United States Department of Agriculture

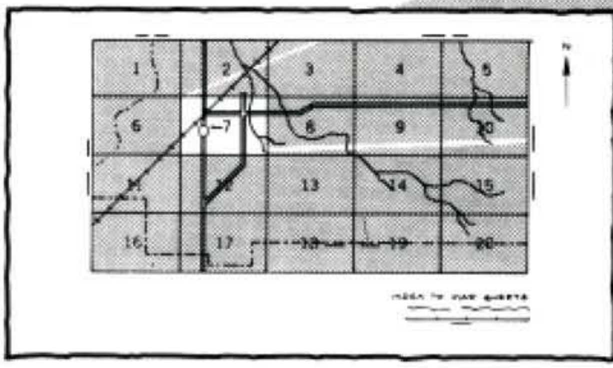
Soil Conservation Service

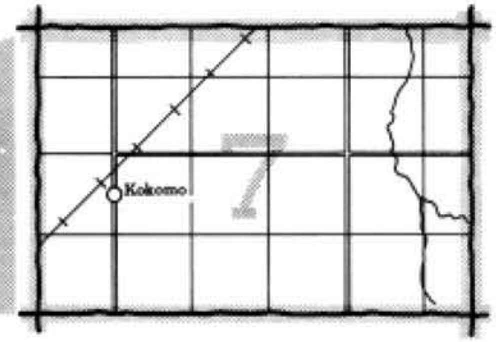
In cooperation with United States Department of Agriculture, Forest Service, and Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

Soil Survey of Vilas County, Wisconsin

HOW TO USE

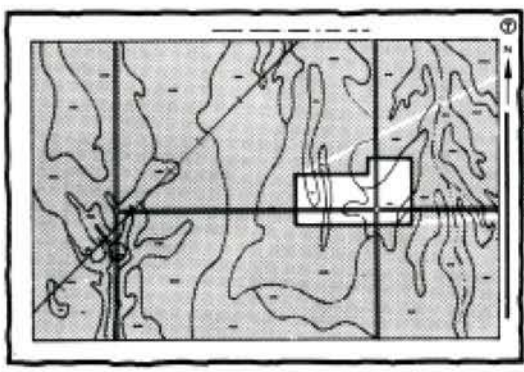
1. Locate your area of interest on the "Index to Map Sheets"

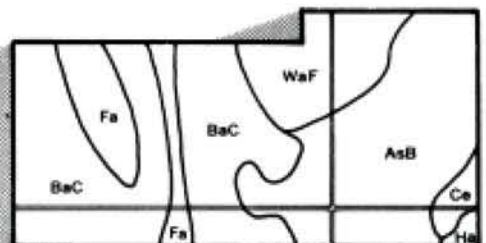




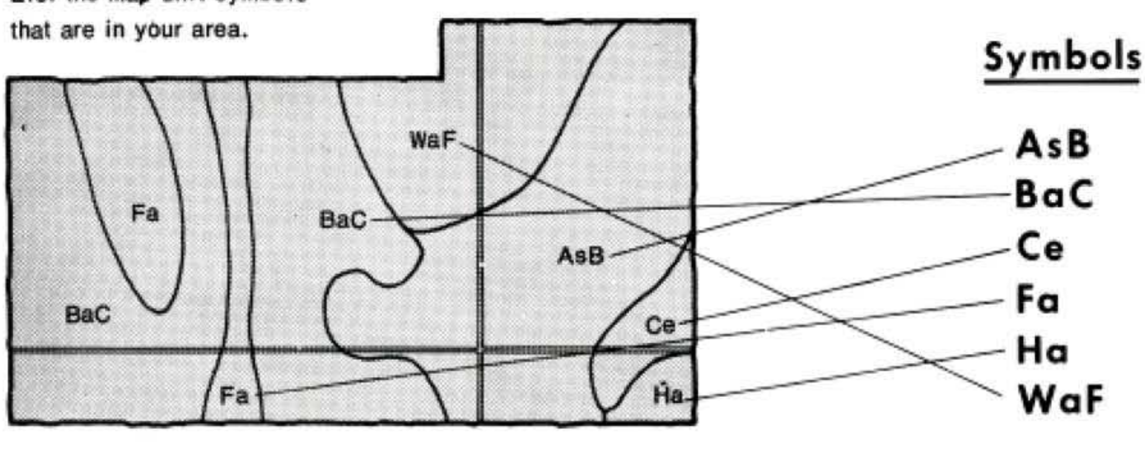
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



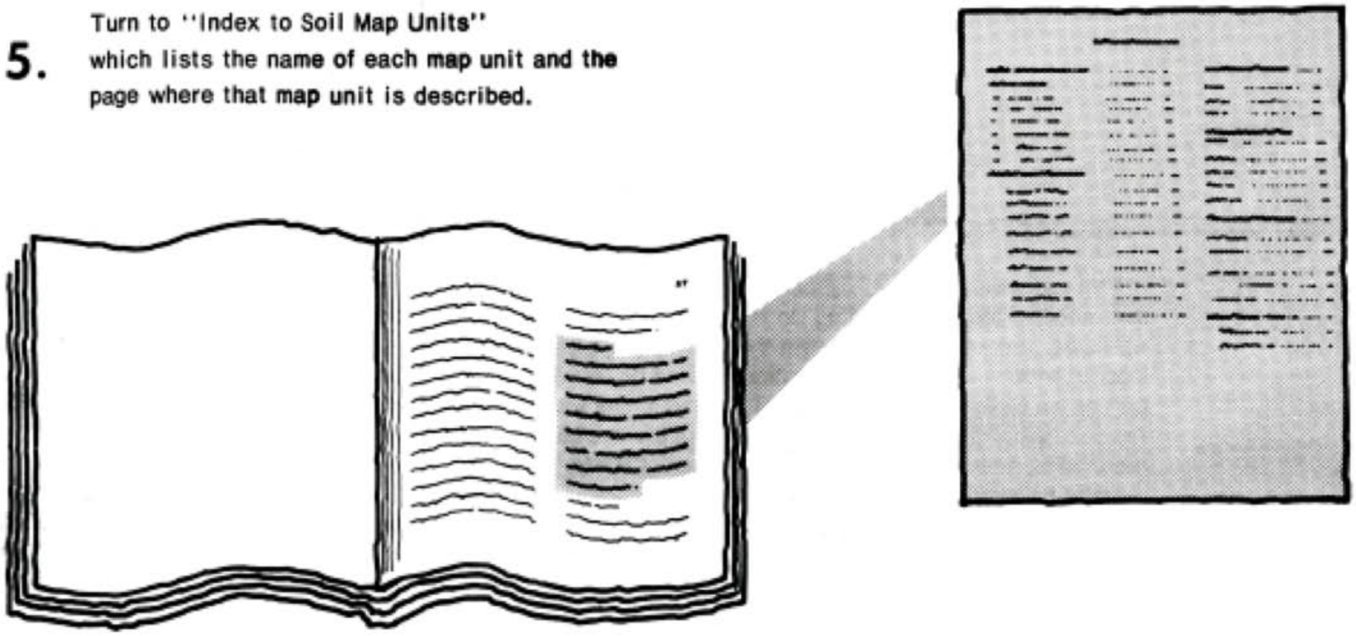


4. List the map unit symbols that are in your area.

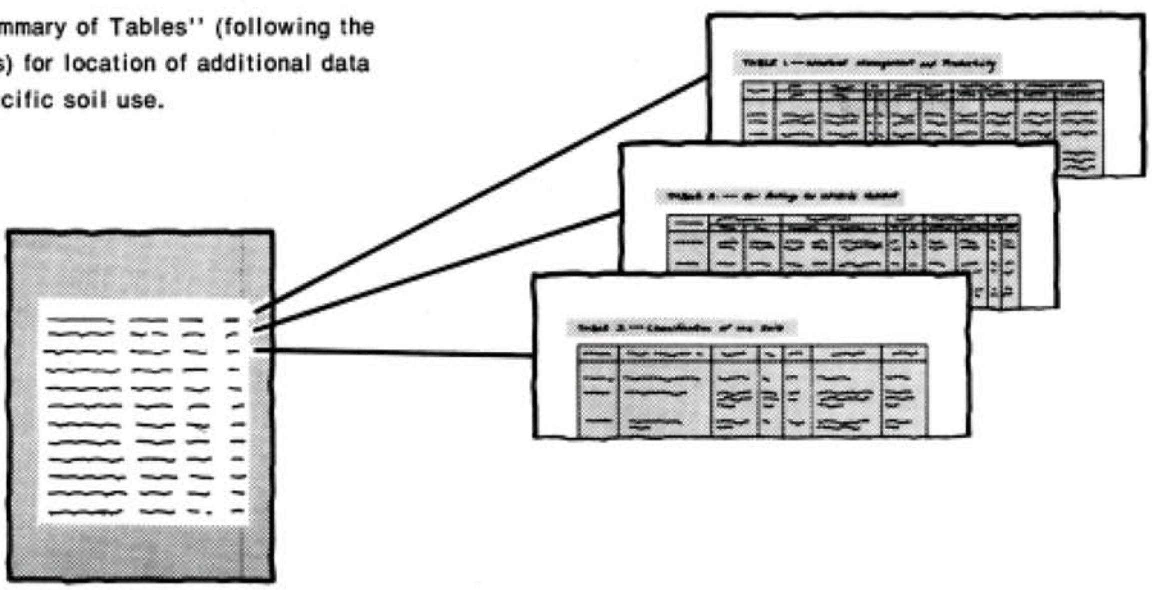


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

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 Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Vilas County Land Conservation Committee and the Lac du Flambeau Band of Lake Superior Chippewa Indians Tribal Council, which helped to finance the fieldwork.

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: An area of Devils Lake. Because of its numerous lakes, Vilas County is a popular vacation area.

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Soil Series

Issued June 1988

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Summary of Tables

Foreword

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

This soil survey is designed for many different users. Foresters, farmers, 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 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 Soil Conservation Service or the Cooperative Extension Service.

Cliffton A. Maguire
State Conservationist
Soil Conservation Service

Soil Survey of Vilas County, Wisconsin

By Larry L. Natzke and David J. Hvizdak, Soil Conservation Service

Fieldwork by Orville L. Haszel, David J. Hvizdak, Everett J. Kissinger, Larry L. Natzke, Steve W. Payne, and Harvey V. Strelow, Soil Conservation Service; Gordon H. Wing, Vilas County Land Conservation Committee; and Edwin W. Neumann, William A. Wertz, and Katherine K. Skrivseth, Forest Service

United States Department of Agriculture, Soil Conservation Service and Forest Service, in cooperation with the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

VILAS COUNTY is along the northern border of Wisconsin (fig. 1). It has a total area of 651,098 acres. Of this total, about 554,777 acres is land and 96,321 acres is water. In 1980, the county had a population of 16,538. The population increased by more than 50 percent from 1970 to 1980. This was the highest increase in the state for that period. Eagle River, the county seat, is the largest town in the county. It had a population of 1,324 in 1980. Recreation and tourism are important industries throughout the county. Lumbering and wood-using industries also are major enterprises.

This soil survey updates a reconnaissance survey published in 1916 (*14*). It provides additional information and larger maps, which show the soils in greater detail.

General Nature of the County

This section gives general information concerning the county. It describes history and development; climate; physiography, relief, and drainage; water supply; and transportation facilities and industry.

History and Development

Very little is known about the early history of the part of Wisconsin now included within the boundaries of Vilas County. The area supported a few Chippewa Indian settlements. The first recorded trading post in the area was established in 1818. The area did not reach the attention of early settlers until the demand for lumber in the mid-1800's. Parcels of land were acquired from the General Land Office for the harvest of timber resources beginning in 1856.

The successful exploitation of the forests was made possible after the advent of railroads in the 1880's. Large sawmills were built at Arbor Vitae, Winegar (Presque Isle), Eagle River, Conover, Phelps, and Winchester. By the early 1920's, most of the choice timber had been cut and the sawmills closed. As a result, some flourishing and then widely known villages all but disappeared. Some land was converted to farmland, and an auxiliary summer resort industry was established.

In 1893, Vilas County was organized from territory formerly part of Oneida County. It was given the name of Vilas in honor of William F. Vilas of Madison, Wisconsin, who was a Lt. Colonel during the Civil War, Postmaster General of the United States from 1885 to 1888, Secretary of the Interior during President Grover A. Cleveland's first administration, and a United States Senator from 1881 to 1897. Several changes were made in the original county boundaries. The present boundaries were not established until 1905.

Farming began in Vilas County after the forests were cleared. Dairying was the most important type of agriculture. The chief crops were hay, oats, potatoes, and corn. Barley, rye, and wheat were grown on smaller acreages. Hay was grown on the largest acreage. Because of the relatively short growing season, farming was never extensive.

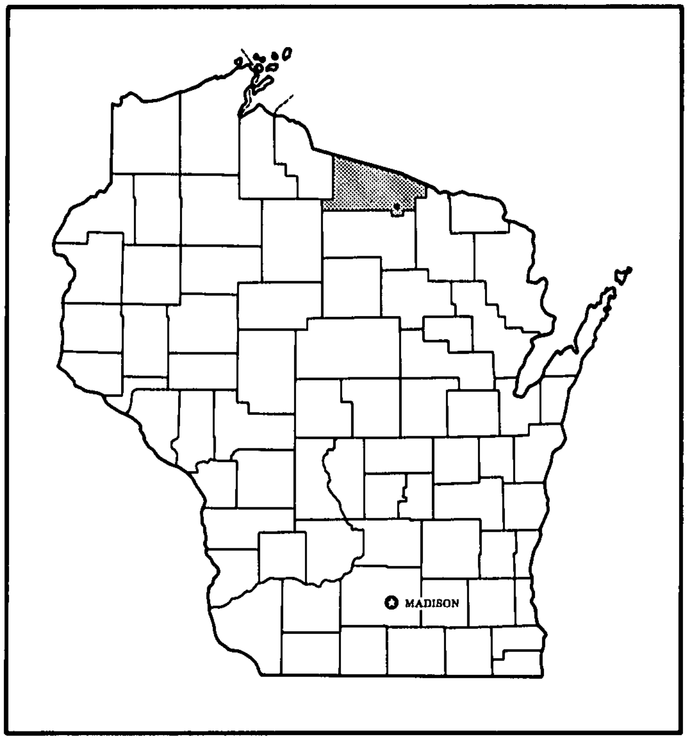

Figure 1.—Location of Vilas County in Wisconsin.

In 1900, the county had 83 farms. From 1900 to 1935, as more settlers arrived, the number of farms increased to a high of 673. In 1935, the acreage of farmland reached a high of 52,279 acres. Only about half of this acreage was cropland. The rest was woodland. Since 1935, the number of farms has declined rapidly. It was 254 in 1950 and 48 in 1982. The acreage of farmland decreased to about 7,500 acres by 1982. Of this total, about 5,000 acres was used for crops or pasture. Hay, potatoes, and oats were the principal crops. The last dairy farm in the county went out of production in 1978.

Currently, agriculture is less important in Vilas County than in any other county in the state. Cash receipts from farm marketing, however, totaled about 3.6 million dollars in 1980. Most of the agricultural income in the county is derived from the sale of cranberries and potatoes. A lesser amount is derived from the sale of beef cattle and of miscellaneous livestock and crops.

In 1983, more than 70 percent of the county was classified as forest land, dominantly commercial forest. About 53 percent of the forest land is owned by units of government. The State of Wisconsin owns almost 26 percent of the forested acreage. This percentage is high because of the expanse of the Northern Highland American Legion State Forest. The Nicolet and Chequamegon National Forests make up about 10.5 percent of the forest land. Land owned by county and municipal governments makes up about 10 percent of the forested acreage, and Indian lands make up about 6.5 percent.

Because of its lakes, streams, wetlands, and woodland, Vilas County is a popular vacation area for residents and out-of-state visitors. Areas near the many lakes and streams are becoming increasingly important as homesites and as recreational areas.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Winters in Vilas County are very cold. Summers are short and fairly warm. A short freeze-free period in summer limits cropping to forage and small grain crops and to adapted vegetables. Precipitation is fairly well distributed throughout the year. It is highest in summer. Snow covers the ground during much of the period from late fall through early spring.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Rest Lake, Wisconsin, in the period 1951 to 1980. 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 13 degrees F, and the average daily minimum temperature is 3 degrees. The lowest temperature on record, which occurred at Rest Lake on January 29, 1951, is -46 degrees. In summer the average temperature is 64 degrees, and the average daily maximum temperature is 75 degrees. The highest recorded temperature, which occurred on July 26, 1955, is 97 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 34 inches. Of this, about 25 inches, or more than 70 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 20 inches. The heaviest 1-day rainfall during the period of record was 5.17 inches at Rest Lake on August 1, 1964. Thunderstorms occur on about 34 days each year.

The average seasonal snowfall is about 85 inches. The greatest snow depth at any one time during the period of record was 43 inches. On the average, 87 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 60 percent of the time possible in summer and 80 percent in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 13 miles per hour, in spring.

Physiography, Relief, and Drainage

Vilas County is in the Northern Highland physiographic region of Wisconsin. This region has some of the highest elevations in the state. Elevations range from about 1,560 feet above sea level in an area along Squaw Creek in the southwest corner of the county to 1,845 feet at Muskellunge Hill. Relief is low.

The county is in the source area of major river systems. Brule, Elvoy, and Kentuck Creeks drain about 10 percent of the county. They drain into the Brule and Menomoniee Rivers, which empty into Lake Michigan. The Wisconsin River and its tributaries drain about 40 percent of the county. The Bear, Manitowish, and Turtle Rivers and Squaw Creek also drain about 40 percent. They drain into the Flambeau River, which empties into the Mississippi River. The Presque Isle River and Tenderfoot Creek drain about 10 percent of the county. They drain northward into Lake Superior.

The secondary drainage system is poorly defined. The county has an abundance of lakes, many of which drain into the river system through shallow, crooked drainageways. Glacial meltwater was unable to establish a system of deeper channels in the hummocky glacial topography. Many lakes have no outlets.

The lakes are of glacial origin. Some formed in broad, deep depressions in the drainage system. Others are in depressions in the glacial drift. The smaller of these are kettles formed at the close of the glacial period by the melting of buried ice blocks.

Swamps and marshes are equally abundant. Some of these are filled lakes, but the larger ones are the result of poor drainage. The largest of these, the Powell marsh, covers about 18 square miles near Manitowish Waters. It includes a large acreage used for cranberries and a waterfowl refuge managed by the Wisconsin Department of Natural Resources. These swamps and marshes are part of the important natural reservoir system, which helps to regulate the flow of the large rivers and helps to keep spring flooding minimal.

Vilas County has a diverse landscape ranging from broad, nearly level glacial outwash plains to rough, broken glacial moraines and areas of pitted outwash. The soils formed mainly in material laid down during or shortly after glaciation. The county has three major areas with distinct physiographic characteristics. An area of drumlins and ground moraines is in the eastern part of the county. Its topography is characterized by low, smoothly rounded, elongated, and oval ridges that are nearly level to moderately steep and are interspersed with long, narrow drainageways.

The Winegar moraine, a major end moraine that is dominantly undulating to steep, extends across the northwestern part of the county. This end moraine is rough and broken. It is characterized by short, steep slopes and ridges and by numerous wet depressions, most of which have no outlets.

