7.4-8.4	Low----------	0.17			
549-------------- Greenwood	0-4	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	-------------	----	5	7	55-75
	4-63	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	-------------	----			
560:											
Greenwood-------	0-8	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	-------------	----	5	7	55-75
	8-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	-------------	----			

TABLE 17.--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 K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
560: Lobo------------	0-37	---	0.02-0.10	6.0-20	0.55-0.65	3.6-4.4	-------------	----	5	8	>25
	37-84	---	0.07-0.20	0.6-6.0	0.45-0.55	3.6-5.0	-------------	----			
561-------------- Bullwinkle	0-17	---	0.20-0.45	0.2-6.0	0.35-0.48	5.6-7.3	-------------	----	5	2	60-85
	17-41	---	0.20-0.45	2.0-6.0	0.35-0.48	5.6-7.3	-------------	----			
	41-45	8-27	1.20-1.50	0.6-2.0	0.14-0.18	6.6-7.8	Low----------	0.32			
	45-60	10-30	1.45-1.75	0.2-2.0	0.11-0.18	6.6-8.4	Moderate-----	0.32			
563-------------- Northwood	0-9	---	0.18-0.25	0.2-6.0	0.35-0.45	6.6-7.8	-------------	----	5	2	50-85
	9-14	3-18	1.45-1.65	2.0-20	0.09-0.17	6.6-7.8	Low----------	0.15			
	14-24	1-10	1.55-1.70	6.0-20	0.06-0.11	6.6-8.4	Low----------	0.15			
	24-60	7-30	1.40-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Moderate-----	0.37			
565-------------- Eckvoll	0-4	5-15	1.30-1.70	2.0-6.0	0.10-0.12	6.1-7.3	Low----------	0.17	5	2	1-3
	4-25	2-10	1.30-1.70	2.0-6.0	0.06-0.08	6.1-7.3	Low----------	0.15			
	25-32	18-35	1.40-1.70	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.37			
	32-60	18-32	1.30-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			
582-------------- Roliss	0-8	18-27	1.10-1.50	0.2-2.0	0.17-0.24	6.6-8.4	Moderate-----	0.28	5	6	3-7
	8-12	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
	12-60	18-35	1.30-1.70	0.2-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.28			
607-------------- Pengilly	0-4	8-15	1.25-1.40	2.0-6.0	0.13-0.22	5.6-7.8	Low----------	0.24	5	3	2-4
	4-60	6-18	1.40-1.60	0.6-2.0	0.12-0.20	6.1-8.4	Low----------	0.24			
616-------------- Effie	0-8	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
	8-28	35-60	1.50-1.70	0.06-0.2	0.12-0.19	5.1-8.4	High---------	0.37			
	28-60	25-55	1.50-1.70	0.06-0.2	0.12-0.19	7.9-8.4	Moderate-----	0.37			
620B------------- Cutaway	0-3	0-8	1.45-1.55	6.0-20	0.10-0.12	5.1-6.5	Low----------	0.17	5	2	.5-2
	3-28	0-8	1.50-1.60	6.0-20	0.06-0.11	5.1-6.5	Low----------	0.17			
	28-45	20-35	1.60-1.75	0.06-0.6	0.12-0.19	5.1-7.8	Moderate-----	0.37			
	45-60	18-30	1.60-1.75	0.06-0.6	0.12-0.19	6.1-8.4	Low----------	0.37			
620C------------- Cutaway	0-3	0-8	1.45-1.55	6.0-20	0.10-0.12	5.1-6.5	Low----------	0.17	5	2	.5-2
	3-28	0-8	1.50-1.60	6.0-20	0.06-0.11	5.1-6.5	Low----------	0.17			
	28-55	20-35	1.60-1.75	0.06-0.6	0.12-0.19	5.1-7.8	Moderate-----	0.37			
	55-60	18-30	1.60-1.75	0.06-0.6	0.12-0.19	6.1-8.4	Low----------	0.37			
621-------------- Morph	0-13	4-12	1.40-1.55	2.0-6.0	0.13-0.22	5.1-6.5	Low----------	0.24	5	3	1-4