Outside of the moraine areas lies an outwash plain. Much of the outwash is pitted, resulting in a rolling or hilly topography with many enclosed basins and depressions. Large sand flats are in scattered areas on this outwash plain. The communities of Eagle River, Manitowish Waters, Conover, St. Germain, and Boulder Junction are on these flats. The sand flats north of Conover, the ones south of Eagle River, and the ones between Manitowish Waters and Lac du Flambeau are characterized by low relief. In some areas, however, these flats are pitted with depressions. Several small end moraines and drumlins also are in scattered areas on the outwash plain.

Water Supply

The many lakes, streams, and rivers in the county furnish an abundant supply of surface water. Ground water is available in quantities adequate to meet present and anticipated future needs for domestic, agricultural, municipal, and industrial uses.

Well water is available at various depths, depending on the general topography, the distance above permanent stream levels, and the character of the underlying aquifer. It is stored in porous strata called aquifers. At certain depths below the surface, all pores and fissures in unconsolidated material, such as sand and gravel, are filled with water. Wells drilled into these layers yield an adequate water supply. The level of ground water rises or falls from season to season and year to year, depending on the amount of rainfall.

Most ground water in Vilas County is obtained from sand and gravel aquifers. These aquifers occur as surficial sand and gravel deposits or as isolated buried deposits in most of the moraine areas.

The surficial sand and gravel deposits are mainly on extensive outwash plains. They are highly permeable and yield large quantities of water to wells. Most high-capacity wells are 40 to 130 feet deep. Well yields range from 50 to 2,000 gallons per minute. High-capacity wells yield 15 to 60 gallons per minute per foot of drawdown (*9*). In some areas where till is intermixed with the sand and gravel, maximum yields are only 500 gallons per minute. Shallow wells in the areas of surficial outwash are subject to pollution.

In the moraine areas in the eastern and northwestern parts of the county, water is obtained mainly from lenses of saturated sand and gravel buried within or below the glacial till. The depth to these lenses ranges from 20 to

200 feet. Well yields generally range from 5 to 50 gallons per minute but may reach as high as 200 gallons per minute where the saturated sand and gravel deposits are thick. The wells in the moraine areas commonly are not subject to pollution.

The ground water in Vilas County is generally of good quality. Local differences in quality are the result of the composition, solubility, and surface of the soil and rock through which the water moves and the length of time that the water is in contact with these materials. The main constituents in the water are calcium, magnesium, and bicarbonate ions (*16*). In some isolated areas, particularly on the moraines, the ground water is hard. A high concentration of iron is a problem throughout the county but is not considered a health hazard.

Vilas County has 96,321 acres of surface water. About 98.6 percent of this acreage occurs as lakes and about 1.4 percent as streams (*4*). The total length of the streams is about 402 miles. The county ranks second in the state in total acreage of surface water and first in total number of lakes. The total number is 1,321.

Most lakes are small. The largest is Trout Lake, which is 3,816 acres in size. It is also the deepest lake. The maximum depth is 115 feet.

The construction of water-control structures on lake outlets and along some rivers has significantly increased the amount of surface water in the county. The structures also help to control flooding. The Eagle Chain of Lakes formed as a result of the construction of a small power dam, the Otter Rapids Dam, at the outlet of Watersmeet Lake, on the Wisconsin River. The dam has a head of 13 feet. The Rest Lake Dam stores water in the Manitowish Chain of Lakes for the Flambeau River system. It has a head of 10 feet and seasonal fluctuations of 1.5 to 3.5 feet, depending on the limits set by the Public Service Commission.

Pollution is a major concern in some lakes as the lakeshores are built up with homes and resorts. The effluent from sewage-disposal facilities can pollute the water and result in excessive growth of undesirable weeds and algae. The problem is intensified in seepage lakes, where there is little water exchange.

Transportation Facilities and Industry

The major north-south highways in Vilas County are U.S. Highway 45 and State Highways 17 and 32, in the eastern part of the county, and U.S. Highway 51, in the western part. State Highway 70 is the main east-west road. Municipal airports serve the communities of Eagle River, Phelps, Land O'Lakes, Manitowish Waters, Boulder Junction, and Minocqua and Woodruff. These airports handle private and charter flights.

The recreation and tourism industry is a major part of the local economy. This industry includes restaurants; taverns; hotels, motels and resorts; trailer parks and campgrounds; sporting goods stores; and amusement and recreation establishments. Fishing, boating, sightseeing, and camping are the main summer activities, and snowmobiling and skiing are popular winter activities.

The timber industry continues to be a significant part of the economy. Most of the cut wood is used for pulp. A smaller portion is used for sawlogs and an even smaller portion for veneer. Major sawmills are near Land O'Lakes and Arbor Vitae.

A few manufacturing plants are throughout the county. A firm that manufactures electrical measuring equipment is the county's biggest employer. Other firms manufacture wood products, building components, concrete products, feathers for archery and darts, and cranberry products. Mineral production is of minor extent. Sand and gravel are the only mineral resources that are mined.

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; and the kinds of crops and native plants growing on the soils. 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 biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the 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 considerable 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, acidity, 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 interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were 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 were 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 state with a fairly high degree of probability 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.

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

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

General Soil Map Units

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

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

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

Soil Descriptions

1. Rubicon-Sayner-Karlin Association

Nearly level to very steep, excessively drained and somewhat excessively drained, sandy soils on uplands

This association consists of soils on glacial outwash plains, stream terraces, kames, eskers, and moraines. The landscape ranges from broad, nearly level plains to pitted outwash plains that have short, uneven slopes, many closed drainageways, and common depressions. Slope ranges from 0 to 35 percent.

This association makes up about 42 percent of the land area of the county. It is about 32 percent Rubicon soils, 25 percent Sayner soils, 11 percent Karlin soils, and 32 percent soils of minor extent (fig. 2).

Rubicon soils are nearly level to very steep and are excessively drained. Permeability is rapid. Available water capacity is low. Typically, about 2 inches of partly decomposed forest litter is at the surface. The surface layer is dark reddish gray sand about 1 inch thick. The subsoil is dark reddish brown, reddish brown, and strong brown sand about 23 inches thick. The substratum to a depth of about 60 inches is strong brown sand.

Sayner soils are nearly level to very steep and are excessively drained. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Available water capacity is low. Typically, about 2 inches of partly decomposed leaf litter is at the surface. The surface layer is dark reddish gray loamy sand about 1 inch thick. The subsoil is about 27 inches thick. It is dark reddish brown and reddish brown loamy sand in the upper part and reddish brown and yellowish red gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel.

Karlin soils are nearly level to moderately steep and are somewhat excessively drained. Permeability is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is low. Typically, the surface layer is very dark gray loamy fine sand about 2 inches thick. The subsurface layer is brown loamy fine sand about 1 inch thick. The subsoil is about 25 inches thick. It is reddish brown and dark brown loamy fine sand in the upper part and brown fine sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown sand.

Some of the soils of minor extent in this association are the Au Gres, Croswell, Dawson, Keweenaw, Kinross, Loxley, Markey, Pence, and Seelyeville soils. The somewhat poorly drained Au Gres, moderately well drained Croswell soils, and poorly drained Kinross soils are sandy throughout. They are in drainageways and depressions and on foot slopes or low lying flats adjacent to streams, wet basins, and lakes. The very poorly drained, organic Dawson, Loxley, Markey, and Seelyeville soils are in depressions, drainageways, and low areas adjacent to lakes and streams. The well drained and moderately well drained Keweenaw soils formed in loamy drift over sandy glacial till. They are on side slopes and low ridges on small moraines. The well drained Pence soils formed in loamy deposits and in the underlying glacial outwash of stratified sand and gravel. They are on flats and side slopes.

Most areas of the major soils are used as woodland. A few areas are used for crops or pasture. These soils are suited to trees. Where irrigated and protected from soil blowing and water erosion, the nearly level and gently sloping areas are suited to some crops. Seedling mortality in areas of the Rubicon soils, and the erosion hazard and equipment limitation on the steeper slopes are the main concerns in managing the soils as woodland. Seedling mortality results from droughtiness. Droughtiness, water erosion, and soil blowing are the main concerns in managing the soils for crops or pasture.

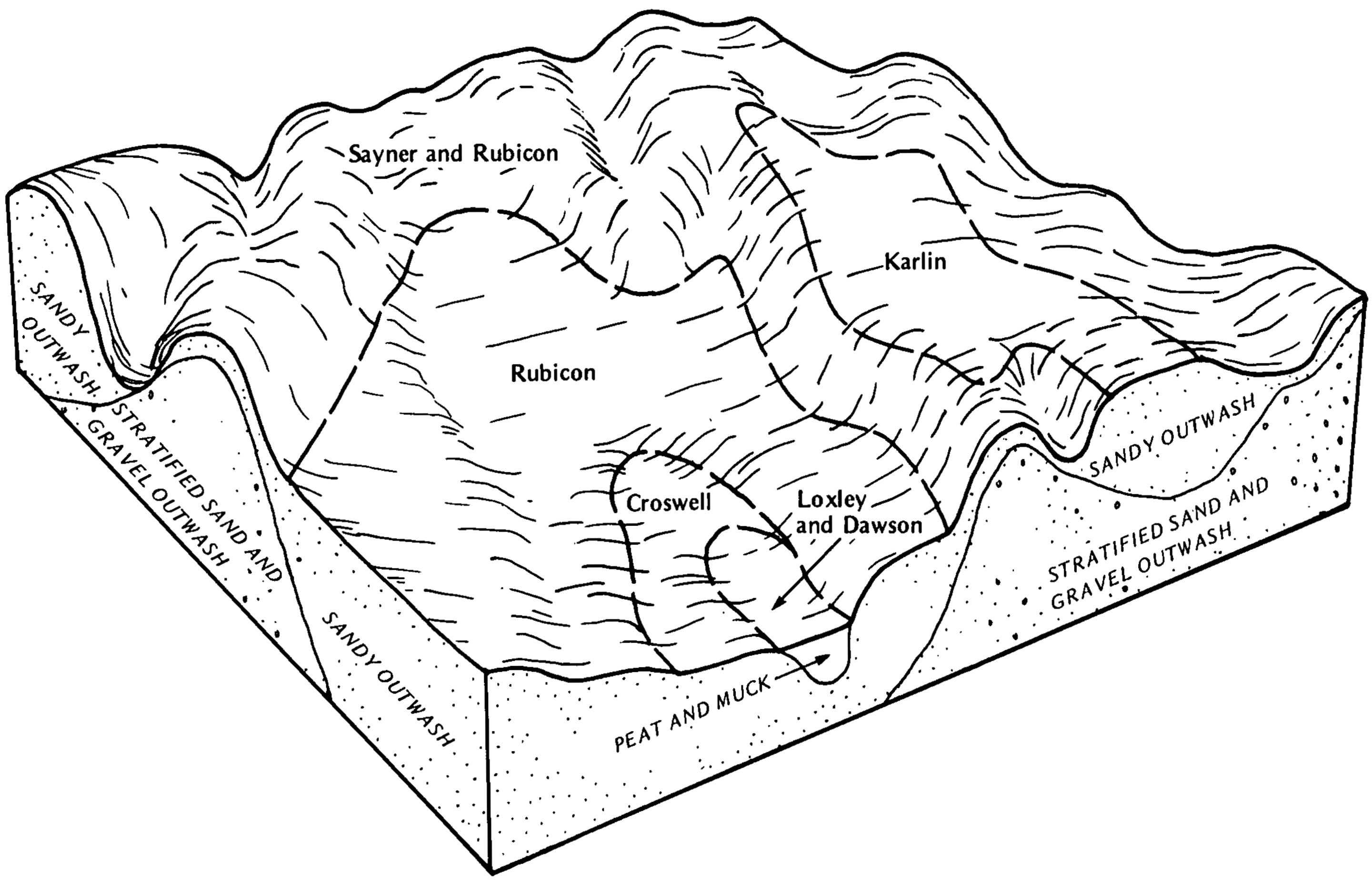

Figure 2.—Pattern of soils and parent material in the Rubicon-Sayner-Karlin association.

The less sloping areas of the major soils are suited to residential development. Septic tank absorption fields function satisfactorily. Because of the rapid or very rapid permeability in the substratum, however, the effluent can pollute ground water.

2. Padus-Pence Association

Nearly level to very steep, well drained, loamy soils on uplands

This association consists of soils on glacial outwash plains, stream terraces, eskers, kames, and moraines. The landscape ranges from broad, nearly level plains to pitted outwash plains that have short, uneven slopes, many closed drainageways, and common depressions. Slope ranges from 0 to 35 percent.

This association makes up about 21 percent of the land area of the county. It is about 34 percent Padus and similar soils, 31 percent Pence and similar soils, and 35 percent soils of minor extent (fig. 3).

Padus soils are moderately permeable in the subsoil and rapidly permeable or very rapidly permeable in the substratum. Available water capacity is moderate. Typically, the surface layer is dark brown fine sandy loam about 1 inch thick. The subsurface layer is reddish gray fine sandy loam about 3 inches thick. The subsoil is about 31 inches thick. It is dark reddish brown and dark brown fine sandy loam in the upper part, brown and reddish brown sandy loam in the next part, and reddish brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel.

Pence soils are moderately rapidly permeable in the subsoil and rapidly permeable or very rapidly permeable in the substratum. Available water capacity is low. Typically, about 2 inches of partly decomposed forest litter is at the surface. The surface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 20 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and reddish brown loamy sand in the lower part. The substratum to a depth of

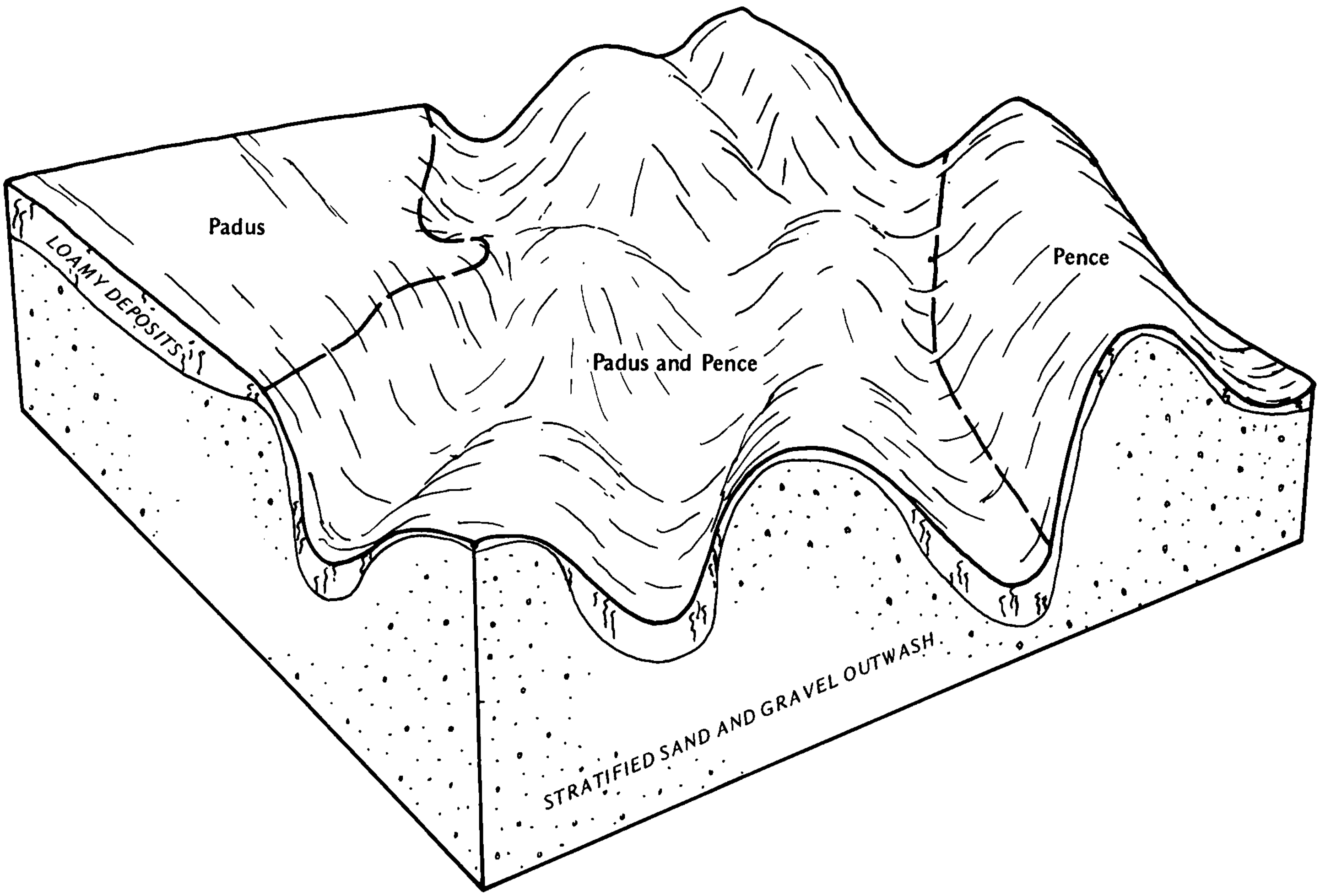

Figure 3.—Pattern of soils and parent material in the Padus-Pence association.

about 60 inches is strong brown, stratified sand and gravel.

Some of the soils of minor extent in this association are the Dawson, Karlin, Keweenaw, Loxley, Manitowish, Markey, Sayner, Seelyeville, and Worcester Variant soils. The very poorly drained, organic Dawson, Loxley, Markey, and Seelyeville soils are in depressions, drainageways, and low areas adjacent to streams and lakes. The somewhat excessively drained Karlin soils are sandy throughout. They are on flats, low ridges and knolls, and gentle side slopes. The moderately well drained and well drained Keweenaw soils formed in loamy drift over sandy glacial till. They are on side slopes on small moraines. The moderately well drained Manitowish soils and the somewhat poorly drained Worcester Variant soils are on low lying flats adjacent to streams, wet basins, and lakes. The excessively drained Sayner soils formed in glacial outwash of stratified sand and gravel. They are on convex ridgetops.

Most areas of the major soils are used as woodland. A few areas are used for crops or pasture. These soils are suited to trees. The less sloping areas of the Padus soils are suitable as cropland, and the Pence soils are moderately suited. The erosion hazard and equipment limitation on the steeper slopes are the main concerns in managing the soils as woodland. Droughtiness in the Pence soils and the erosion hazard are the main concerns in managing the soils for crops or pasture.

The less sloping areas of the major soils are suited to residential development. Septic tank absorption fields function satisfactorily. Because of the rapid or very rapid permeability in the substratum, however, the effluent can pollute ground water.

3. Gogebic-Pence-Fence Association

Nearly level to steep, moderately well drained and well drained, loamy and silty soils on uplands

This association is on a glacial end moraine. Slopes are short and uneven, and small wet areas and depressions are common. The landscape is hummocky throughout the association, probably because of the melting of buried glacial ice and the subsequent collapse of the overlying soil material. The collapse and subsequent mixing of this soil material resulted in a complex pattern of soils throughout most of the association. Slope ranges from 0 to 30 percent.

This association makes up about 14 percent of the land area of the county. It is about 37 percent Gogebic soils, 20 percent Pence soils, 13 percent Fence and similar soils, and 30 percent soils of minor extent.

Gogebic soils are nearly level to steep and are moderately well drained and well drained. Permeability is slow in firm, dense subsoil layers and moderate in the substratum. Available water capacity is low. Typically, the surface layer is dark brown fine sandy loam about 3 inches thick. The subsoil is about 54 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part; reddish gray and reddish brown, mottled, firm, dense fine sandy loam in the next part; and reddish brown loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam.