	13-35	18-30	1.55-1.70	0.6-2.0	0.11-0.19	5.1-7.3	Low----------	0.24			
	35-60	8-27	1.55-1.70	0.6-2.0	0.11-0.19	6.6-8.4	Low----------	0.24			
624-------------- Rosy	0-15	3-12	1.40-1.55	0.6-2.0	0.14-1.19	5.1-7.3	Low----------	0.24	5	3	.5-2
	15-36	8-18	1.50-1.65	0.6-2.0	0.14-0.19	5.1-7.3	Low----------	0.28			
	36-60	6-18	1.55-1.70	0.6-2.0	0.11-0.17	5.6-8.4	Low----------	0.28			
625-------------- Sandwick	0-8	0-8	1.45-1.55	6.0-20	0.08-0.10	5.1-6.5	Low----------	0.17	5	2	.5-2
	8-22	0-8	1.50-1.60	6.0-20	0.06-0.09	5.1-6.5	Low----------	0.15			
	22-48	18-35	1.65-1.80	0.2-0.6	0.10-0.16	5.6-7.3	Moderate-----	0.37			
	48-60	18-30	1.65-1.80	0.2-0.6	0.02-0.10	6.6-8.4	Low----------	0.37			
626B------------- Suomi	0-6	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
	6-23	35-60	1.50-1.70	0.06-0.2	0.10-0.19	5.1-7.3	High---------	0.32			
	23-60	27-45	1.50-1.70	0.06-0.2	0.11-0.17	7.4-8.4	Moderate-----	0.32			
626C------------- Suomi	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
	8-28	35-60	1.50-1.70	0.06-0.2	0.10-0.19	5.1-7.3	High---------	0.32			
	28-60	27-45	1.50-1.70	0.06-0.2	0.11-0.17	7.4-8.4	Moderate-----	0.32			

TABLE 17.--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 K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
626D------------- Suomi	0-5	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
	5-21	35-60	1.50-1.70	0.06-0.2	0.10-0.19	5.1-7.3	High---------	0.32			
	21-60	27-45	1.50-1.70	0.06-0.2	0.11-0.17	7.4-8.4	Moderate-----	0.32			
627-------------- Tawas	0-6	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----	4	2	40-60
	6-33	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----			
	33-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low----------	0.15			
628-------------- Talmoon	0-4	---	0.13-0.42	2.0-6.0	0.25-0.40	5.1-7.3	-------------	----	5	2	15-50
	4-14	15-27	1.20-1.40	0.6-2.0	0.13-0.22	5.1-7.3	Moderate-----	0.28			
	14-24	18-35	1.40-1.60	0.2-0.6	0.16-0.19	5.6-7.3	Moderate-----	0.37			
	24-60	15-35	1.40-1.60	0.2-0.6	0.15-0.19	7.4-8.4	Moderate-----	0.37			
653-------------- Smiley	0-4	---	0.10-0.25	0.2-2.0	0.35-0.48	6.6-7.8	-------------	----	5	2	35-80
	4-11	6-18	1.30-1.70	0.2-2.0	0.13-0.18	6.6-7.8	Moderate-----	0.24			
	11-18	18-35	1.35-1.60	0.2-2.0	0.15-0.19	6.6-7.8	Moderate-----	0.24			
	18-60	16-32	1.40-1.70	0.2-2.0	0.14-0.19	6.6-8.4	Moderate-----	0.24			
702:											
Bullwinkle------	0-12	---	0.20-0.45	0.2-6.0	0.35-0.48	5.6-7.3	-------------	----	5	2	60-85
	12-34	---	0.20-0.45	2.0-6.0	0.35-0.48	5.6-7.3	-------------	----			
	34-40	8-27	1.20-1.50	0.6-2.0	0.14-0.18	6.6-7.8	Low----------	0.32			
	40-60	10-30	1.45-1.75	0.2-2.0	0.11-0.18	6.6-8.4	Moderate-----	0.32			
Cathro----------	0-20	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-------------	----	5	2	60-85
	20-60	10-25	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.28			
709B------------- Lengby	0-5	5-12	1.25-1.40	2.0-6.0	0.12-0.18	6.1-7.3	Low----------	0.24	5	3	1-2
	5-18	3-10	1.40-1.65	6.0-20	0.08-0.12	5.6-7.3	Low----------	0.17			