Pence soils are nearly level to steep and are well drained. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Available water capacity is low. Typically, about 2 inches of partly decomposed forest litter is at the surface. The surface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 20 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and reddish brown loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel.

Fence soils are nearly level to moderately steep and are well drained and moderately well drained. Permeability is moderately slow. Available water capacity is high. Typically, the surface layer is dark reddish brown silt loam about 4 inches thick. The subsoil is reddish brown silt loam about 39 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is reddish brown, stratified silt and very fine sand.

Some of the soils of minor extent in this association are the Alcona, Dawson, Gaastra, Loxley, Markey, Sayner, and Seelyeville soils. The well drained Alcona soils formed in stratified, loamy and sandy lacustrine deposits in drainageways and on concave slopes. The very poorly drained, organic Dawson, Loxley, Markey, and Seelyeville soils are in depressions, drainageways, and low areas adjacent to streams and lakes. The somewhat poorly drained Gaastra soils formed in stratified, silty and loamy lacustrine deposits in depressions and drainageways. The excessively drained Sayner soils formed in glacial outwash of stratified sand and gravel. They are on ridgetops.

The major soils in this association are used as woodland. They are suited to trees. The erosion hazard and equipment limitation on the steeper slopes are concerns in managing the soils as woodland. The windthrow of trees, which results from a shallow rooting depth, also is a management concern in areas of the Gogebic soils.

The less sloping areas of the Gogebic and Fence soils are poorly suited to residential development because of the seasonal high water table. The less sloping areas of the Pence soils are suited to this use. Septic tank absorption fields function satisfactorily in the Pence soils. Because of the rapid or very rapid permeability in the substratum, however, the effluent can pollute ground water.

4. Champion Association

Nearly level to moderately steep, moderately well drained, silty soils on uplands

This association consists of soils on prominent drumlins and glacial moraines. The drumlins are oriented from northeast to southwest. They commonly have sharp crests and gentle slopes. Many of the tops are nearly level, and some are quite broad. The moraines are irregularly shaped ridges and knolls. Slope ranges from 1 to 20 percent.

This association makes up about 8 percent of the land area of the county. It is about 75 percent Champion soils and 25 percent soils of minor extent (fig. 4).

Champion soils are slowly permeable in firm, dense subsoil layers and moderately permeable or moderately rapidly permeable in the substratum. Available water capacity is low. Typically, the surface layer is very dark grayish brown silt loam about 2 inches thick. The subsurface layer is reddish gray silt loam about 3 inches thick. The subsoil is about 40 inches thick. It is reddish brown silt loam in the upper part; reddish gray, mottled, firm, dense loamy sand and reddish brown, mottled, firm, dense sandy loam in the next part; and brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly loamy sand.

Some of the soils of minor extent in this association are the Cable, Dawson, Loxley, Markey, Monico, Padus, and Seelyeville soils. The poorly drained Cable and somewhat poorly drained Monico soils are in depressions and narrow drainageways. The very poorly drained, organic Dawson, Loxley, Markey, and Seelyeville soils are in drainageways and low areas adjacent to streams and lakes. The well drained Padus soils formed in loamy deposits and in the underlying outwash of sand and gravel. They are on side slopes.

Most areas of the Champion soils are used as woodland. Some are used for crops or pasture. These soils are suited to trees. The less sloping areas are suitable as cropland if water erosion is controlled. The windthrow of trees, which results from a shallow rooting

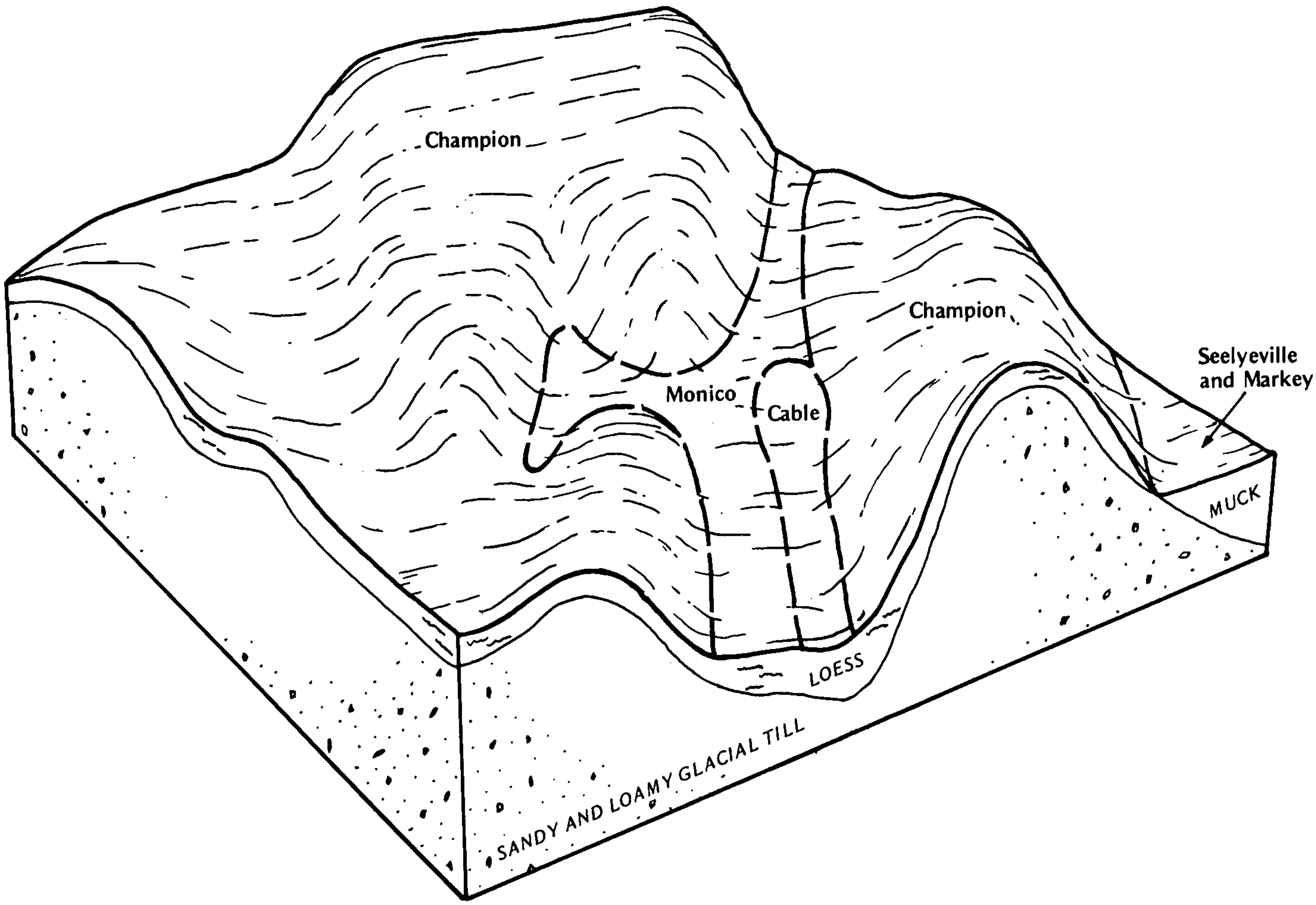

Figure 4.—Pattern of soils and parent material in the Champion association.

depth, is a concern in managing the soils as woodland. The erosion hazard and equipment limitation on the steeper slopes also are management concerns. Water erosion is the main hazard in the areas used for crops or pasture.

The Champion soils are poorly suited to residential development because of the seasonal high water table.

5. Loxley-Dawson Association

Nearly level, very poorly drained, organic soils in depressions and on low lying flats

This association consists of soils in depressional areas of glacial lake basins and in low areas adjacent to lakes and streams. Slope is 0 to 1 percent.

This association makes up about 2 percent of the land area of the county. It is about 50 percent Loxley soils, 35 percent Dawson soils, and 15 percent soils of minor extent.

Loxley soils are moderately rapidly permeable. Available water capacity is very high. Typically, the surface layer is brown peat about 12 inches thick. Below this to a depth of about 60 inches is dark brown and dark reddish brown muck.

Dawson soils are moderately rapidly permeable in the organic layer and rapidly permeable in the sandy substratum. Available water capacity is very high. Typically, the surface layer is dark reddish brown peat about 11 inches thick. Below this to a depth of about 35 inches is very dark gray muck. The substratum to a depth of about 60 inches is dark grayish brown sand.

Some of the soils of minor extent in this association are the Au Gres, Croswell, Kinross, Markey, Rubicon, and Seelyeville soils. The somewhat poorly drained Au Gres, moderately well drained Croswell, and poorly drained Kinross soils are on the slightly higher flats. The very poorly drained, organic Markey and Seelyeville soils are on low flats and in drainageways and depressions. The excessively drained Rubicon soils are on ridges. They are sandy throughout.

Most areas of the major soils are used as wetland wildlife habitat. One area is used for the commercial production of cranberries. These soils are generally unsuited to trees and to residential development. The trees that grow on these soils are not of merchantable size and quality.

6. Keweenaw-Karlin Association

Nearly level to steep, moderately well drained to somewhat excessively drained, loamy and sandy soils on uplands

This association consists of soils on drumlins, water-worked glacial moraines, and outwash plains. The moraines occur as broad flats and as irregularly shaped ridges and knolls. The drumlins are oriented from northeast to southwest. They commonly are less than 1 mile long and are narrow. Elevation ranges from only a few feet to more than 100 feet. Slope ranges from 0 to 30 percent.

This association makes up about 5 percent of the land area of the county. It is about 50 percent Keweenaw soils, 20 percent Karlin soils, and 30 percent soils of minor extent.

Keweenaw soils are nearly level to steep and are moderately well drained and well drained. Permeability is moderate or moderately rapid. Available water capacity is low. Typically, the surface layer is dark brown sandy loam about 2 inches thick. The subsurface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 39 inches thick. It is reddish brown. It is sandy loam in the upper part; firm, mottled gravelly loamy sand in the next part; and gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly loamy sand.

Karlin soils are nearly level to moderately steep and are somewhat excessively drained. Permeability is moderately rapid in the subsoil and rapid in the substratum. Available water capacity is low. Typically, the surface layer is very dark gray loamy fine sand about 2 inches thick. The subsurface layer is brown loamy fine sand about 1 inch thick. The subsoil is about 25 inches thick. It is reddish brown and dark brown loamy fine sand in the upper part and brown fine sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown sand.

Some of the soils of minor extent in this association are the Croswell, Dawson, Loxley, Markey, Pence, Rubicon, Sayner, and Seelyeville soils. The moderately well drained Croswell soils formed in sandy deposits in drainageways and depressions. The very poorly drained, organic Dawson, Loxley, Markey, and Seelyeville soils are in drainageways, depressions, and low areas adjacent to streams and lakes. Pence and Sayner soils are on side slopes. The well drained Pence soils formed in loamy deposits and in the underlying stratified sand and gravel. The excessively drained Sayner soils formed in glacial outwash of stratified sand and gravel. The excessively drained Rubicon soils formed in sandy deposits on flats and side slopes.

Most areas of the major soils are used as woodland. A few areas are used for crops and pasture. These soils are suited to trees. Where irrigated and protected from soil blowing and water erosion, the nearly level and gently sloping areas are suited to some crops. The erosion hazard and equipment limitation on the steeper slopes are the main concerns in managing the soils as woodland.

Nearly level and gently sloping areas of the Keweenaw soils are poorly suited to residential development because of the seasonal high water table. The more sloping areas where these soils are well drained are moderately suited to this use. The less sloping areas of the Karlin soils are suited to residential development. Septic tank absorption fields function satisfactorily in the Karlin soils. Because of the rapid permeability in the substratum, however, the effluent can pollute ground water.

7. Croswell-Dawson-Au Gres Association

Nearly level and gently sloping, moderately well drained, very poorly drained, and somewhat poorly drained, sandy and peaty soils on flats and in upland drainageways and depressions

This association consists of soils on low lying flats and foot slopes and in depressions and drainageways on outwash plains and glacial lake plains. Slope ranges from 0 to 3 percent.

This association makes up about 8 percent of the land area of the county. It is about 30 percent Croswell soils, 25 percent Dawson and similar soils, 10 percent Au Gres soils, and 35 percent soils of minor extent.

Croswell soils are nearly level and gently sloping and are moderately well drained. Permeability is rapid. Available water capacity is low. Typically, about 2 inches of partly decomposed leaf litter is at the surface. The surface layer is brown sand about 4 inches thick. The subsoil is sand about 21 inches thick. It is dark reddish brown and reddish brown in the upper part and yellowish red in the lower part. The substratum to a depth of about 60 inches is reddish brown sand. It is mottled below a depth of about 31 inches.

Dawson soils are nearly level and are very poorly drained. Permeability is moderately rapid in the organic layers and rapid in the substratum. Available water capacity is very high. Typically, the surface layer is dark reddish brown peat about 11 inches thick. Below this to a depth of about 35 inches is very dark gray muck. The substratum to a depth of about 60 inches is dark grayish brown sand.

Au Gres soils are nearly level and are somewhat poorly drained. Permeability is rapid. Available water capacity is low. Typically, about 2 inches of partly decomposed forest litter is at the surface. The surface layer is brown sand about 4 inches thick. The subsoil is about 28 inches thick. It is mostly dark reddish brown and reddish brown, mottled sand. The substratum to a depth of about 60 inches is reddish brown, mottled sand.

Some of the soils of minor extent in this association are the Croswell soils that have a loamy substratum and the Kinross, Loxley, Manitowish, Markey, Rubicon, and Seelyeville soils. The moderately well drained Croswell and Manitowish soils are on flats. Croswell soils are underlain by loamy and silty deposits. The poorly drained Kinross soils are in depressions and drainageways. The very poorly drained, organic Loxley, Markey, and Seelyeville soils are in depressions and on low lying flats adjacent to lakes and streams. The excessively drained Rubicon soils are on the higher flats and side slopes.

Most areas of the Croswell and Au Gres soils are used as woodland. A few areas of the Croswell soils are used for crops or pasture. Most areas of the Dawson soils support native wetland vegetation. The Croswell and Au Gres soils are suited to trees, but the Dawson soils are generally unsuited. Where irrigated and protected from soil blowing, the Croswell soils are suited to some crops. Seedling mortality, which results from droughtiness, is the main concern in managing the Croswell soils as woodland. The equipment limitation and the windthrow hazard are the main concerns in areas of the Au Gres soils. Droughtiness and soil blowing are the main concerns in managing the Croswell soils for crops or pasture.

The Croswell and Au Gres soils are poorly suited and the Dawson soils generally unsuited to residential development. The seasonal high water table is the main limitation.

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 "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 substratum, 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 substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Rubicon sand, 0 to 6 percent slopes, is a phase in the Rubicon series.

Some map units are made up of two or more major soils. These map units are called soil complexes 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. Padus-Pence complex, 6 to 15 percent slopes, 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. Seelyeville and Markey mucks, 0 to 1 percent slopes, 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.

Soil Descriptions

Au—Au Gres sand, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is in drainageways, in depressions, and on low flats adjacent to wet basins and lakes. In many areas the surface is uneven because trees have been windthrown. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 400 acres in size.

Typically, about 2 inches of partially decomposed forest litter is at the surface. The surface layer is brown sand about 4 inches thick. The subsoil is about 28 inches thick. It is dominantly dark reddish brown and reddish brown, mottled sand. The substratum to a depth of about 60 inches is reddish brown, mottled sand. In places the surface layer is loamy sand or loamy fine sand. In some areas the substratum is gravelly sand. In other areas it has strata of loamy or silty deposits more than 2 feet thick.

Included with this soil in mapping are small areas of Croswell and Kinross soils. The moderately well drained Croswell soils are slightly higher on the landscape than the Au Gres soil. The poorly drained Kinross soils are in the slightly lower landscape positions. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Au Gres soil. The available water capacity is low. A seasonal high water table is at a depth of 1 to 2 feet.

Most areas of this soil are used as woodland. A few small areas are used as cropland or pasture.

This soil is suited to trees. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table. The soil is easily rutted by wheeled vehicles during these periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means may be needed to control plant competition.

This soil generally is unsuited to septic tank absorption fields because of the wetness and the rapid permeability. In some areas the effluent can be pumped to an absorption field established on higher lying, better suited soils.

Because of the wetness, this soil is poorly suited to dwellings. Constructing dwellings without basements on fill material, which raises the level of the site, and constructing basements above the level of wetness help to overcome this limitation. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the wetness and the potential for frost action, this soil is only moderately suited to local roads and streets. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by installing a good surface and subsurface drainage system, which lowers the seasonal high water table.

The land capability classification is IVw. The woodland ordination symbol is 6W. The habitat type is TMC (Vaccinium phase).

CaA—Cable silt loam, 0 to 3 percent slopes. This nearly level and gently sloping, poorly drained soil is in depressions and narrow drainageways. It is subject to ponding. Individual areas are long and narrow or oblong and range from about 5 to 40 acres in size.

Typically, about 2 inches of partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown silt loam about 5 inches thick. The subsurface layer is dark brown, mottled silt loam about 3 inches thick. The subsoil is about 30 inches thick. It is brown, mottled silt loam in the upper part; reddish gray, mottled fine sandy loam in the next part; and brown, mottled sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, mottled sandy loam. In some places the surface layer is mucky silt loam or fine sandy loam. In other places the substratum is loamy sand or gravelly loamy sand.

Included with this soil in mapping are small areas of Markey and Monico soils. The very poorly drained Markey soils are in positions on the landscape similar to those of Cable soil. They are muck to a depth of 16 to 51 inches and are underlain by sandy deposits. The somewhat poorly drained Monico soils are in the slightly higher areas. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Cable soil. The available water capacity is high. A seasonal high water table is near or above the surface.

Most areas of this soil are used as woodland. A few small areas are used as cropland or pasture.

This soil is suited to trees. The major concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The soil is usually wet from fall to spring. Ruts form easily when wheeled skidders are used during the wet periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Access by machinery is limited to dry summer months or winter months when the snow cover is adequate. On sites for all-weather logging roads, a gravel base is needed. Also, culverts are needed to maintain the natural drainage system. Wetness and low strength are severe limitations on landing sites. The better suited adjacent soils may be needed as sites for landings. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Trees generally are not planted on this soil because of the excessive wetness.

Because of the ponding, this soil generally is unsuited to septic tank absorption fields and dwellings. Overcoming this hazard is difficult. A better site should be selected.

This soil is poorly suited to local roads and streets because of the ponding and the potential for frost action. Surface water can be removed through suitable outlets by culverts and ditches. Additions of fill material can raise the roads above the ponding level. Installing culverts helps to prevent road damage by equalizing the water level on both sides of the road. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is VIw. The woodland ordination symbol is 2W. The primary habitat type is FI, and the secondary habitat type is TTS.

ChB—Champion silt loam, 1 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is in convex areas on the top and foot slopes of drumlins and upland ridges. Individual areas are elongated or irregularly shaped. Most range from about 10 to 320 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 2 inches thick. The subsurface layer is reddish gray silt loam about 3 inches thick. The subsoil is about 40 inches thick. It is reddish brown silt loam in the upper part; reddish gray, mottled, firm, dense loamy sand and reddish brown, mottled, firm, dense sandy loam in the next part; and brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the surface layer is loam. In other places the substratum is loamy sand.