	18-28	18-35	1.30-1.55	0.6-2.0	0.15-0.19	6.1-7.3	Moderate-----	0.37			
	28-41	2-18	1.40-1.70	2.0-6.0	0.08-0.16	7.4-8.4	Low----------	0.28			
	41-60	2-8	1.60-1.75	6.0-20	0.06-0.12	7.4-8.4	Low----------	0.17			
709C, 709D------- Lengby	0-3	5-12	1.25-1.40	2.0-6.0	0.12-0.18	6.1-7.3	Low----------	0.24	5	3	1-2
	3-11	3-10	1.40-1.65	6.0-20	0.08-0.12	5.6-7.3	Low----------	0.17			
	11-19	18-35	1.30-1.55	0.6-2.0	0.15-0.19	6.1-7.3	Moderate-----	0.37			
	19-60	2-8	1.60-1.75	6.0-20	0.06-0.12	7.4-8.4	Low----------	0.17			
712-------------- Rosewood	0-7	8-18	1.20-1.40	2.0-6.0	0.13-0.18	7.4-8.4	Low----------	0.24	3	3	4-7
	7-18	6-18	1.20-1.40	2.0-6.0	0.11-0.15	7.4-8.4	Low----------	0.24			
	18-60	1-6	1.45-1.65	6.0-20	0.05-0.08	7.4-8.4	Low----------	0.24			
765-------------- Smiley	0-8	8-20	1.20-1.50	0.6-2.0	0.20-0.24	6.6-7.8	Low----------	0.24	5	5	2-5
	8-13	18-35	1.35-1.60	0.6-2.0	0.15-0.19	6.6-8.4	Moderate-----	0.24			
	13-60	16-32	1.40-1.70	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.24			
799:											
Seelyeville-----	0-28	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----	5	2	>25
	28-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-------------	----			
Bowstring-------	0-35	---	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	-------------	----	5	8	40-90
	35-43	1-12	1.40-1.60	0.6-20	0.08-0.14	5.6-8.4	Low----------	0.17			
	43-60	---	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	-------------	----			
867B:											
Graycalm--------	0-5	0-10	1.30-1.55	6.0-20	0.06-0.12	4.5-6.5	Low----------	0.17	5	2	.5-2
	5-32	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low----------	0.15			
	32-46	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15			
	46-60	0-10	1.50-1.65	6.0-20	0.04-0.06	5.6-8.4	Low----------	0.15			

TABLE 17.--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 K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
867B:											
Menahga---------	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
	3-36	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low----------	0.15			
	36-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low----------	0.15			
867C:											
Graycalm--------	0-3	0-10	1.30-1.55	6.0-20	0.06-0.12	4.5-6.5	Low----------	0.17	5	2	.5-2
	3-30	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low----------	0.15			
	30-50	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15			
	50-60	0-10	1.50-1.65	6.0-20	0.04-0.06	5.6-8.4	Low----------	0.15			
Menahga---------	0-2	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low----------	0.15	5	2	.5-2
	2-30	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low----------	0.15			
	30-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.3	Low----------	0.15			
1029. Pits											
1085B, 1085C: Urban land.											
Graycalm--------	0-3	0-10	1.30-1.55	6.0-20	0.06-0.12	4.5-6.5	Low----------	0.17	5	2	.5-2
	3-13	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low----------	0.15			
	13-60	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15			
1086: Urban land.											
Cormant---------	0-7	3-10	1.30-1.50	6.0-20	0.08-0.12	6.1-7.3	Low----------	0.17	5	2	2-10
	7-60	0-5	1.50-1.70	6.0-20	0.06-0.10	6.1-7.8	Low----------	0.17			
1804------------- Hamre	0-8	---	0.18-0.22	0.2-2.0	0.35-0.48	6.6-7.8	-------------	----	5	2	85-95
	8-18	18-35	1.30-1.70	0.2-2.0	0.17-0.19	6.6-7.8	Moderate-----	0.32			
	18-60	18-35	1.40-1.70	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
1807------------- Cathro	0-24	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-------------	----	5	2	60-85
	24-30	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	-------------	----			
	30-60	10-25	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low----------	0.28			
1808------------- Markey	0-28	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	----	4	2	55-85
	28-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low----------	0.15			
1878------------- Hamre	0-9	---	0.18-0.22	0.2-2.0	0.35-0.48	6.6-7.8	-------------	----	5	2	85-95
	9-13	18-35	1.30-1.70	0.2-2.0	0.17-0.19	6.6-7.8	Moderate-----	0.32			
	13-60	18-35	1.40-1.70	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
1922------------- Chilgren	0-3	5-18	1.30-1.60	2.0-6.0	0.14-0.16	6.1-7.3	Low----------	0.28	5	8	1-3
	3-11	2-18	1.40-1.60	0.6-2.0	0.13-0.22	6.1-7.3	Low----------	0.28			
	11-18	18-35	1.30-1.70	0.6-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28			
	18-60	10-27	1.30-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.28			
1923------------- Garnes	0-8	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
	8-17	18-30	1.50-1.65	0.6-2.0	0.17-0.20	6.6-7.8	Moderate-----	0.32			
	17-60	10-27	1.60-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
1924------------- Grygla	0-11	2-15	1.40-1.60	6.0-20	0.13-0.15	6.1-7.3	Low----------	0.15	5	8	1-4
	11-27	1-10	1.30-1.75	6.0-20	0.06-0.11	6.6-7.8	Low----------	0.15			
	27-60	8-27	1.40-1.65	0.2-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			

TABLE 17.--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 K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1925-------------- Eckvoll	0-4	5-15	1.30-1.70	2.0-6.0	0.08-0.10	6.1-7.3	Low----------	0.10	5	8	1-3
	4-25	2-10	1.30-1.70	2.0-6.0	0.06-0.08	6.1-7.3	Low----------	0.15			
	25-32	18-35	1.40-1.70	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.37			
	32-60	18-32	1.30-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.37			
1935-------------- Epoufette	0-4	---	0.18-0.45	2.0-6.0	0.35-0.48	6.1-7.3	-------------	0.10	4	2	80-85
	4-8	5-15	1.35-1.50	2.0-6.0	0.09-0.14	6.1-7.3	Low----------	0.17			
	8-18	5-15	1.40-1.55	6.0-20	0.05-0.07	6.1-7.3	Low----------	0.17			
	18-30	8-18	1.40-1.60	2.0-6.0	0.08-0.14	6.6-7.8	Low----------	0.17			
	30-60	0-8	1.40-1.65	>20	0.01-0.03	7.4-8.4	Low----------	0.10			
1939-------------- Northwood	0-11	---	0.18-0.25	0.2-6.0	0.30-0.40	6.6-7.8	-------------	----	5	8	50-85
	11-15	3-18	1.45-1.65	2.0-20	0.09-0.17	6.6-7.8	Low----------	0.15			
	15-25	1-10	1.55-1.70	6.0-20	0.06-0.11	6.6-8.4	Low----------	0.15			
	25-60	7-30	1.40-1.75	0.6-2.0	0.14-0.19	7.4-8.4	Moderate-----	0.37			
1959-------------- Nary	0-4	4-15	1.50-1.65	0.6-2.0	0.12-0.20	5.1-6.0	Low----------	0.20	5	8	1-3
	4-14	2-12	1.40-1.55	2.0-6.0	0.09-0.13	5.1-6.0	Low----------	0.20			
	14-45	18-27	1.55-1.75	0.2-0.6	0.16-0.20	5.6-6.5	Moderate-----	0.20			
	45-60	5-18	1.55-1.80	0.6-2.0	0.11-0.16	7.4-7.8	Low----------	0.20			
1991-------------- Stuntz	0-12	8-22	1.10-1.40	0.6-2.0	0.19-0.24	4.5-6.5	Low----------	0.28	5	5	1-3