Included with this soil in mapping are small areas of Monico and Padus soils. The somewhat poorly drained Monico soils are in shallow depressions and drainageways. The well drained Padus soils are along the edges of moraines, in landscape positions similar to those of the Champion soil. They do not have firm, dense layers in the subsoil and are underlain by sand and gravel outwash. Also included are some areas of Champion soils that do not have the firm, dense layers in the subsoil or that have a slope of more than 6 percent. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the firm, dense layers in the subsoil of the Champion soil and moderate or moderately rapid in the substratum. The available water capacity is low. A seasonal high water table is at a depth of 1 to 2 feet.

Many areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to native woodland.

This soil is suited to trees. Northern hardwoods are dominant in the stands. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the perched seasonal high water table and low strength. The soil is easily rutted if wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. Unsurfaced roads tend to be slippery, and ruts form easily when the soil is wet. On sites for all-weather logging roads, a gravel base is needed. Landings can better withstand the repeated use of heavy equipment if they are stabilized with gravel. A shallow rooting depth, which is caused by the firm, dense layers in the subsoil, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Undesirable plants that invade clearcut areas may delay or prevent the establishment of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading hardwoods may be needed. Selective cutting can increase or maintain the extent of the preferred species in the stand.

Because of the wetness and the slow permeability, this soil is poorly suited to septic tank absorption fields. These limitations can be overcome by constructing a mound of suitable filtering material.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by adding fill material, which raises the site; by constructing basements above the level of wetness; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. Interceptor tile is needed in some areas to carry off the seepage from the higher adjacent slopes.

This soil is only moderately suited to local roads and streets because of the wetness and the potential for frost action (fig. 5). The wetness can be overcome by installing a good surface and subsurface drainage system, which lowers the water table, or by adding fill material, which raises the roadbed above the level of wetness. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is IIe. The woodland ordination symbol is 3W. The primary habitat type is AVO, and the secondary habitat type is ATD.

ChC—Champion silt loam, 6 to 20 percent slopes. This sloping and moderately steep, moderately well drained soil is on the crests and sides of drumlins and on knolls and ridges. Individual areas are elongated or irregularly shaped. Most range from about 10 to 320 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 2 inches thick. The subsurface layer is dark reddish gray silt loam about 2 inches thick. The subsoil is about 40 inches thick. It is reddish brown and dark brown silt loam in the upper part; brown and dark brown, mottled, firm, dense sandy loam in the next part; and brown loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly loamy

Figure 5.—Blacktop road in an area of Champion silt loam, 1 to 6 percent slopes. This soil has a moderate potential for frost action, which can result in road damage during periods of spring thaw.

sand. In some places the surface layer is loam. In other places the substratum is loamy sand.

Included with this soil in mapping are small areas of Monico and Padus soils. The somewhat poorly drained Monico soils are in shallow depressions and narrow drainageways. The well drained Padus soils are along the edges of moraines, in landscape positions similar to those of the Champion soil. They do not have firm, dense layers in the subsoil and are underlain by sand and gravel outwash. Also included are some areas of Champion soils that do not have the firm, dense layers in the subsoil or that have a slope of more than 20 or less than 6 percent. The areas where the slope is less than 6 percent are on foot slopes and the top of drumlins and broad ridges. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the firm, dense layers in the subsoil of the Champion soil and moderate or moderately rapid in the substratum. The available water capacity is low. A seasonal high water table is at a depth of 1 to 2 feet.

Many areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to native woodland.

This soil is suited to trees. Northern hardwoods are dominant in the stands. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the perched seasonal high water table and low strength. The degree of saturation generally is higher on the lower parts of the slopes. Small flats or benches on the lower slopes remain wet for longer periods than the more sloping areas. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. On sites for all-weather logging roads, a gravel base is needed. A shallow rooting depth, which is caused by the firm, dense layers in the subsoil, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

The slope is a limitation on sites for logging roads and landings. The roads can be designed so that they conform to the topography. The gradient should be kept as low as possible. Landings can be established on the nearly level or gently sloping included or adjacent soils.

Undesirable plants that invade clearcut areas may delay or prevent the establishment of desirable tree species. Special harvest methods may be needed to control the competing vegetation. If trees are planted, site preparation by mechanical or chemical means is needed to control plant competition. Subsequent control of invading hardwoods may be needed. Selective cutting can increase or maintain the extent of the preferred species in the stand.

This soil is poorly suited to septic tank absorption fields because of the wetness and the slow permeability. Overcoming these limitations is especially difficult in the steeper areas. In the less sloping areas, the limitations can be overcome by constructing a mound of suitable filtering material.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing basements above the level of wetness; by adding fill material, which raises the site; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. Interceptor tile is needed in some areas to carry off the seepage from the higher adjacent slopes. In the steeper areas cutting and filling are needed.

This soil is only moderately suited to local roads and streets because of the wetness, the slope, and the potential for frost action. The wetness can be overcome by installing a good surface and subsurface drainage system, which lowers the water table, or by adding fill material, which raises the roadbed above the level of wetness. The slope can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is IIIe. The woodland ordination symbol is 3W. The primary habitat type is AVO, and the secondary habitat type is ATD.

CrA—Croswell sand, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is in depressions and drainageways and on low flats and foot slopes. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 1,200 acres in size.

Typically, about 2 inches of partially decomposed leaf litter is at the surface. The surface layer is brown sand about 4 inches thick. The subsoil is sand about 21 inches thick. It is dark reddish brown and reddish brown in the upper part and yellowish red in the lower part. The substratum to a depth of about 60 inches is reddish brown sand that is mottled below a depth of about 31 inches. In places the substratum is gravelly sand.

Included with this soil in mapping are small areas of Au Gres and Rubicon soils and the Croswell soils that have a loamy substratum. The somewhat poorly drained Au Gres soils are in shallow depressions and drainageways. The Croswell soils that have a loamy substratum are in positions on the landscape similar to those of this Croswell soil. They have strata of silty and loamy material at a depth of 40 to 60 inches. The strata are more than 2 feet thick. The excessively drained Rubicon soils are higher on the landscape than the Croswell soil. Also included are some areas where the soil is fine sand throughout and some areas where the surface layer and subsoil are loamy sand. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in this Croswell soil. The available water capacity is low. A seasonal high water table is at a depth of 2 to 4 feet.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Many areas have been planted to pine.

This soil is suited to trees. The major concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before the trees are planted, site preparation by mechanical or chemical means may be needed to control plant competition.

This soil is poorly suited to septic tank absorption fields because of the wetness and the rapid permeability. These limitations can be overcome by constructing a mound of suitable filtering material. In some areas the effluent can be pumped to an absorption field established on higher lying, better suited soils.

Because of the wetness, this soil is poorly suited to dwellings with basements and is only moderately suited to dwellings without basements. This limitation can be overcome by constructing basements above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the wetness, this soil is only moderately suited to local roads and streets. This limitation can be overcome by adding fill material, which raises the roadbed above the level of wetness, and by installing a good surface and subsurface drainage system.

The land capability classification is IVs. The woodland ordination symbol is 8S. The primary habitat type is AQVac, and the secondary habitat type is QAE.

CsA—Croswell sand, loamy substratum, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is on flats and concave slopes. Individual areas are irregular in shape. Most range from about 10 to 200 acres in size.

Typically, the surface layer is brown sand about 3 inches thick. The subsoil is sand about 24 inches thick. It is dark brown and strong brown in the upper part and reddish yellow in the lower part. The upper part of the substratum is brownish yellow, mottled sand. The lower part to a depth of about 60 inches is brown, mottled, stratified fine sandy loam and silt loam.

Included with this soil in mapping are small areas of Au Gres and Rubicon soils and the Croswell soils that do not have a loamy substratum. None of the included soils have loamy or silty strata at a depth of 40 to 60 inches. The somewhat poorly drained Au Gres soils are in shallow depressions. The Croswell soils that do not have a loamy substratum are in positions on the landscape similar to those of this Croswell soil. The excessively drained Rubicon soils are higher on the landscape than the Croswell soil. Also included are some areas where the surface layer and subsoil are loamy sand. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the sandy upper part of this Croswell soil and moderately slow in the underlying loamy and silty deposits. The available water capacity is moderate. A seasonal high water table is at a depth of 2.5 to 5.0 feet.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland.

This soil is suited to trees. The major concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before the trees are planted, site preparation by mechanical or chemical means generally is needed to control plant competition.

Because of the wetness, the rapid permeability in the subsoil, and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. These limitations can be overcome by constructing a mound of suitable filtering material. In some areas the effluent can be pumped to an absorption field established on higher lying, better suited soils.

This soil is suited to dwellings without basements and to local roads and streets. It is only moderately suited to dwellings with basements because of the seasonal high water table. This limitation can be overcome by constructing the basement above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

The land capability classification is IVs. The woodland ordination symbol is 8S. The habitat type is AQVac.

FeB—Fence-Alcona complex, 0 to 6 percent slopes. These nearly level and gently sloping soils are on flats and concave slopes. The Fence soil is moderately well drained, and the Alcona soil is well drained. Individual areas are irregular in shape and generally range from about 5 to 60 acres in size. They are 50 to 75 percent Fence soil and 20 to 40 percent Alcona soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Fence soil has a surface layer of dark reddish brown silt loam about 4 inches thick. The subsoil is reddish brown silt loam about 39 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is reddish brown silt loam that has strata of very fine sand. In places loamy glacial till is at a depth of 40 to 60 inches.

Typically, the Alcona soil has a surface layer of dark reddish brown fine sandy loam about 3 inches thick. The subsurface layer is reddish gray fine sandy loam about 2 inches thick. The subsoil is about 31 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part; yellowish red, reddish brown, and dark reddish gray loamy fine sand in the next part; and dark reddish brown sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish red and reddish brown, stratified silt loam, very fine sandy loam, and fine sand (fig. 6). In places the surface layer and the upper part of the subsoil are loamy fine sand.

Included with these soils in mapping are small areas of Gaastra and Karlin soils. The somewhat poorly drained

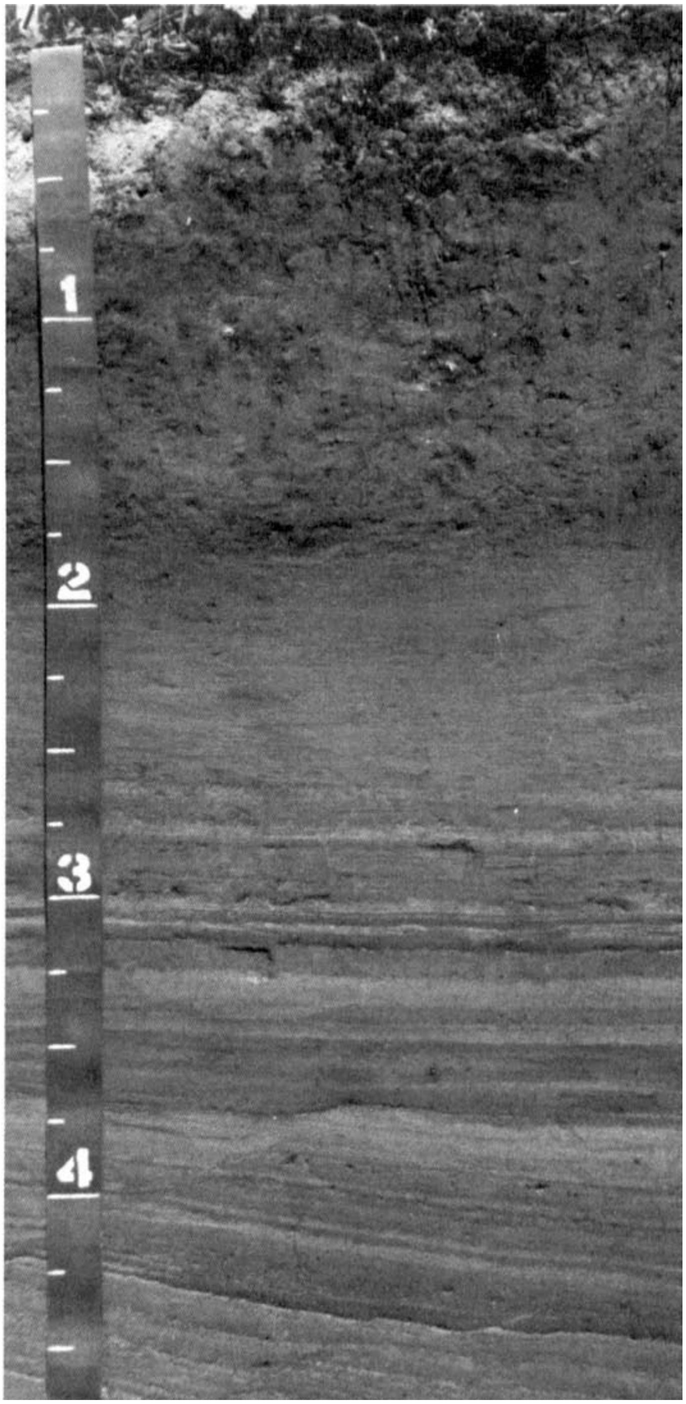

Figure 6.—Typical profile of Alcona fine sandy loam, which formed in stratified, loamy and sandy lacustrine deposits. Depth is marked in feet.

Gaastra soils are in depressions and drainageways. They contain more sand in the subsoil than the Fence soil. The somewhat excessively drained Karlin soils are on convex slopes. They formed in sandy deposits. Also included are areas where the Alcona soil is moderately well drained. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Fence soil. It is moderately rapid in the subsoil of the Alcona soil and moderate in the substratum. The available water capacity is high in the Fence soil and moderate in the Alcona soil. The Fence soil has a seasonal high water table at a depth of 2 to 6 feet.

Most areas of these soils are used as woodland. A few small areas are used as cropland or pasture.

These soils are suited to trees. The major concern in managing woodland is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or have an adequate snow cover. Unsurfaced roads on the Fence soil are slippery and easily rutted during wet periods. On sites for year-round roads, a gravel base is needed. If stabilized, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited Alcona soil.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

The Alcona soil is suited to septic tank absorption fields, but the Fence soil is poorly suited because of the wetness and the moderately slow permeability. These limitations can be overcome by constructing a mound of suitable filtering material.

The Alcona soil is suited to dwellings. Because of the wetness, however, the Fence soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements. This limitation can be overcome by constructing basements above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

The Fence soil is poorly suited and the Alcona soil only moderately suited to local roads and streets because of the potential for frost action. This limitation can be overcome by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by installing a good surface and subsurface drainage system.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is TM.

FeC—Fence-Alcona complex, 6 to 15 percent slopes. These sloping and moderately steep, well drained soils are on side slopes. Individual areas are irregular in shape and generally range from about 5 to 60 acres in size. They are 40 to 60 percent Fence soil and 30 to 45 percent Alcona soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Fence soil has a surface layer of black silt loam about 1 inch thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is silt loam about 25 inches thick. It is dark brown and brown in the upper part, light reddish brown in the next part, and reddish brown and light reddish brown in the lower part. The substratum to a depth of about 60 inches is reddish brown, stratified silt loam and very fine sandy loam. In places loamy glacial till is at a depth of 40 to 60 inches.

Typically, the Alcona soil has a surface layer of dark reddish brown fine sandy loam about 2 inches thick. The subsurface layer is pinkish gray fine sandy loam about 2 inches thick. The subsoil is about 29 inches thick. It is reddish brown fine sandy loam and sandy loam in the upper part and reddish gray loamy fine sand and dark brown fine sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified loamy fine sand and fine sand. In places the surface layer and the upper part of the subsoil are loamy fine sand.

Included with these soils in mapping are small areas of the somewhat excessively drained Karlin soils. These included soils are in positions on the landscape similar to those of the Alcona and Fence soils. They are sandy throughout. Also included are small areas on concave slopes and in depressions where the soils are wetter than the Fence and Alcona soils and small areas where the slope is less than 6 percent. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Fence soil. It is moderately rapid in the subsoil of the Alcona soil and moderate in the substratum. The available water capacity is high in the Fence soil and moderate in the Alcona soil.

These soils are wooded. They are suited to trees. The use of equipment is restricted during excessively wet periods because of low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or have an adequate snow cover. Unsurfaced roads on the Fence soil are slippery and easily rutted during wet periods. On sites for all-weather roads, a gravel base is needed. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

The Fence soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. This limitation can be overcome by constructing a mound of suitable filtering material. The Alcona soil is only moderately suited to septic tank absorption fields because of the slope. This limitation can be overcome by cutting and filling or by installing a trench absorption system on the contour.

These soils are only moderately suited to dwellings because of the slope. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

The Fence soil is poorly suited to local roads and streets because of the potential for frost action, and the Alcona soil is only moderately suited because of the slope and the potential for frost action. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system. The slope can be overcome by cutting and filling.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is TM.

Fh—Fluvaquents, sandy, nearly level. These poorly drained and very poorly drained soils are on flood plains. They are subject to ponding and are frequently flooded. Many areas are dissected by old river channels. Slope ranges from 0 to 2 percent. Individual areas are long and narrow. Most range from about 10 to several hundred acres in size.

Typically, these soils consist of layers that vary widely in color and thickness. They are dominantly sand and loamy sand intermixed with thin layers of muck. In some places the surface layer is muck. In other places the soils have thin layers of silt, silt loam, sandy loam, or gravelly sand.

Included with these soils in mapping are small areas of Au Gres, Kinross, Markey, and Seelyeville soils. The somewhat poorly drained Au Gres soils are on low, narrow ridges. They are sandy throughout. The poorly drained Kinross and very poorly drained Markey and Seelyeville soils are on low flats and in drainageways and depressions. Kinross soils are sandy throughout. Markey soils are muck to a depth of 16 to 51 inches and are underlain by sandy deposits. Seelyeville soils are muck to a depth of more than 51 inches. Also included are areas that are covered with 1 to 3 feet of water most of the year. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Fluvaquents. The available water capacity is low. A seasonal high water table is near or above the surface during wet periods.

Most areas of these soils support native wetland vegetation of marsh grasses, sedges, reeds, cattails, and alder brush. A few small areas are used as woodland.

These soils are poorly suited to trees. The trees grow so poorly and have such poor form that they are barely merchantable at best. Because of wetness, planting by hand or by machine on prepared ridges is needed if natural regeneration is unreliable. Vigorous planting stock is essential. The heavy equipment needed in harvesting can be used only when the soils are frozen or have adequate snow cover.

These soils generally are unsuited to building site development because of the ponding, the frequent flooding, and the high water table. Overcoming these limitations is difficult. A better site should be selected.

The land capability classification is Vw. No woodland ordination symbol or habitat type is assigned.

Ga—Gaastra silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is in shallow depressions and drainageways. Individual areas are irregular in shape. Most range from about 5 to 40 acres in size.

Typically, about 2 inches of partially decomposed leaf litter is at the surface. The surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is brown silt loam about 2 inches thick. The subsoil is mottled silt loam about 32 inches thick. It is reddish brown in the upper part and reddish brown and brown in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, stratified silt loam and very fine sandy loam. In places the surface layer is loam.

Included with this soil in mapping are small areas of the well drained Alcona and well drained and moderately well drained Fence soils in the higher landscape positions. Fence soils contain less sand in the subsoil than the Gaastra soil. Also included are small areas of poorly drained soils in shallow depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Gaastra soil. The available water capacity is high. A seasonal high water table is at a depth of 1 to 2 feet.