	12-60	20-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.8	Moderate-----	0.28			
1993B:											
Snellman---------	0-5	5-18	1.35-1.60	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.20	5	3	1-3
	5-13	5-15	1.50-1.70	0.6-2.0	0.09-0.14	5.1-6.5	Low----------	0.28			
	13-28	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	28-60	7-18	1.60-1.80	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			
Wykeham----------	0-8	5-18	1.30-1.55	0.6-6.0	0.13-0.18	5.1-6.5	Low----------	0.20	5	3	2-6
	8-14	5-15	1.50-1.70	0.6-2.0	0.10-0.17	5.1-6.5	Low----------	0.28			
	14-32	18-30	1.50-1.70	0.6-2.0	0.12-0.18	5.6-7.3	Moderate-----	0.28			
	32-60	10-18	1.55-1.75	0.6-2.0	0.11-0.16	7.4-8.4	Low----------	0.28			

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "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			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
32B, 32C, 32D----- Nebish	B	None--------	---	---	>6.0	---	---	---	Moderate	Moderate	Low.
48---------------- Hiwood	A	None--------	---	---	2.0-5.0	Apparent	Apr-Jun	---	Moderate	Low------	Low.
72---------------- Shooker	C	None--------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High-----	High-----	Low.
77---------------- Garnes	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	---	High-----	Moderate	Low.
116--------------- Redby	B	None--------	---	---	1.5-3.0	Apparent	Apr-Jul	---	Moderate	Low------	Low.
117--------------- Cormant	A/D	None--------	---	---	1.0-3.0	Apparent	Apr-Jun	---	Moderate	High-----	Low.
121--------------- Wykeham	B	None--------	---	---	2.5-4.0	Apparent	Apr-Jun	---	Moderate	Moderate	Moderate.
125--------------- Beltrami	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	---	High-----	Moderate	Low.
147--------------- Spooner	C/D	None--------	---	---	1.0-3.0	Apparent	Apr-Jul	---	High-----	High-----	Low.
158B, 158C-------- Zimmerman	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
167--------------- Baudette	B	None--------	---	---	3.0-6.0	Apparent	May-Jul	---	High-----	Moderate	Low.
191--------------- Epoufette	B/D	None--------	---	---	0.5-2.0	Apparent	Oct-Jun	---	High-----	High-----	Moderate.
199B, 199C-------- Sol	B	None--------	---	---	>6.0	---	---	---	Moderate	High-----	High.
202--------------- Meehan	B	None--------	---	---	1.0-3.0	Apparent	Apr-Jun	---	Moderate	Low------	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Total subsidence	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
205---------------- Karlstad	A	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	---	Moderate	Low-------	Low.
240B, 240C-------- Warba	B	None---------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
242B, 242C-------- Marquette	A	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Low.
243---------------- Stuntz	C	None---------	---	---	1.5-3.0	Perched	Apr-Jun	---	High------	High------	Moderate.
267B, 267C, 267D-- Snellman	B	None---------	---	---	>6.0	---	---	---	Moderate	Low-------	Moderate.
272---------------- Bemidji	B	None---------	---	---	2.0-6.0	Apparent	Apr-Jun	---	Moderate	Moderate	Moderate.
280---------------- Pelan	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	---	Moderate	Moderate	Low.
328B--------------- Sartell	A	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Moderate.
404---------------- Chilgren	C	None---------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High------	High------	Low.