Most areas of this soil are used as woodland. A few are used as pasture.

This soil is suited to trees. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring, late in fall, and in other excessively wet periods because of the perched seasonal high water table and low strength. Ruts form easily when wheeled skidders are used during these periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for year-round roads, a gravel base is needed. Also, culverts are needed to maintain the natural drainage system. If stabilized, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil generally is unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability. In some areas the effluent can be pumped to an absorption field established on higher lying, better suited soils.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by building dwellings without basements on fill material, which raises the site, and by constructing basements above the level of wetness. The wetness also can be overcome by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is IIw. The woodland ordination symbol is 7W. The habitat type is TMC (Dryopteris phase).

GoB—Gogebic-Fence-Pence complex, 0 to 6 percent slopes. These nearly level and undulating soils are on moraines. The moderately well drained Gogebic soil is on convex slopes and broad ridges. The moderately well drained Fence soil is on flats and concave slopes and in drainageways. The well drained Pence soil commonly is on low, narrow ridges. Slopes are short and irregular. Small wet areas and depressions are common. Individual areas are irregular in shape and generally range from about 10 to 500 acres in size. They are 40 to 75 percent Gogebic soil, 10 to 20 percent Fence soil, and 10 to 20 percent Pence soil. The three soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Gogebic soil has a surface layer of reddish gray fine sandy loam about 3 inches thick. The subsoil is about 56 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part; dark reddish gray, mottled, firm, dense fine sandy loam and reddish brown, mottled, firm, dense loam in the next part (fig. 7); and reddish brown loam and fine sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown fine sandy loam. In places the surface layer is sandy loam or loam. In some areas the substratum is sandy loam. In other areas it has strata of silt, clay loam, loamy sand, or sand and gravel.

Typically, the Fence soil has a surface layer of dark reddish brown silt loam about 4 inches thick. The subsoil is silt loam about 43 inches thick. It is dark brown in the upper part and reddish brown and mottled in the lower part. The substratum to a depth of about 60 inches is reddish brown silt loam. In some places the surface layer is loam. In other places the subsoil or substratum has thin strata of silt, silty clay loam, very fine sandy loam, fine sandy loam, very fine sand, or fine sand. In some areas loamy glacial till is at a depth of 40 to 60 inches.

Typically, the Pence soil has about 1 inch of partially decomposed forest litter at the surface. The surface layer is black sandy loam about 3 inches thick. The subsurface layer is dark reddish gray sandy loam about 3 inches thick. The subsoil is about 16 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and yellowish red loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand.

Included with these soils in mapping are small areas of Alcona, Gaastra, Loxley, and Seelyeville soils. The well drained Alcona soils are in positions on the landscape similar to those of the Fence soil. They contain more sand in the subsoil than the Fence soil. The somewhat poorly drained Gaastra soils are in shallow depressions and drainageways. The very poorly drained, organic Loxley and Seelyeville soils are in deep depressions. Also included are a few areas where slopes are short and are more than 6 percent. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the firm, dense layer in the subsoil of the Gogebic soil and moderate in the substratum. It is moderately slow in the Fence soil. It is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. The available water capacity is low in the Gogebic and Pence soils and high in the Fence soil. The Gogebic soil has a seasonal high water table at a depth of 1 to 2 feet, and the Fence soil has one at a depth of 2 to 6 feet.

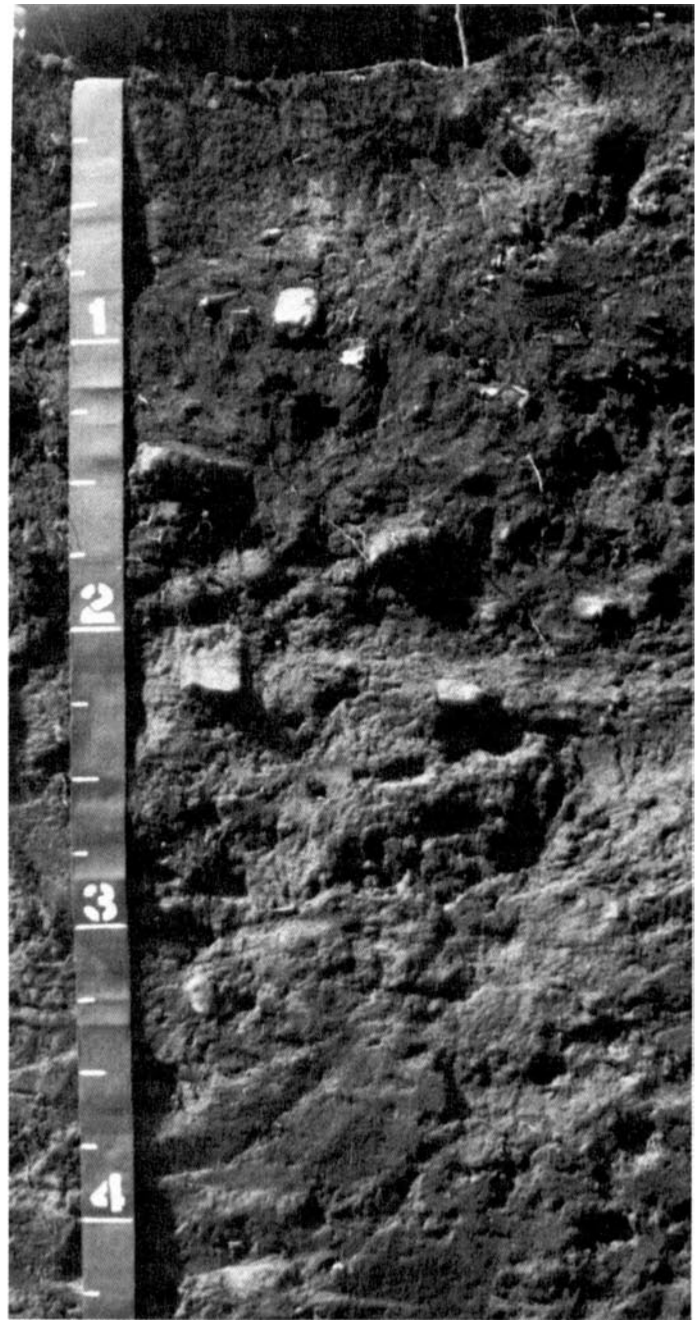

Figure 7.—Typical profile of Gogebic fine sandy loam. Firm, dense layers are between depths of about 24 and 36 inches. Depth is marked in feet.

These soils are wooded. They are suited to trees. The main concerns in managing woodland are the equipment limitation in areas of the Gogebic and Fence soils and the windthrow hazard on the Gogebic soil. Because of the firm, dense layer in the subsoil, trees on the Gogebic soil are shallow rooted. The shallow rooting depth can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. The use of equipment is restricted in the spring and in other excessively wet periods because of a perched seasonal high water table in the Gogebic soil and low strength in the Fence soil. Ruts form easily if wheeled skidders are used when these soils are wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or have an adequate snow cover. Unsurfaced roads are slippery and easily rutted during wet periods. On sites for year-round roads, a gravel base is needed. If stabilized, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited Pence soil.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

The Pence soil is suitable as a site for dwellings and for local roads and streets. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

The Gogebic and Fence soils are poorly suited to septic tank absorption fields because of the wetness and the restricted permeability. These limitations can be overcome by constructing a mound of suitable filtering material.

Because of the wetness, the Gogebic soil is poorly suited to dwellings and the Fence soil is only moderately suited to dwellings without basements and poorly suited to dwellings with basements. This limitation can be overcome by constructing basements above the level of wetness; by adding fill material, which raises the site; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. In some areas of the Gogebic soil, interceptor tile is needed to carry off seepage from the higher adjacent slopes.

The Gogebic soil is only moderately suited to local roads and streets because of the wetness and the potential for frost action, and the Fence soil is poorly suited because of the potential for frost action. The wetness can be overcome by installing a good surface and subsurface drainage system, which lowers the water table, or by adding fill material, which raises the roadbed above the level of wetness. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is IIe. The woodland ordination symbol assigned to the Gogebic soil is 3D, the one assigned to the Fence soil is 3L, and the one assigned to the Pence soil is 7S. The primary habitat type is ATD, and the secondary habitat type is TM.

GoC—Gogebic-Fence-Pence complex, 3 to 15 percent slopes. These undulating to hilly soils are on moraines. The moderately well drained Gogebic soil is on broad ridges and convex side slopes. The well drained Fence soil is on concave side slopes and in drainageways. The well drained Pence soil is on narrow ridges and the upper side slopes along drainageways. Slopes are short and irregular. Small wet areas and depressions are common. Individual areas are irregular in shape and generally range from about 10 to 640 acres in size. They are 40 to 70 percent Gogebic soil, 10 to 25 percent Fence soil, and 10 to 20 percent Pence soil. The three soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Gogebic soil has a surface layer of dark brown fine sandy loam about 3 inches thick. The subsoil is about 54 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part; reddish gray and reddish brown, mottled, dense, firm fine sandy loam in the next part; and reddish brown loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places the surface layer is sandy loam or loam. In some areas the substratum is fine sandy loam. In other areas it has strata of silt, clay loam, loamy sand, or sand and gravel.

Typically, the Fence soil has about 2 inches of partially decomposed forest litter at the surface. The surface layer is dark reddish brown silt loam about 2 inches thick. The subsoil is reddish brown, dark brown, and yellowish red silt loam about 39 inches thick. The substratum to a depth of about 60 inches is reddish brown, stratified silt loam, very fine sandy loam, and very fine sand. In some places the surface layer is loam. In other places the substratum is silt loam. In some areas it has strata of silty clay loam, fine sandy loam, or fine sand. In other areas loamy glacial till is at a depth of 40 to 60 inches.

Typically, the Pence soil has about 1 inch of partially decomposed forest litter at the surface. The surface layer is dark reddish brown sandy loam about 4 inches thick. The subsurface layer is dark reddish gray sandy loam about 1 inch thick. The subsoil is about 18 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and yellowish red gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish red gravelly sand.

Included with these soils in mapping are small areas of Alcona, Loxley, Sayner, and Seelyeville soils. The well drained Alcona soils are in positions on the landscape similar to those of the Fence soil. They contain more sand in the subsoil than the Fence soil. The very poorly drained, organic Loxley and Seelyeville soils are in deep depressions. The excessively drained Sayner soils are in positions on the landscape similar to those of the Pence soil. They contain more sand in the surface layer and in the upper part of the subsoil than the Pence soil. Also included are a few areas where the slope is more than 15 percent. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the firm, dense layer in the subsoil of the Gogebic soil and moderate in the substratum. It is moderately slow in the Fence soil. It is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. The available water capacity is low in the Gogebic and Pence soils and high in the Fence soil. The Gogebic soil has a seasonal high water table at a depth of 1 to 2 feet.

These soils are used as woodland. They are suited to trees. The major concerns in managing woodland are the equipment limitation in areas of the Gogebic and Fence soils and the windthrow hazard on the Gogebic soil. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table in the Gogebic soil and low strength in the Fence soil. Ruts form easily if wheeled skidders are used when these soils are wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soils are dry or have an adequate snow cover. Unsurfaced roads are slippery and easily rutted during wet periods. Year-round logging roads should be graveled. The slope limits the selection of landing sites. The best sites for landings are undulating areas of the Pence soil. Trees are shallow rooted on the Gogebic soil because of the firm, dense layer in the subsoil. The shallow rooting depth can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

The Gogebic soil is poorly suited to septic tank absorption fields because of the wetness and the restricted permeability, and the Fence soil is poorly suited because of the restricted permeability. The wetness and restricted permeability can be overcome by constructing a mound of suitable filtering material. The Pence soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

The Gogebic soil is poorly suited to dwellings because of the wetness. This limitation can be overcome by constructing basements above the level of wetness; by adding fill material, which raises the site; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet. In areas of the Gogebic soil, interceptor tile may be needed to carry off seepage from the higher adjacent slopes. The Fence and Pence soils are only moderately suited to dwellings because of the slope. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

The Gogebic soil is only moderately suited to local roads and streets because of the wetness, the slope, and the potential for frost action. The Fence soil is poorly suited because of the potential for frost action. The Pence soil is only moderately suited because of the slope. The wetness can be overcome by installing a good surface and subsurface drainage system, which lowers the water table, or by adding fill material, which raises the roadbed above the level of wetness. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system. The slope can be overcome by cutting and filling.

The land capability classification is IIIe. The woodland ordination symbol assigned to the Gogebic soil is 3D, the one assigned to the Fence soil is 3L, and the one assigned to the Pence soil is 7S. The primary habitat type is ATD, and the secondary habitat type is TM.

GpD—Gogebic-Pence complex, 15 to 30 percent slopes. These hilly and steep, well drained soils are on side slopes, knolls, and ridges. Small wet areas and depressions are common. Individual areas are irregular in shape and generally range from about 10 to 400 acres in size. They are 50 to 80 percent Gogebic soil and 10 to 30 percent Pence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Gogebic soil has about 2 inches of partially decomposed forest litter at the surface. The surface layer is reddish gray fine sandy loam about 2 inches thick. The subsoil is about 54 inches thick. It is reddish brown fine sandy loam in the upper part; reddish brown, dense, firm fine sandy loam in the next part; and reddish brown sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places the surface layer is sandy loam or loam. In some areas the substratum is fine sandy loam. In other areas it has strata of silt, clay loam, loamy sand, or sand and gravel.

Typically, the Pence soil has a surface layer of dark reddish brown sandy loam about 2 inches thick. The subsoil is about 16 inches thick. It is reddish brown and yellowish red sandy loam in the upper part and yellowish red loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish red, stratified sand and gravel.

Included with these soils in mapping are small areas of Loxley, Sayner, and Seelyeville soils. The very poorly drained, organic Loxley and Seelyeville soils are in deep depressions. The excessively drained Sayner soils are in positions on the landscape similar to those of the Pence soil. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included, on ridgetops and foot slopes, are small areas where the slope is less than 15 percent. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the firm, dense layer in the subsoil of the Gogebic soil and moderate in the substratum. It is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. The available water capacity is low in both soils.

These soils are used as woodland. They are suited to trees. The main concerns in managing woodland are the erosion hazard and the equipment limitation. Also, windthrow is a hazard on the Gogebic soil. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. On the Gogebic soil, the use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form if wheeled skidders are used when this soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or undulating included or adjacent soils.

Trees are shallow rooted on the Gogebic soil because of the firm, dense layer in the subsoil. The shallow rooting depth can result in windthrow of some trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

The Gogebic soil generally is unsuited to septic tank absorption fields because of the slow permeability and the slope. Overcoming these limitations is difficult. A better site should be selected. The Pence soil is poorly suited to septic tank absorption fields because of the slope. A slope of less than 20 percent can be overcome by cutting and filling. This soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

These soils are poorly suited to dwellings because of the slope. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. In some areas of the Gogebic soil, interceptor tile is needed to carry off seepage from the higher adjacent slopes.

These soils are poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Gogebic soil is 3R, and the one assigned to the Pence soil is 7R. The primary habitat type is ATD, and the secondary habitat type is TM.

Hp—Histosols, ponded. These nearly level, very poorly drained soils are adjacent to streams and lakes and in some depressions on uplands. They are ponded all or most of the year, and some areas are frequently flooded. Individual areas are irregularly shaped or circular. Most range from about 5 to 100 acres in size.

Typically, these soils have an organic layer ranging from 16 to more than 51 inches in thickness. The substratum below the organic layer is dominantly sandy. In places the organic layer is less than 16 inches thick.

These soils have a water table above the surface most of the year. In some areas the high water table is the result of water-control structures. In these areas the water level is periodically drawn down.

These soils support native wetland vegetation, such as reeds, sedges, cattails, arrowhead, duckweed, and waterlily. They generally are unsuited to trees and to any type of development because of the ponding, the frequent flooding, and the high water table. Overcoming these limitations is difficult on sites for dwellings and local roads. A better site should be selected.

The land capability classification is VIIIw. No woodland ordination symbol or habitat type is assigned.

KaB—Karlin loamy fine sand, 0 to 6 percent slopes. This nearly level and gently sloping, somewhat excessively drained soil is on flats and convex slopes. Individual areas are irregular in shape. Most range from about 10 to 250 acres in size.

Typically, the surface layer is very dark gray loamy fine sand about 2 inches thick. The subsurface layer is brown loamy fine sand about 1 inch thick. The subsoil is about 25 inches thick. It is reddish brown and dark brown loamy fine sand in the upper part and brown fine sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places thin layers of sandy loam are in the subsoil. In other places the surface layer and subsoil are loamy sand. In some areas thin, discontinuous strata of loamy sand or sandy loam are below a depth of 40 inches. In other areas the content of pebbles in the subsoil is as much as 20 percent.

Included with this soil in mapping are small areas of Pence, Rubicon, and Sayner soils. These soils are in positions on the landscape similar to those of the Karlin soil. The well drained Pence soils are sandy loam in the surface layer and in the upper part of the subsoil. The excessively drained Rubicon soils are sand throughout. The excessively drained Sayner soils are loamy sand in the surface layer and in the upper part of the subsoil and contain more gravel in the substratum than the Karlin soil. Also included are a few areas of the moderately well drained Croswell soils in shallow depressions and narrow drainageways and a few areas where the Karlin soil has a slope of more than 6 percent. Croswell soils are sand throughout. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Karlin soil and rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to pine.

This soil is suited to trees. After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation is needed to control competing vegetation.

This soil is suited to dwellings and to local roads and streets. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs. The woodland ordination symbol is 6S. The primary habitat type is TMV, and the secondary habitat type is AQVac.

KaC—Karlin loamy fine sand, 6 to 15 percent slopes. This sloping and moderately steep, somewhat excessively drained soil is on knolls, ridges, and the sides of terraces. Individual areas are long and narrow or irregularly shaped. Most range from about 10 to 80 acres in size.

Typically, the surface layer is dark reddish brown loamy fine sand about 3 inches thick. The subsurface layer is reddish gray loamy fine sand about 2 inches thick. The subsoil is reddish brown and dark brown loamy fine sand about 23 inches thick. The substratum to a depth of about 60 inches is brown and light brown sand. In some places thin layers of sandy loam are in the subsoil. In other places the surface layer and subsoil are loamy sand. In some areas the content of pebbles in the subsoil is as much as 20 percent.

Included with this soil in mapping are small areas of Pence, Rubicon, and Sayner soils. These soils are in positions on the landscape similar to those of the Karlin soil. The well drained Pence soils are sandy loam in the surface layer and in the upper part of the subsoil. The excessively drained Rubicon soils are sand throughout. The excessively drained Sayner soils are loamy sand in the surface layer and in the upper part of the subsoil and contain more gravel in the substratum than the Karlin soil. Also included are areas where the slope is more than 15 percent and small areas where it is less than 6 percent. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Karlin soil and rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to pine.

This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included soils. After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation is needed to control competing vegetation.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is only moderately suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IVe. The woodland ordination symbol is 6S. The primary habitat type is TMV, and the secondary habitat type is AQVac.

KbB—Keweenaw sandy loam, 0 to 6 percent slopes. This nearly level and gently sloping, moderately well drained soil is on the top and foot slopes of drumlins. Individual areas are elongated. Most range from about 10 to 500 acres in size.

Typically, the surface layer is dark brown sandy loam about 3 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil is about 29 inches thick. It is reddish brown and dark brown sandy loam in the upper part; reddish brown, mottled, firm loamy sand in the next part; and reddish brown, mottled loamy sand and sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown gravelly loamy sand. In some areas it is loamy sand. In other areas it has strata or pockets of sandy loam.