432---------------- Strandquist	B/D	None---------	---	---	0.5-3.0	Apparent	Apr-Jun	---	High------	High------	Low.
439---------------- Rockwell	B/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High------	High------	Low.
458B, 458C, 458D-- Menahga	A	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Moderate.
481---------------- Kratka	B/D	None---------	---	---	0.5-3.0	Apparent	Oct-Jun	---	Moderate	High------	Low.
482---------------- Grygla	B/D	None---------	---	---	0.5-2.0	Apparent	Oct-Jun	---	High------	High------	Low.
496B, 496C, 496D-- Andrusia	A	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Low.
503B, 503C, 503D-- Balmlake	B	None---------	---	---	>6.0	---	---	---	Moderate	Low-------	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
505B, 505C-------- Debs	B	None--------	---	---	>6.0	---	---	---	High-----	Moderate	Low.
514--------------- Tacoosh	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	9-29	High-----	High-----	Moderate.
534--------------- Mooselake	A/D	None--------	---	---	+1.-1.0	Apparent	Oct-Jun	>12	High-----	High-----	High.
538--------------- Waskish	D	None--------	---	---	0-2.0	Apparent	Oct-Jun	---	High-----	High-----	High.
540--------------- Seelyeville	A/D	None--------	---	---	+2-2.0	Apparent	Oct-Jun	50-55	High-----	High-----	Moderate.
541--------------- Rifle	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	---	High-----	High-----	Low.
543--------------- Markey	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	25-30	High-----	High-----	Low.
544--------------- Cathro	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	19-22	High-----	High-----	Low.
545--------------- Rondeau	A/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	35	High-----	High-----	Low.
546--------------- Lupton	A/D	None--------	---	---	0-1.0	Apparent	Oct-Jun	50-55	High-----	High-----	Low.
547--------------- Deerwood	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	5-10	Moderate	High-----	Low.
549--------------- Greenwood	A/D	None--------	---	---	0-1.0	Apparent	Oct-Jun	---	High-----	High-----	High.
560:											
Greenwood--------	A/D	None--------	---	---	0-1.0	Apparent	Oct-Jun	---	High-----	High-----	High.
Lobo-------------	D	None--------	---	---	0-2.0	Apparent	Oct-Jun	55-50	High-----	High-----	High.
561--------------- Bullwinkle	D	None--------	---	---	0-1.0	Apparent	Oct-Jun	19-22	High-----	High-----	Moderate.
563--------------- Northwood	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	8-10	High-----	High-----	Low.
565--------------- Eckvoll	B	None--------	---	---	2.0-5.0	Apparent	Apr-Jun	---	High-----	Moderate	Low.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
582----------------- Roliss	B/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High-----	High-----	Low.
607----------------- Pengilly	B/D	Frequent----	Brief-----	May-Jun	0-2.0	Apparent	Oct-Jun	---	High-----	High-----	Moderate.
616----------------- Effie	C	None---------	---	---	1.0-2.5	Perched	Apr-Jun	---	High-----	High-----	Moderate.
620B, 620C-------- Cutaway	B	None---------	---	---	>6.0	---	---	---	Low------	Moderate	Moderate.
621----------------- Morph	B/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High-----	Moderate	Low.
624----------------- Rosy	B	None---------	---	---	3.0-5.0	Apparent	Mar-Jun	---	Moderate	Moderate	Moderate.
625----------------- Sandwick	B	None---------	---	---	1.0-2.0	Apparent	Apr-Jun	---	Moderate	High-----	Moderate.
626B, 626C, 626D-- Suomi	C	None---------	---	---	2.5-5.0	Perched	Apr-May	---	Moderate	Moderate	Moderate.
627----------------- Tawas	A/D	None---------	---	---	0-1.0	Apparent	Oct-Jun	25-30	High-----	High-----	Moderate.
628----------------- Talmoon	D	None---------	---	---	+1-1.0	Apparent	Oct-Jun	---	High-----	High-----	Moderate.