Included with this soil in mapping are small areas of Karlin and Pence soils on the toe slopes of the drumlins. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil and are underlain by sandy glacial outwash. The well drained Pence soils are underlain by sand or sand and gravel glacial outwash. Also included are areas of Keweenaw soils that are well drained and areas where the surface layer is stony. Included soils make up 2 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. The available water capacity is low. A seasonal high water table is at a depth of 1 to 3 feet during wet periods.

This soil is used as woodland. It is suited to trees. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the wetness, this soil is poorly suited to septic tank absorption fields and dwellings. On sites for absorption fields, this limitation can be overcome by constructing a mound of suitable filtering material. On sites for dwellings, it can be overcome by adding fill material, which raises the site; by constructing basements above the level of wetness; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

This soil is only moderately suited to local roads and streets because of the wetness. This limitation can be overcome by installing a good surface and subsurface drainage system or by adding fill material, which raises the roadbed above the level of wetness.

The land capability classification is IIIe. The woodland ordination symbol is 3S. The habitat type is TMV.

KbC—Keweenaw sandy loam, 6 to 15 percent slopes. This sloping and moderately steep, well drained soil is on the sides of drumlins. Individual areas are long and narrow. Most range from about 10 to 80 acres in size.

Typically, the surface layer is brown sandy loam about 2 inches thick. The subsoil is about 43 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part; reddish brown, firm loamy sand in the next part; and reddish brown, brittle sandy loam and loamy sand in the lower part. The substratum to a depth of about 60 inches is reddish brown gravelly loamy sand. In places it is loamy sand.

Included with this soil in mapping are small areas of Karlin and Pence soils on foot slopes. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil and are underlain by sandy glacial outwash. The well drained Pence soils are underlain by sand or sand and gravel glacial outwash. Also included are areas where the surface layer is stony. Included areas make up 2 to 10 percent of the unit.

Permeability is moderate or moderately rapid in Keweenaw soil. The available water capacity is low.

This soil is used as woodland. It is suited to trees. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping adjacent soils. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the slope, this soil is only moderately suited to septic tank absorption fields, dwellings, and local roads and streets. This limitation can be overcome by cutting and filling, by installing a trench absorption system on the contour, and by designing dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IVe. The woodland ordination symbol is 3S. The habitat type is TMV.

KbD—Keweenaw sandy loam, 15 to 30 percent slopes. This moderately steep and steep, well drained soil is on the sides of drumlins. Individual areas are long and narrow. Most range from about 10 to 80 acres in size.

Typically, the surface layer is brown sandy loam about 3 inches thick. The subsoil is about 39 inches thick. It is reddish brown. It is sandy loam in the upper part, firm loamy sand in the next part, and brittle loamy sand in the lower part. The substratum to a depth of about 60 inches is reddish brown gravelly loamy sand. In places it is loamy sand.

Included with this soil in mapping are small areas of Karlin and Pence soils on foot slopes. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil and are underlain by sandy glacial outwash. The well drained Pence soils are underlain by sand or sand and gravel glacial outwash. Included soils make up 2 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. The available water capacity is low.

This soil is used as woodland. It is suited to trees. The main concerns in managing woodland are the erosion hazard and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or gently sloping adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the slope, this soil is poorly suited to septic tank absorption fields and dwellings. A slope of less than 20 percent can be overcome by cutting and filling and by designing dwellings so that they conform to the natural slope of the land. A slope of more than 20 percent cannot be easily overcome. A less sloping site should be selected.

This soil is poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIe. The woodland ordination symbol is 3R. The habitat type is TMV.

KeB—Keweenaw-Karlin complex, 0 to 6 percent slopes. These nearly level and gently sloping soils are on flats and convex slopes. The Keweenaw soil is moderately well drained, and the Karlin soil is somewhat excessively drained. Individual areas are irregular in shape and generally range from about 10 to 320 acres in size. They are 50 to 75 percent Keweenaw soil and 20 to 40 percent Karlin soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Keweenaw soil has a surface layer of dark brown sandy loam about 2 inches thick. The subsurface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 39 inches thick. It is reddish brown. It is sandy loam in the upper part; mottled, firm gravelly loamy sand in the next part; and gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the surface layer is loam. In other places the subsoil and substratum are cobbly throughout. In some areas the substratum is loamy sand.

Typically, the Karlin soil has a surface layer of brown loamy fine sand about 3 inches thick. The subsoil is about 26 inches thick. It is dark brown loamy fine sand in the upper part, brown and reddish brown loamy sand in the next part, and brown sand in the lower part. The substratum to a depth of about 60 inches is strong brown sand. In some places thin layers of sandy loam are in the subsoil. In other places the surface layer and subsoil are loamy sand. In some areas thin, discontinuous strata of loamy sand or sandy loam are below a depth of 40 inches. In other areas thin layers of gravel are in the subsoil.

Included with these soils in mapping are small areas of Pence and Rubicon soils. These included soils are in positions on the landscape similar to those of the Keweenaw and Karlin soils. The well drained Pence soils are sandy loam in the surface layer and in the upper part of the subsoil and are underlain by sand or sand and gravel glacial outwash. The excessively drained Rubicon soils are sand throughout. Also included are some areas of Keweenaw soils that have a very stony or bouldery surface layer or that are well drained. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. It is moderately rapid in the subsoil of the Karlin soil and rapid in the substratum. The available water capacity is low in both soils. The Keweenaw soil has a seasonal high water table at a depth of 1 to 3 feet.

Most areas of these soils are used as woodland. Some are used as cropland or pasture. A few areas of idle cropland are reverting naturally to native woodland. Some areas have been planted to pine.

These soils are suited to trees. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species is needed.

The Keweenaw soil is poorly suited to septic tank absorption fields because of the wetness. This limitation can be overcome by constructing a mound of suitable filtering material. The Karlin soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

The Karlin soil is suited to dwellings, but the Keweenaw soil is poorly suited because of the wetness. This limitation can be overcome by constructing basements above the level of wetness; by adding fill material, which raises the site; or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

The Karlin soil is suited to local roads and streets, but the Keweenaw soil is only moderately suited because of the wetness. This limitation can be overcome by installing a good surface and subsurface drainage system or by adding fill material, which raises the roadbed above the level of wetness.

The land capability classification is IIIe. The woodland ordination symbol assigned to the Keweenaw soil is 3S, and the one assigned to the Karlin soil is 6S. The primary habitat type is TM, and the secondary habitat type is TMV.

KeC—Keweenaw-Karlin complex, 6 to 15 percent slopes. These sloping and moderately steep soils are on water-worked moraines. The well drained Keweenaw soil is on the top and upper sides of knolls and ridges. The somewhat excessively drained Karlin soil is on the lower side slopes. Individual areas are irregular in shape and generally range from about 10 to 200 acres in size. They are 50 to 75 percent Keweenaw soil and 20 to 40 percent Karlin soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Keweenaw soil has a surface layer of very dark gray sandy loam about 1 inch thick. The subsurface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 44 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part; reddish brown and reddish gray, firm loamy sand in the next part; and reddish brown and brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly loamy sand. In some places the surface layer is loam. In other places the subsoil and substratum are cobbly throughout. In some areas the substratum is loamy sand.

Typically, the Karlin soil has a surface layer of brown loamy fine sand about 3 inches thick. The subsoil is about 31 inches thick. It is dark brown loamy fine sand in the upper part, brown loamy sand in the next part, and strong brown sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown sand. In some places thin layers of sandy loam are in the subsoil. In other places the surface layer and subsoil are loamy sand. In some areas thin, discontinuous strata of loamy sand or sandy loam are below a depth of 40 inches. In other areas thin layers of gravel are in the subsoil.

Included with these soils in mapping are small areas of Pence, Rubicon, and Sayner soils. Pence and Sayner soils are in positions on the landscape similar to those of the Keweenaw soil. The well drained Pence soils are underlain by sand or sand and gravel outwash. The excessively drained Sayner soils are loamy sand in the surface layer and in the upper part of the subsoil and are underlain by sand and gravel outwash. The excessively drained Rubicon soils are in positions on the landscape similar to those of the Karlin soil. They are sand throughout. Also included are some areas of Keweenaw soils that have a very stony or bouldery surface layer, areas where the slope is more than 15 percent, small areas where the slope is less than 6 percent, and some small areas of wet soils in depressions. Included soils make up 5 to 25 percent of the unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. It is moderately rapid in the subsoil of the Karlin soil and rapid in the substratum. The available water capacity is low in both soils.

Most areas of these soils are used as woodland. A few are used as cropland or pasture.

These soils are suited to trees. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

The Keweenaw soil is only moderately suited to septic tank absorption fields because of the slope. This limitation can be overcome by cutting and filling or by installing a trench absorption system on the contour. The Karlin soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

These soils are only moderately suited to dwellings and to local roads and streets because of the slope. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

The land capability classification is IVe. The woodland ordination symbol assigned to the Keweenaw soil is 3S, and the one assigned to the Karlin soil is 6S. The primary habitat type is TM, and the secondary habitat type is TMV.

KnD—Keweenaw-Sayner complex, 15 to 30 percent slopes. These moderately steep and steep soils are on knolls and ridges. The Keweenaw soil is well drained, and the Sayner soil is excessively drained. Individual areas are irregular in shape and generally range from about 10 to 200 acres in size. They are 45 to 65 percent Keweenaw soil and 25 to 45 percent Sayner soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Keweenaw soil has a surface layer of reddish gray sandy loam about 3 inches thick. The subsoil is about 39 inches thick. It is dominantly reddish brown and dark brown sandy loam in the upper part; brown, firm loamy sand in the next part; and brown and reddish brown loamy sand in the lower part. The substratum to a depth of about 60 inches is brown loamy sand. In some places the surface layer is loam. In other places the subsoil and substratum are cobbly throughout. In some areas the substratum is gravelly loamy sand.

Typically, the Sayner soil has a surface layer of dark reddish brown loamy sand about 2 inches thick. The subsurface layer is reddish gray loamy sand about 2 inches thick. The subsoil is about 22 inches thick. It is reddish brown loamy sand in the upper part and brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some areas the surface layer is gravelly sandy loam.

Included with these soils in mapping are small areas of Pence and Rubicon soils. These included soils are in positions on the landscape similar to those of the Keweenaw and Sayner soils. The well drained Pence soils are sandy loam in the surface layer and in the upper part of the subsoil and are underlain by sand or sand and gravel. The excessively drained Rubicon soils are sand throughout. Also included are some areas of Keweenaw soils that have a very stony or bouldery surface layer, small areas on foot slopes where the slope is less than 15 percent, and some small areas of wet soils in depressions. Included soils make up 10 to 25 percent of the unit.

Permeability is moderate or moderately rapid in the Keweenaw soil. It is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. The available water capacity is low in both soils.

These soils are used as woodland. They are suited to trees. The main concerns in managing woodland are the erosion hazard and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the slope, these soils are poorly suited to septic tank absorption fields. A slope of less than 20 percent can be overcome by cutting and filling. The Sayner soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

These soils are poorly suited to dwellings because of the slope. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

These soils are poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Keweenaw soil is 3R, and the one assigned to the Sayner soil is 7R. The primary habitat type is TM, and the secondary habitat type is TMV.

Kr—Kinross mucky sand, 0 to 2 percent slopes. This nearly level, poorly drained soil is in depressions and drainageways and on low flats adjacent to drainageways, wet basins, and lakes. It is subject to ponding. In some areas the surface is uneven because trees have been windthrown. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 200 acres in size.

Typically, the upper 4 inches is black muck. Below this is reddish gray sand about 6 inches thick. The subsoil is dark reddish brown, reddish brown, and yellowish red, mottled sand about 24 inches thick. The substratum to a depth of about 60 inches is dark brown, mottled sand. In some places the surface layer is loamy sand. In other places the soil is fine sand throughout. In some areas the substratum is gravelly sand.

Included with this soil in mapping are small areas of Au Gres, Dawson, and Markey soils. The somewhat poorly drained Au Gres soils are slightly higher on the landscape than the Kinross soil. The very poorly drained Dawson and Markey soils are in the slightly lower landscape positions. They are organic to a depth of 16 to 51 inches. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Kinross soil. The available water capacity is low. A seasonal high water table is near or above the surface throughout the year.

Most areas of this soil are used as woodland. A few support native wetland vegetation of reeds, sedges, and speckled alder.

This soil is suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The high water table restricts the use of equipment to periods when the soil has an adequate snow cover. The better suited adjacent soils may be needed as sites for landings. Reforestation is limited to natural regeneration or to hand planting. Trees generally are not planted on this soil because of the wetness. The seedling mortality rate can be reduced by planting vigorous nursery stock on the crest of cradle-knolls or on prepared ridges. Trees are shallow rooted because of the high water table. They can be blown down by strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After a harvest, plant competition can prevent or delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants.

This soil generally is unsuited to septic tank absorption fields and dwellings, mainly because of the ponding. Overcoming this hazard is difficult. A better site should be selected.

Because of the ponding, this soil is poorly suited to local roads and streets. Surface water can be removed by culverts and ditches, and the roads can be constructed on fill material, which raises the roadway above the level of ponding. The culverts help to prevent road damage by equalizing the water level on both sides of the road.

The land capability classification is VIw. The woodland ordination symbol is 7W. The primary habitat type is TTS, and the secondary habitat type is TMC (Vaccinium phase).

Lo—Loxley and Dawson peats, 0 to 1 percent slopes. These nearly level, very poorly drained soils are on low flats and in drainageways and depressions. They are subject to ponding. Individual areas are circular or irregularly shaped. They generally are about 5 to 640 acres in size but range to several thousand acres. Some are 60 to 90 percent Loxley soil and 0 to 30 percent Dawson soil. Some are 60 to 90 percent Dawson soil and 0 to 30 percent Loxley soil. Others are 30 to 45 percent each soil. The two soils are similar enough in behavior characteristics to be mapped as one unit.

Typically, the Loxley soil has a surface layer of brown peat about 12 inches thick. Below this to a depth of about 60 inches is dark brown and dark reddish brown muck. In some places the muck has thin layers of mucky peat or peat. In other places the surface layer is muck or mucky peat.

Typically, the Dawson soil has a surface layer of dark reddish brown peat about 11 inches thick. Below this is very dark gray muck about 24 inches thick. The substratum to a depth of about 60 inches is dark grayish brown sand. In places the surface layer is mucky peat or muck. In some areas the substratum has loamy layers. In other areas it is gravelly sand.

Included with these soils in mapping are small areas of the somewhat poorly drained Au Gres and poorly drained Kinross soils on the slightly higher parts of the landscape. Kinross soils formed in a thin layer of organic material and in sandy deposits. Au Gres soils are sandy throughout. Also included are small areas of the poorly drained and very poorly drained, sandy Flauvaquents on flood plains; small areas of the very poorly drained, ponded Histosols adjacent to streams and lakes and along the edges of the depressions; and small areas of open water. The Histosols are covered with 1 to 3 feet of water most of the year. Included areas make up 10 to 25 percent of the unit.

Permeability is moderately rapid in the Loxley soil. It is moderately rapid in the organic part of the Dawson soil and rapid in the sandy substratum. The available water capacity is very high in both soils. Both have a water table near or above the surface throughout the year.

Most areas support native wetland vegetation, mainly sphagnum moss, leatherleaf, bog rosemary, and widely spaced, stunted black spruce and tamarack (fig. 8). Some areas are used as woodland. A few are used for the commercial production of cranberries. Because they are extremely acid, these soils generally are unsuited to trees. They generally are unsuited to septic tank absorption fields and dwellings because of the ponding and low strength. Overcoming these limitations is difficult. A better site should be selected.

These soils are poorly suited to local roads and streets because of the ponding, the potential for frost action, and low strength. Surface water can be removed through suitable outlets by culverts and ditches, and the roads can be built on fill material, which raises the roadway above the level of ponding. The culverts help to prevent road damage by equalizing the water level on both sides of the road. Frost action and low strength can be overcome by excavating the organic material and replacing it with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement.

The land capability classification is VIw. The woodland ordination symbol is 2W. The habitat type is PCS.

MaA—Manitowish sandy loam, 0 to 3 percent slopes. This nearly level and gently sloping, moderately well drained soil is on low flats and foot slopes and in depressions. Individual areas are irregular in shape. Most range from about 20 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 1 inch thick. The subsoil is about 15 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and reddish brown loamy coarse sand in the lower part. The upper part of the substratum is strong brown coarse sand. The lower part to a depth of about 60 inches is dark brown, mottled, stratified coarse sand and gravel. In places the substratum is gravelly sand or sand.

Included with this soil in mapping are small areas of Pence and Worcester Variant soils. The well drained Pence soils are higher on the landscape than the Manitowish soil. The somewhat poorly drained Worcester Variant soils are in the lower landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Manitowish soil and rapid or very rapid in the substratum. The available water capacity is low. A seasonal high water table is at a depth of 3 to 6 feet.

Most areas of this soil are used as woodland. A few are used as cropland or pasture.

Figure 8.—Sphagnum moss, leatherleaf, bog rosemary, and stunted black spruce and tamarack in an area of Loxley and Dawson peats, 0 to 1 percent slopes. The pine and spruce in the background are on Au Gres soils.

This soil is suited to trees. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the wetness and the rapid or very rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. These limitations can be overcome by constructing a mound of suitable filtering material. In some areas the effluent can be pumped to an absorption field established on higher lying, better suited soils.

This soil is suited to local roads and streets and to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by constructing the basement above the level of wetness or by installing a subsurface drainage system that has a gravity outlet or another dependable outlet.

The land capability classification is IIIs. The woodland ordination symbol is 3S. The habitat type is TM.

MoA—Monico silt loam, 0 to 3 percent slopes. This nearly level and gently sloping, somewhat poorly drained soil is in shallow depressions and narrow drainageways. It is occasionally flooded. In many areas the surface is uneven because trees have been windthrown. Individual areas are long and narrow and range from about 5 to 70 acres in size.

Typically, the surface layer is dark brown silt loam about 4 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 29 inches thick. It is reddish brown and brown, mottled fine sandy loam in the upper part and brown, mottled sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, mottled gravelly loamy sand. In some places the surface layer is loam. In other places the substratum is loamy sand or sandy loam.

Included with this soil in mapping are small areas of Cable and Champion soils. The poorly drained Cable soils are slightly lower on the landscape than the Monico soil. The moderately well drained Champion soils are in the higher areas. Also included are areas where the surface layer is very stony. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Monico soil. The available water capacity also is moderate. A seasonal high water table is at a depth of 1 to 3 feet.

Most areas of this soil are used as woodland. A few small areas are used as cropland or pasture.

This soil is suited to trees. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in spring, late in fall, and in other excessively wet periods because of the perched seasonal high water table, low strength, and flooding. Ruts form easily if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. When the soil is wet, unsurfaced roads tend to be slippery and ruts form easily. On sites for all-weather logging roads, a gravel base is needed. Also, large culverts are needed to maintain the natural drainage system and to drain floodwater. If stabilized with gravel, landings can better withstand the repeated use of heavy equipment. Also, they can be established on the better suited adjacent soils. A shallow rooting depth, which is caused by the high water table, can result in windthrow of many trees during periods of strong winds and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the flooding and the wetness, this soil generally is unsuited to septic tank absorption fields and dwellings. Overcoming these limitations is difficult. A better site should be selected.