653----------------- Smiley	B/D	None---------	---	---	+2-1.0	Apparent	Oct-Jun	---	High-----	High-----	Low.
702:											
Bullwinkle--------	D	None---------	---	---	0-1.0	Apparent	Oct-Jun	19-22	High-----	High-----	Moderate.
Cathro------------	A/D	None---------	---	---	+1-1.0	Apparent	Oct-Jun	19-22	High-----	High-----	Low.
709B, 709C, 709D-- Lengby	B	None---------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
712----------------- Rosewood	A/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jun	---	Moderate	High-----	Low.
765----------------- Smiley	B/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High-----	High-----	Low.
799:											
Seelyeville-------	A/D	Frequent----	Long------	Mar-Jun	+2-2.0	Apparent	Oct-Jun	50-55	High-----	High-----	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
799:											
Bowstring--------	A/D	Frequent----	Long------	Mar-Jun	0-2.0	Apparent	Oct-Jun	20-30	High-----	High-----	Low.
867B, 867C:											
Graycalm---------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Menahga----------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
1029.											
Pits											
1085B, 1085C:											
Urban land.											
Graycalm---------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
1086:											
Urban land.											
Cormant----------	A/D	None--------	---	---	1.0-3.0	Apparent	Apr-Jun	---	Moderate	High-----	Low.
1804-------------- Hamre	C/D	None--------	---	---	+2-0.5	Apparent	Jan-Dec	---	High-----	High-----	Low.
1807-------------- Cathro	A/D	None--------	---	---	+1-0.5	Apparent	Jan-Dec	19-22	High-----	High-----	Low.
1808-------------- Markey	A/D	None--------	---	---	+1-0.5	Apparent	Jan-Dec	25-30	High-----	High-----	Low.
1878-------------- Hamre	C/D	None--------	---	---	+2-1.0	Apparent	Oct-Jun	---	High-----	High-----	Low.
1922-------------- Chilgren	C	None--------	---	---	1.0-3.0	Apparent	Apr-Jun	---	High-----	High-----	Low.
1923-------------- Garnes	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jun	---	High-----	Moderate	Low.
1924-------------- Grygla	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jul	---	High-----	High-----	Low.
1925-------------- Eckvoll	B	None--------	---	---	2.0-5.0	Apparent	Apr-Jun	---	High-----	Moderate	Low.
1935-------------- Epoufette	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	---	Moderate	High-----	Moderate.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
1939-------------- Northwood	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jun	8-10	High-----	High-----	Low.
1959-------------- Nary	B	None--------	---	---	2.5-5.0	Apparent	Apr-Jun	---	Moderate	High-----	Moderate.
1991-------------- Stuntz	C	None--------	---	---	1.5-3.0	Perched	Mar-Jun	---	High-----	High-----	Moderate.
1993B:											
Snellman---------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
Wykeham----------	B	None--------	---	---	2.5-4.0	Apparent	Apr-Jun	---	Moderate	Moderate	Moderate.

TABLE 19.--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
Aeric Glossaqualfs	Aeric Glossaqualfs
Alfic Udipsamments	Alfic Udipsamments
Andrusia	Loamy, mixed Arenic Eutroboralfs
Aqualfs	Aqualfs
Aquic Eutroboralfs	Aquic Eutroboralfs
Arenic Eutroboralfs	Arenic Eutroboralfs
Balmlake	Coarse-loamy, mixed Typic Eutroboralfs
Baudette	Fine-silty, mixed Aquic Eutroboralfs
Beltrami	Fine-loamy, mixed Aquic Eutroboralfs
Bemidji	Loamy, mixed Aquic Arenic Eutroboralfs
Bowstring	Euic Fluvaquentic Borosaprists
Bullwinkle	Loamy, mixed, euic Terric Borosaprists
Cathro	Loamy, mixed, euic Terric Borosaprists
Chilgren	Fine-loamy, mixed, frigid Typic Ochraqualfs
Cormant	Mixed, frigid Mollic Psammaquents
Cutaway	Loamy, mixed Arenic Eutroboralfs
Debs	Fine-silty, mixed Typic Eutroboralfs
Deerwood	Sandy, mixed, frigid Histic Humaquepts
Eckvoll	Loamy, mixed Aquic Arenic Eutroboralfs
Effie	Fine, mixed, frigid Typic Ochraqualfs
Epoufette	Coarse-loamy, mixed, frigid Mollic Ochraqualfs
Garnes	Fine-loamy, mixed Aquic Eutroboralfs
Glossic Eutroboralfs	Glossic Eutroboralfs
Graycalm	Mixed, frigid Alfic Udipsamments
Greenwood	Dysic Typic Borohemists
Grygla	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
Hamre	Fine-loamy, mixed, nonacid, frigid Histic Humaquepts
Histosols	Histosols
Hiwood	Mixed, frigid Aquic Udipsamments
Humaquepts	Humaquepts
Karlstad	Coarse-loamy, mixed Aquic Eutroboralfs
Kratka	Sandy over loamy, mixed, frigid Typic Haplaquolls
Lengby	Fine-loamy, mixed Typic Eutroboralfs
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
Mooselake	Euic Typic Borohemists
Morph	Fine-loamy, mixed, frigid Typic Glossaqualfs
Nary	Fine-loamy, mixed Aquic Eutroboralfs
Nebish	Fine-loamy, mixed Typic Eutroboralfs
Northwood	Sandy over loamy, mixed, nonacid, frigid Histic Humaquepts
Pelan	Loamy-skeletal, mixed Psammentic Eutroboralfs
Pengilly	Coarse-loamy, mixed, nonacid, frigid Typic Fluvaquents
Psammentic Eutroboralfs	Psammentic Eutroboralfs
Redby	Mixed, frigid Aquic Udipsamments
Rifle	Euic Typic Borohemists
Rockwell	Coarse-loamy, frigid Typic Calciaquolls
Roliss	Fine-loamy, mixed (calcareous), frigid Typic Haplaquolls
Rondeau	Marly, euic Limnic Borosaprists
Rosewood	Sandy, frigid Typic Calciaquolls
Rosy	Coarse-loamy, mixed Glossaquic Eutroboralfs
Sandwick	Loamy, mixed, frigid Arenic Glossaqualfs
Sartell	Mixed, frigid Typic Udipsamments
Seelyeville	Euic Typic Borosaprists
*Shooker	Fine-loamy, mixed, frigid Typic Ochraqualfs
Smiley	Fine-loamy, mixed, frigid Typic Argiaquolls

TABLE 19.--CLASSIFICATION OF THE SOILS--Continued

Soil name	Family or higher taxonomic class
Snellman	Fine-loamy, mixed Typic Eutroboralfs
Sol	Fine-loamy, mixed Glossic Eutroboralfs
Spooner	Fine-silty, mixed, frigid Typic Ochraqualfs
Strandquist	Sandy-skeletal over loamy, mixed (calcareous), frigid Typic Haplaquolls
Stuntz	Fine-loamy, mixed, frigid Aeric Glossaqualfs
*Suomi	Fine, mixed Glossaquic Eutroboralfs
Tacoosh	Loamy, mixed, euic Terric Borohemists
Talmoon	Fine-loamy, mixed, frigid Mollic Ochraqualfs
Tawas	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Typic Borohemists	Typic Borohemists
Typic Borosaprists	Typic Borosaprists
Typic Ochraqualfs	Typic Ochraqualfs
Typic Udipsamments	Typic Udipsamments
Udipsamments	Udipsamments
Warba	Fine-loamy, mixed Glossic Eutroboralfs
Waskish	Dysic, frigid Typic Sphagnofibrists
Wykeham	Fine-loamy, mixed Aquic Eutroboralfs
Zimmerman	Mixed, frigid Alfic Udipsamments

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