This soil is poorly suited to local roads and streets because of the flooding and the potential for frost action. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system. Fill material helps to elevate the roads above the level of flooding. Covering a dip in the road with concrete and installing riprap on the sides result in stable overflow sections. Large culverts help to drain the floodwater.

The land capability classification is IIw. The woodland ordination symbol is 3W. The primary habitat type is AVO (Circaea-Impatiens phase), and the secondary habitat type is TMC (Dryopteris phase).

PaB—Padus fine sandy loam, 0 to 6 percent slopes. This nearly level and gently sloping, well drained soil is on flats and convex slopes. Individual areas are irregular in shape. Most range from about 5 to several hundred acres in size.

Typically, the surface layer is dark brown fine sandy loam about 1 inch thick. The subsurface layer is reddish gray fine sandy loam about 3 inches thick. The subsoil is about 31 inches thick. It is dark reddish brown and dark brown fine sandy loam in the upper part, brown and reddish brown sandy loam in the next part, and reddish brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In some areas the surface layer is loam or sandy loam. In places the substratum is sand or gravelly sand.

Included with this soil in mapping are small areas of Karlin, Manitowish, Pence, and Sayner soils. The somewhat excessively drained Karlin soils are in positions on the landscape similar to those of the Padus soil. They are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. Manitowish and Pence soils are shallower to sand and gravel than the Padus soil. The moderately well drained Manitowish soils are in shallow depressions. The well drained Pence soils are on ridgetops and slope breaks. The excessively drained Sayner soils are on sharp slope breaks. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included are some areas where the surface layer and the upper part of the subsoil are silt loam and areas where the slope is more than 6 percent. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Padus soil and rapid or very rapid in the substratum. The available water capacity is moderate.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland.

This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

This soil is suited to dwellings. It is only moderately suited to local roads and streets because of the potential for frost action. This limitation can be overcome by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system.

The land capability classification is IIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is TM.

PaC—Padus fine sandy loam, 6 to 15 percent slopes. This sloping and moderately steep, well drained soil is on the sides of terraces and on knolls and ridges. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 240 acres in size.

Typically, the surface layer is brown fine sandy loam about 2 inches thick. The subsoil is about 31 inches thick. It is dark brown fine sandy loam in the upper part, reddish brown and brown sandy loam in the next part, and strong brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown gravelly sand. In some areas the surface layer is loam or sandy loam. In places the substratum is sand or stratified sand and gravel.

Included with this soil in mapping are small areas of Karlin, Pence, and Sayner soils. The somewhat excessively drained Karlin soils are in positions on the landscape similar to those of Padus soil. They are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. The well drained Pence soils are on ridgetops and the upper side slopes. They are shallower to sand and gravel than the Padus soil. The excessively drained Sayner soils are on sharp slope breaks. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included are some areas where the surface layer and the upper part of the subsoil are silt loam, areas where the slope is more than 15 percent, and small areas where the slope is less than 6 percent. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Padus soil and rapid or very rapid in the substratum. The available water capacity is moderate.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland.

This soil is suited to trees. The main concern in managing woodland is the equipment limitation. The use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. Frost action can be controlled by covering or replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by providing a good surface and subsurface drainage system. The slope can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IIIe. The woodland ordination symbol is 3L. The primary habitat type is ATD, and the secondary habitat type is TM.

PaD—Padus fine sandy loam, 15 to 25 percent slopes. This moderately steep and steep, well drained soil is on the sides of terraces and on knolls and ridges. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 240 acres in size.

Typically, the surface layer is dark reddish brown fine sandy loam about 2 inches thick. The subsurface layer is reddish gray fine sandy loam about 2 inches thick. The subsoil is about 33 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part, brown and dark brown sandy loam in the next part, and reddish brown sand in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In some areas the surface layer is loam or sandy loam. In places the substratum is sand or gravelly sand.

Included with this soil in mapping are small areas of Pence and Sayner soils. The well drained Pence soils are on ridgetops and the upper side slopes. They are shallower to sand and gravel than the Padus soil. The excessively drained Sayner soils are on sharp slope breaks. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included are some areas where the surface layer and the upper part of the subsoil are silt loam and, on ridgetops and foot slopes, small areas where the slope is less than 15 percent. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Padus soil and rapid or very rapid in the substratum. The available water capacity is moderate.

Most areas of this soil are used as woodland. A few small areas are used as pasture.

This soil is suited to trees. Because of the slope, the main concerns in managing woodland are the erosion hazard and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. The use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is poorly suited to septic tank absorption fields because of the slope. A slope of less than 20 percent can be overcome by cutting and filling. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is poorly suited to dwellings. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

This soil is poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIe. The woodland ordination symbol is 3R. The primary habitat type is ATD, and the secondary habitat type is TM.

PeC—Padus-Pence complex, 6 to 15 percent slopes. These rolling and hilly, well drained soils are on pitted outwash plains. The Padus soil is on the mid and lower side slopes and on broad ridgetops. The Pence soil is on narrow ridges, slope breaks, and the upper side slopes. Individual areas are irregular in shape and generally range from about 20 to 400 acres in size. They are 45 to 65 percent Padus soil and 20 to 30 percent Pence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a surface layer of dark brown fine sandy loam about 1 inch thick. The subsurface layer is reddish gray fine sandy loam about 4 inches thick. The subsoil is about 33 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part, brown and dark brown sandy loam in the next part, and dark brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown gravelly sand. In some areas the surface layer is sandy loam or loam. In places the substratum is stratified sand and gravel.

Typically, the Pence soil has a surface layer of dark brown sandy loam about 3 inches thick. The subsoil is about 18 inches thick. It is reddish brown sandy loam in the upper part and yellowish red loamy sand in the lower part. The substratum to a depth of about 60 inches is brown gravelly sand. In places it is stratified sand and gravel.

Included with these soils in mapping are small areas of Karlin and Sayner soils. The somewhat excessively drained Karlin soils are in positions on the landscape similar to those of the Padus and Pence soils. They are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. The excessively drained Sayner soils are on sharp slope breaks. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included are areas where the slope is more than 15 percent, small areas where it is less than 6 percent, and some small areas of wet soils in depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Padus soil and moderately rapid in the subsoil of the Pence soil. It is rapid or very rapid in the substratum of both soils. The available water capacity is moderate in the Padus soil and low in the Pence soil.

These soils are used as woodland. They are suited to trees. The main concern in managing woodland is the equipment limitation in areas of the Padus soil. The use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. The slope limits the selection of landing sites. Landings can be established on the nearly level or undulating included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Trees generally are not planted on these soils.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, these soils are only moderately suited to dwellings. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

These soils are moderately suited to local roads and streets. The slope of both soils and the potential for frost action in the Padus soil are limitations. Frost action can be controlled by covering or replacing the upper part of the Padus soil with coarse textured base material, such as sand or gravel. The slope can be overcome by cutting and filling.

The land capability classification is IVe. The woodland ordination symbol assigned to the Padus soil is 3L, and the one assigned to the Pence soil is 7S. The primary habitat type is ATD, and the secondary habitat type is TM.

PeD—Padus-Pence complex, 15 to 35 percent slopes. These hilly to very steep, well drained soils are on pitted outwash plains. The Padus soil is on the mid and lower side slopes and on broad ridgetops. The Pence soil is on narrow ridges, slope breaks, and the upper side slopes. Individual areas are irregular in shape and generally range from about 20 to 320 acres in size. They are 40 to 60 percent Padus soil and 20 to 35 percent Pence soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Padus soil has a surface layer of dark brown fine sandy loam about 4 inches thick. The subsoil is about 31 inches thick. It is dark reddish brown and reddish brown fine sandy loam in the upper part, brown and reddish brown sandy loam in the next part, and reddish brown gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown gravelly sand. In some areas the surface layer is sandy loam or loam. In places the substratum is stratified sand and gravel.

Typically, the Pence soil has a surface layer of reddish gray sandy loam about 4 inches thick. The subsoil is about 15 inches thick. It is reddish brown. It is sandy loam in the upper part and gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In places it is gravelly sand.

Included with these soils in mapping are small areas of the excessively drained Sayner soils on sharp slope breaks. These included soils are loamy sand in the surface layer and in the upper part of the subsoil. Also included are small areas on ridgetops and foot slopes where the slope is less than 15 percent and some small areas of wet soils in depressions. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the subsoil of the Padus soil and moderately rapid in the subsoil of the Pence soil. It is rapid or very rapid in the substratum of both soils. The available water capacity is moderate in the Padus soil and low in the Pence soil.

These soils are used as woodland. They are suited to trees. The main concerns in managing woodland are the erosion hazard and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. On the Padus soil, the use of equipment is restricted in the spring and in other excessively wet periods because of low strength. Ruts form if wheeled skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or undulating included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

These soils are poorly suited to septic tank absorption fields because of the slope. A slope of less than 20 percent can be overcome by cutting and filling. The soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, these soils are poorly suited to dwellings. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

These soils are poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling.

The land capability classification is VIIe. The woodland ordination symbol assigned to the Padus soil is 3R, and the one assigned to the Pence soil is 7R. The primary habitat type is ATD, and the secondary habitat type is TM.

PnB—Pence sandy loam, 0 to 6 percent slopes. This nearly level and gently sloping, well drained soil is on flats and convex slopes. Individual areas are irregular in shape. Most range from about 10 to several hundred acres in size.

Typically, about 2 inches of partially decomposed forest litter is at the surface. The surface layer is reddish gray sandy loam about 3 inches thick. The subsoil is about 20 inches thick. It is dark reddish brown and reddish brown sandy loam in the upper part and reddish brown loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In places it is sand or gravelly sand.

Included with this soil in mapping are small areas of Karlin, Manitowish, Padus, and Sayner soils. The somewhat excessively drained Karlin soils are in positions on the landscape similar to those of Pence soil. They are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. The moderately well drained Manitowish soils are in depressions and on foot slopes adjacent to wet basins or to lakes. The well drained Padus soils are on concave slopes and the lower side slopes. They are deeper to sand and gravel than the Pence soil. The excessively drained Sayner soils are on slope breaks. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included are a few areas of Pence soils that have a slope of more than 6 percent. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Many areas have been planted to pine.

This soil is suited to trees. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil is suited to dwellings and to local roads and streets. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIe. The woodland ordination symbol is 7S. The primary habitat type is TM, and the secondary habitat type is TMV.

PnC—Pence sandy loam, 6 to 15 percent slopes. This sloping and moderately steep, well drained soil is on the sides of terraces and on knolls and ridges. Individual areas are long and narrow or irregularly shaped. Most range from about 10 to 240 acres in size.

Typically, about 2 inches of partially decomposed forest litter is at the surface. The surface layer is brown sandy loam about 2 inches thick. The subsoil is about 18 inches thick. It is reddish brown. It is sandy loam in the upper part and gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish red gravelly sand. In some areas it is sand or stratified sand and gravel.

Included with this soil in mapping are small areas of Karlin, Manitowish, Padus, and Sayner soils. The somewhat excessively drained Karlin soils are in positions on the landscape similar to those of the Pence soil. They are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. The moderately well drained Manitowish soils are on foot slopes adjacent to wet basins or to lakes. The well drained Padus soils are on concave side slopes. They are deeper to sand and gravel than the Pence soil. The excessively drained Sayner soils are on sharp slope breaks and narrow ridgetops. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included are areas where the slope is more than 15 percent and small areas where it is less than 6 percent. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. Some are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to pine.

This soil is suited to trees. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is only moderately suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling and by designing dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is IVe. The woodland ordination symbol is 7S. The primary habitat type is TM, and the secondary habitat type is TMV.

PnD—Pence sandy loam, 15 to 25 percent slopes. This moderately steep and steep, well drained soil is on the sides of terraces and on knolls and ridges. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 200 acres in size.

Typically, the surface layer is dark reddish brown sandy loam about 3 inches thick. The subsoil is about 19 inches thick. It is reddish brown and dark brown sandy loam in the upper part and strong brown loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown gravelly sand. In places it is sand or stratified sand and gravel.

Included with this soil in mapping are small areas of Manitowish, Padus, Rubicon, and Sayner soils. The moderately well drained Manitowish soils are on foot slopes adjacent to wet basins or to lakes. The well drained Padus soils are on concave slopes. They are deeper to sand and gravel than the Pence soil. The excessively drained Rubicon soils are in positions on the landscape similar to those of the Pence soil. They are sand throughout. The excessively drained Sayner soils are on sharp slope breaks and narrow ridgetops. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included, on ridgetops and foot slopes, are small areas where the slope is less than 15 percent. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Pence soil and rapid or very rapid in the substratum. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as pasture.

This soil is suited to trees. The main concerns in managing woodland are the erosion hazard and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. In areas where the slope limits the use of equipment, yarding logs by cable may be necessary.

The slope limits the selection of sites for logging roads and landings. Logging roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or gently sloping included or adjacent soils.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the slope, this soil is poorly suited to septic tank absorption fields. A slope of less than 20 percent can be overcome by cutting and filling. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

This soil is poorly suited to dwellings because of the slope. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

This soil is poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIe. The woodland ordination symbol is 7R. The primary habitat type is TM, and the secondary habitat type is TMV.

Pt—Pits, gravel. This map unit is in areas where sand, sand and gravel, and glacial till have been removed. Individual areas are irregular in shape and range from about 3 to 60 acres in size.

Typically, the material on the bottom and sidewalls of the pits is sand, stratified sand and gravel, or sandy or loamy glacial till.

Included with this unit in mapping are small areas of spoil. The spoil includes soil material pushed from the pit areas before excavation and piles of material that was discarded because it did not contain enough gravel or was considered unsuitable for some other reason. Also included in some pits are stones and boulders that are too large to be crushed.

Many pits are still in use. Some have been abandoned and are overgrown with brush and weeds. Some of the abandoned pits are used as sanitary landfills. Water is in a few pits. The main management concern is reclamation of the site after excavation. Before most areas can support a plant cover, land shaping and additions of suitable topsoil are needed.

Onsite investigation is needed to determine the suitability of this unit for septic tank absorption fields, dwellings, and local roads and streets.

No land capability classification, woodland ordination symbol, or a habitat type is assigned.

RoB—Rubicon sand, 0 to 6 percent slopes. This nearly level and gently sloping, excessively drained soil is on flats and convex slopes. Individual areas are irregular in shape. Most range from about 10 to several hundred acres in size.

Typically, about 2 inches of partially decomposed leaf litter is at the surface. The surface layer is dark reddish gray sand about 1 inch thick. The subsoil is dark reddish brown, reddish brown, and strong brown sand about 23 inches thick. The substratum to a depth of about 60 inches is strong brown sand. In places thin layers of gravel are in the substratum.

Included with this soil in mapping are small areas of Croswell, Karlin, and Sayner soils. The moderately well drained Croswell soils are in drainageways and shallow depressions and on foot slopes adjacent to wet basins or to lakes. Karlin and Sayner soils are in positions on the landscape similar to those of the Rubicon soil. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil. The excessively drained Sayner soils are loamy sand in the surface layer and in the upper part of the subsoil and contain more gravel in the substratum than the Rubicon soil. Also included are areas where thin strata of loamy fine sand or sandy loam are in the substratum and areas where the slope is more than 6 percent. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Many areas have been planted to pine.

This soil is suited to trees. Pine and aspen are the dominant species in the stands. The major concern in managing woodland is the seedling mortality resulting from droughtiness. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

This soil is suited to dwellings and to local roads and streets. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs. The woodland ordination symbol is 6S. The primary habitat type is QAE, and the secondary habitat type is AQVac.

RoC—Rubicon sand, 6 to 15 percent slopes. This sloping and moderately steep, excessively drained soil is on knolls, ridges, and the sides of terraces. Individual areas are long and narrow or irregularly shaped. Most range from about 10 to several hundred acres in size.

Typically, about 2 inches of partially decomposed forest litter is at the surface. The surface layer is dark reddish gray sand about 1 inch thick. The subsoil is dark reddish brown, reddish brown, and strong brown sand about 33 inches thick. The substratum to a depth of about 60 inches is strong brown sand. In places thin layers of gravel are in the substratum.

Included with this soil in mapping are small areas of Croswell, Karlin, and Sayner soils. The moderately well drained Croswell soils are on foot slopes adjacent to wet basins or to lakes. Karlin and Sayner soils are in positions on the landscape similar to those of the Rubicon soil. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil. The excessively drained Sayner soils are loamy sand in the surface layer and in the upper part of the subsoil and contain more gravel in the substratum than the Rubicon soil. Also included are areas where the slope is more than 15 percent and small areas where it is less than 6 percent. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low.

Most areas of this soil are used as woodland. A few small areas are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Many areas have been planted to pine.

This soil is suited to trees. Pine and aspen are the dominant species in the stands. The major concern in managing woodland is the seedling mortality resulting from droughtiness. The equipment limitation also is a concern. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. The slope limits the selection of landing sites. Landings can be established on the nearly level or gently sloping included or adjacent soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

This soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is only moderately suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling and by designing dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIs. The woodland ordination symbol is 6S. The primary habitat type is QAE, and the secondary habitat type is AQVac.

RoD—Rubicon sand, 15 to 30 percent slopes. This moderately steep and steep, excessively drained soil is on side slopes. Individual areas are long and narrow or irregularly shaped. Most range from about 5 to 240 acres in size.

Typically, about 1 inch of partially decomposed leaf litter is at the surface. The surface layer is reddish gray sand about 3 inches thick. The subsoil is reddish brown and strong brown sand about 23 inches thick. The substratum to a depth of about 60 inches is reddish yellow sand. In places thin layers of gravel are in the substratum.

Included with this soil in mapping are small areas of Croswell and Sayner soils. The moderately well drained Croswell soils are on foot slopes adjacent to wet basins or to lakes. The excessively drained Sayner soils are in positions on the landscape similar to those of the Rubicon soil. They are loamy sand in the surface layer and in the upper part of the subsoil and contain more gravel in the substratum than the Rubicon soil. Also included, on broad ridgetops and on foot slopes, are small areas where the slope is less than 15 percent. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low.

Most areas of this soil are used as woodland. A few are used as pasture.

This soil is suited to trees. Pine and aspen are the dominant species in the stands. The major concerns in managing woodland are the erosion hazard, seedling mortality, and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads and trails on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. The rate of seedling mortality resulting from droughtiness can be reduced by planting when the soil is moist. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. Before trees are planted, site preparation by mechanical or chemical means may be needed to control competing vegetation.

In areas where the slope limits the use of equipment, yarding logs by cable may be necessary. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or gently sloping adjacent soils. Loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel.

This soil is poorly suited to septic tank absorption fields because of the slope. A slope of less than 20 percent can be overcome by cutting and filling. The soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is poorly suited to dwellings. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

This soil is poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol is 6R. The primary habitat type is QAE, and the secondary habitat type is AQVac.

SaB—Sayner-Rubicon complex, 0 to 6 percent slopes. These nearly level and undulating, excessively drained soils are on flats and convex slopes. Individual areas are irregular in shape and generally range from about 10 to 320 acres in size. They are 50 to 75 percent Sayner soil and 20 to 40 percent Rubicon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Sayner soil has about 1 inch of partially decomposed forest litter at the surface. The surface layer is very dark brown loamy sand about 1 inch thick. The subsurface layer is dark reddish gray loamy sand about 2 inches thick. The subsoil is about 19 inches thick. It is dark reddish brown and reddish brown loamy sand in the upper part and reddish brown and yellowish red gravelly sand in the lower part. The substratum to a depth of about 60 inches is reddish yellow, stratified sand and gravel (fig. 9). In places the content of gravel is more than 35 percent in the surface layer, subsoil, or substratum.

Typically, the Rubicon soil has about 1 inch of partially decomposed forest litter at the surface. The surface layer is reddish gray sand about 2 inches thick. The subsoil is dark reddish brown and reddish brown sand about 26 inches thick. The substratum to a depth of about 60 inches is light brown sand. In some areas thin, discontinuous layers of gravel are in the substratum.

Included with these soils in mapping are small areas of Croswell, Karlin, and Pence soils. The moderately well drained Croswell soils are in drainageways and shallow depressions and on foot slopes adjacent to wet basins or to lakes. Karlin and Pence soils are in positions on the landscape similar to those of the Rubicon and Sayner soils. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. The well drained Pence soils are sandy loam in the surface layer and in the upper part of the subsoil. Also included are some areas of Rubicon soils that have a surface layer and subsoil of loamy sand and small areas of Sayner and Rubicon soils that have a slope of more than 6 percent. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. It is rapid in the Rubicon soil. Available water capacity is low in both soils.

Most areas of these soils are used as woodland. A few are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Many areas have been planted to pine.

These soils are suited to trees. The main concern in managing woodland is the seedling mortality resulting from droughtiness in the Rubicon soil. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate. In areas of the Rubicon soil, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. Also, the landings can be established in areas of the Sayner soil.

After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means generally is needed to control competing vegetation.

These soils are suited to dwellings and to local roads and streets. They readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

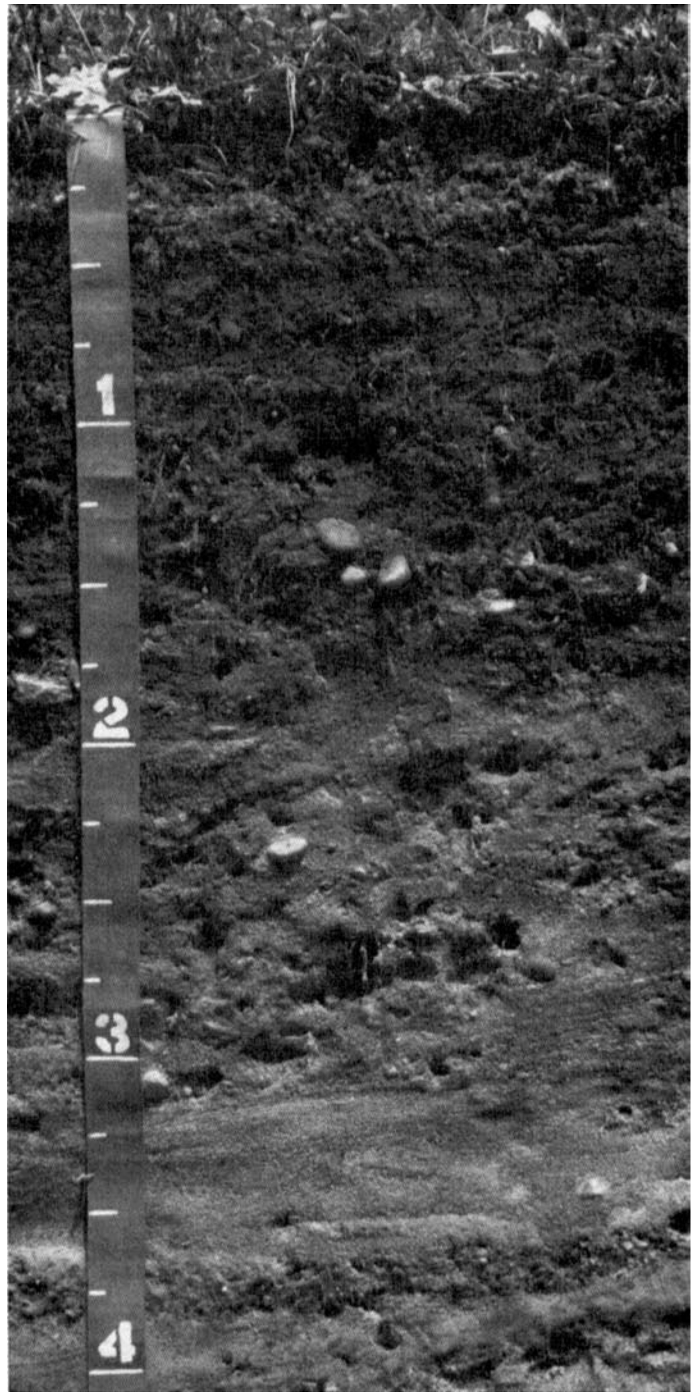

Figure 9.—Typical profile of Sayner loamy sand, which formed in sandy deposits and in the underlying outwash of stratified sand and gravel. Depth is marked in feet.

The land capability classification is IVs. The woodland ordination symbol assigned to the Sayner soil is 7S, and the one assigned to the Rubicon soil is 6S. The primary habitat type is AQVac, and the secondary habitat type is TMV.

SaC—Sayner-Rubicon complex, 6 to 15 percent slopes. These rolling and hilly, excessively drained soils are on knolls, ridges, and the sides of terraces. Individual areas are long and narrow or irregularly shaped and generally range from about 10 to several hundred acres in size. They are 50 to 75 percent Sayner soil and 20 to 40 percent Rubicon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Sayner soil has about 2 inches of partially decomposed forest litter at the surface. The surface layer is dark reddish gray loamy sand about 1 inch thick. The subsoil is about 27 inches thick. It is dark reddish brown and reddish brown loamy sand in the upper part and reddish brown and yellowish red gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In places the content of gravel is more than 35 percent in the surface layer, subsoil, or substratum.

Typically, the Rubicon soil has a surface layer of dark brown sand about 2 inches thick. The subsurface layer is brown sand about 3 inches thick. The subsoil is reddish brown sand about 18 inches thick. The substratum to a depth of about 60 inches is light brown sand. In some areas thin, discontinuous layers of gravel are in the substratum.

Included with these soils in mapping are small areas of Croswell, Karlin, and Pence soils. The moderately well drained Croswell soils are on foot slopes adjacent to wet basins or to lakes. Karlin and Pence soils are in positions on the landscape similar to those of the Rubicon and Sayner soils. The somewhat excessively drained Karlin soils are loamy fine sand in the surface layer and in the upper part of the subsoil and have a substratum of sand. The well drained Pence soils are sandy loam in the surface layer and in the upper part of the subsoil. Also included are some areas of Rubicon soils that are loamy sand in the surface layer and in the upper part of the subsoil, areas where the slope is more than 15 percent, and small areas where it is less than 6 percent. Included soils make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid or very rapid in the substratum. It is rapid in the Rubicon soil. The available water capacity is low in both soils.

Most areas of these soils are used as woodland. A few small areas are used as cropland or pasture. Areas of idle cropland are reverting naturally to woodland. Some areas have been planted to pine.

These soils are suited to trees. The major concern in managing woodland is the seedling mortality resulting from droughtiness in the Rubicon soil. Planting when the soil is moist can reduce seedling losses. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

The slope limits the selection of landing sites. Landings can be established in the nearly level or undulating areas. In areas of the Rubicon soil, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. Also, the landings can be established in areas of the Sayner soil.

After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation by mechanical or chemical means generally is needed to control competing vegetation.

These soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, these soils are only moderately suited to dwellings and to local roads and streets. This limitation can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land. Constructing roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIs. The woodland ordination symbol assigned to the Sayner soil is 7S, and the one assigned to the Rubicon soil is 6S. The primary habitat type is AQVac, and the secondary habitat type TMV.

SaD—Sayner-Rubicon complex, 15 to 35 percent slopes. These hilly to very steep, excessively drained soils are on knolls, ridges, and the sides of terraces. Individual areas are long and narrow or irregularly shaped and generally range from about 5 to several hundred acres in size. They are 50 to 75 percent Sayner soil and 20 to 40 percent Rubicon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical.

Typically, the Sayner soil has a surface layer of dark reddish brown loamy sand about 2 inches thick. The subsurface layer is dark reddish gray loamy sand about 3 inches thick. The subsoil is about 22 inches thick. It is reddish brown loamy sand in the upper part, yellowish red sand in the next part, and brown gravelly sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In places the content of gravel is more than 35 percent in the surface layer, subsoil, or substratum.

Typically, the Rubicon soil has a surface layer of dark reddish brown sand about 1 inch thick. The subsurface layer is reddish gray sand about 4 inches thick. The subsoil is dark reddish brown and reddish brown sand about 15 inches thick. The substratum to a depth of about 60 inches is strong brown sand. In some areas thin, discontinuous layers of gravel are in the substratum.

Included with these soils in mapping are small areas of Croswell and Pence soils. The moderately well drained Croswell soils are on foot slopes adjacent to wet basins or to lakes. The well drained Pence soils are in positions on the landscape similar to those of the Rubicon and Sayner soils. They are sandy loam in the surface layer and in the upper part of the subsoil. Also included are some areas of Rubicon soils that are loamy sand in the surface layer and in the upper part of the subsoil, small areas of wet soils in depressions, and small areas on broad ridgetops and on foot slopes where the slope is less than 15 percent. Included soils make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the subsoil of the Sayner soil and rapid in the substratum. It is rapid in the Rubicon soil. The available water capacity is low in both soils.

These soils are used as woodland. They are suited to trees. The main concerns in managing woodland are the erosion hazard, seedling mortality, and the equipment limitation. Erosion results from the concentration of runoff on logging roads, skid trails, and landings. Removing water by water bars, out-sloping road surfaces, ditches, and culverts and establishing logging roads and trails on the contour minimize erosion. Seeding areas exposed by logging activities helps to establish a protective vegetative cover. Seedling survival during dry periods can be improved by planting when the Rubicon soil is moist, especially on the southern exposures. Planting containerized seedlings or vigorous nursery stock also can reduce the seedling mortality rate.

In areas where the slope limits the use of equipment, special logging methods, such as yarding the logs by cable, may be needed. The slope also limits the selection of sites for logging roads and landings. The roads can be designed so that they conform to the topography. The grade should be kept as low as possible. Landings can be established on the nearly level or undulating included soils. In areas of the Rubicon soil, loose sand can interfere with the traction of wheeled equipment, especially during dry periods. Landings and other areas that are subject to the repeated use of heavy equipment can be stabilized with gravel. Also, the landings can be established in areas of the Sayner soil.

After trees are cut, plant competition can be expected to delay the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. Before trees are planted, site preparation generally is needed to control competing vegetation.

Because of the slope, these soils are poorly suited to septic tank absorption fields. A slope of less than 20 percent can be overcome by cutting and filling. The soils readily absorb but do not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water.

These soils are poorly suited to dwellings because of the slope. A slope of more than 20 percent cannot be easily overcome. A slope of less than 20 percent can be overcome by cutting and filling and by designing the dwellings so that they conform to the natural slope of the land.

These soils are poorly suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling. Constructing the roads on the contour minimizes the amount of cutting required to shape the roadway.

The land capability classification is VIIs. The woodland ordination symbol assigned to the Sayner soil is 7R, and the one assigned to the Rubicon soil is 6R. The primary habitat type is AQVac, and the secondary habitat type is TMV.

Se—Seelyeville and Markey mucks, 0 to 1 percent slopes. These nearly level, very poorly drained soils are on low flats adjacent to streams and lakes and in drainageways and depressions. The soils are subject to ponding. Individual areas are long and narrow or irregularly shaped. They generally are about 5 to 640 acres in size but range to 2,000 acres. Some areas are 60 to 90 percent Seelyeville soil and 0 to 30 percent Markey soil. Some are 60 to 90 percent Markey soil and 0 to 30 percent Seelyeville soil. Others are 30 to 45 percent each soil. The two soils are similar enough in behavior characteristics to be mapped as one unit.

Typically, the Seelyeville soil is black muck more than 60 inches thick. The muck is of herbaceous origin. In some areas 1 to 4 inches of peat moss is at the surface. In other areas thin layers of mucky peat are below the surface. In places the muck is derived primarily from woody plants and contains woody fragments.

Typically, the Markey soil is black and dark brown muck in the upper 40 inches. The muck is of herbaceous origin. The substratum to a depth of about 60 inches is brown sand. In places the muck is derived primarily from woody plants and contains woody fragments. In some areas thin layers of loamy material are directly above the sandy substratum or are in the substratum. In other areas the substratum is gravelly sand.

Included with these soils in mapping are small areas of the poorly drained Kinross soils on the slightly higher parts of the landscape. These included soils formed in a thin layer of organic material and in sandy deposits. Also included are small areas of the poorly drained and very poorly drained, sandy Fluvaquents on flood plains; small areas of the very poorly drained, ponded Histosols adjacent to streams and lakes and along the edges of depressions; and small areas of open water. Included areas make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the Seelyeville soil. It is moderately rapid in the organic part of the Markey soil and rapid in the sandy substratum. The available water capacity is very high in both soils. Both have a water table that is near or above the surface throughout the year.

Most areas of these soils are used as woodland. Some areas, commonly those adjacent to streams, support native wetland vegetation of marsh grasses, sedges, reeds, cattails, and speckled alder.

These soils are suited to trees. The main concerns in managing woodland are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is generally limited to winter, when access roads are frozen. Reforestation is limited to natural regeneration. Trees generally are not planted on these soils because of the wetness, severe seedling mortality, and plant competition. A shallow rooting depth, which is caused by the wetness, can result in windthrow of many trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After a harvest, plant competition can prevent or delay the natural regeneration of desirable tree species unless precautionary measures are applied. Special harvest methods may be needed to control the competing plants.

Because of the ponding and low strength, these soils generally are unsuited to septic tank absorption fields and dwellings. Overcoming these limitations is difficult. A better site should be selected.

These soils are poorly suited to local roads and streets because of the ponding, the potential for frost action, and low strength. Surface water can be removed through suitable outlets by culverts and ditches. Additions of fill material can raise the roads above the level of ponding. Culverts help to prevent road damage by equalizing the water level on both sides of the road. Frost action and low strength can be overcome by excavating the organic material and replacing it with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement.

The land capability classification is VIw. The woodland ordination symbol assigned to the Seelyeville soil is 8W, and the one assigned to the Markey soil is 7W. The primary habitat type is TTS, and the secondary habitat type is FMC.

Wv—Worcester Variant sandy loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low flats and in depressions. Individual areas are irregular in shape. Most range from about 10 to 70 acres in size.

Typically, about 1 inch of partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown sandy loam about 1 inch thick. The subsurface layer is reddish gray sandy loam about 4 inches thick. The subsoil is dark reddish brown and reddish brown sandy loam about 13 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown, mottled gravelly sand. In places it is sand or stratified sand and gravel.

Included with this soil in mapping are small areas of the moderately well drained Manitowish soils in the slightly higher positions on the landscape. Also included are small areas of poorly drained soils in shallow depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Worcester Variant soil and rapid or very rapid in the substratum. The available water capacity is low. A seasonal high water table is at a depth of 1 to 3 feet.

This soil is used as woodland. It is suited to trees. The major concerns in managing woodland are the equipment limitation and the windthrow hazard. The use of equipment is restricted in the spring and in other excessively wet periods because of the seasonal high water table. The soil is easily rutted by wheeled vehicles during these periods. Deep ruts tend to restrict lateral drainage and result in damage to tree roots. Equipment should be used only when the soil is dry or has an adequate snow cover. A shallow rooting depth, which is caused by the high water table, can result in windthrow of some trees during periods of strong winds. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

After trees are cut, plant competition can be expected to delay or prevent the natural regeneration of desirable tree species. Special harvest methods may be needed to control the competing plants. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. Subsequent control of invading species may be needed.

Because of the wetness and the rapid or very rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. In some areas the effluent can be pumped to an absorption field established on higher lying, better suited soils.

Because of the wetness, this soil is poorly suited to dwellings. Dwellings without basements can be constructed on fill material, which raises the level of the site. Basements can be constructed above the level of wetness. A subsurface drainage system that has a gravity outlet or another dependable outlet also helps to overcome the wetness.

This soil is only moderately suited to local roads and streets because of the wetness and the potential for frost action. These limitations can be overcome by adding suitable fill material, such as sand or gravel, which raises the roadbed above the level of wetness, and by installing a good surface and subsurface drainage system, which lowers the water table.

The land capability classification is IIw. The woodland ordination symbol is 2W. The habitat type is TMC.

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 and 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 inputs 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 Soil Conservation Service.

About 38,000 acres in Vilas County, or 6.8 percent of the land area, is prime farmland. Scattered areas of this land are throughout the county, mainly in associations 2 and 4, which are described under the heading "General Soil Map Units." Some of this prime farmland is used for crops, mainly hay, oats, and potatoes, but much of it is woodland.

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 for 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.

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 avoid 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 behavior 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 as woodland; for crops and pasture; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the suitability 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 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.

Woodland Management and Productivity

George W. Alley, forester, Soil Conservation Service, helped prepare this section.

Forest resources have long been of major importance in Vilas County. About 398,500 acres, or nearly 72 percent of the land area, was forested in 1983 (*15*). Of this, about 371,300 acres was commercial forest. More than half of the forested acreage is in public ownership. Pine types were originally dominant throughout most of the county. Because of logging and fires, however, the pine generally has been replaced by aspen and paper birch.

Northern hardwoods dominate in areas of soil associations 2, 3, 4, and 6, which are described under the heading "General Soil Map Units." Sugar maple is the dominant species in associations 3 and 4, but other northern hardwoods also are in the stands. The major species are sugar maple, basswood, yellow birch, and hemlock. Other species include white pine, balsam fir, American elm, rock elm, black cherry, white ash, and white spruce. Aspen and paper birch stands are common, especially in association 3, but usually are quickly invaded by sugar maple and other northern hardwoods. Balsam fir and spruce are on the wetter sites.

Sugar maple and red oak dominate most timber stands in associations 2 and 6. Basswood, hemlock, yellow birch, paper birch, red maple, white pine, red pine, white spruce, aspen, and balsam fir are in most stands in association 2. Paper birch, red maple, white pine, red pine, aspen, and balsam fir are common in association 6. Stands of aspen, white birch, and red maple and an understory of balsam fir are common in both associations.

Although aspen and pine dominate in associations 1 and 7, these associations support all the timber types commonly grown in the county. Some small areas support a wide variety of different species, but many areas support a single timber type. The common species are jack pine, red pine, white pine, aspen, paper birch, red maple, red oak, pin oak, and balsam fir. Many pine plantations are in areas of these associations (fig. 10).

Wooded swamps, which are in scattered areas throughout the county, support mainly black spruce, tamarack, northern white-cedar, and balsam fir. Red maple, black ash, paper birch, and yellow birch are in some stands.

In 1983, the composition of the commercial forest land, by stand-size class, was 31 percent sawtimber, 45 percent poletimber, and 24 percent seedlings and saplings. The sawtimber was mostly sugar maple and red pine, but it also included oak, birch, elm, ash, aspen, and other species. Poletimber, seedlings, and saplings were mostly aspen and maple, but they also included birch, balsam, spruce, pine, oak, basswood, ash, and

Figure 10.—Jack pine planted in an area of Rubicon sand, 0 to 6 percent slopes. Jack pine is suitable for planting on this droughty soil.

other species. The trend is toward fewer seedlings and saplings, less poletimber, and more sawtimber.

The composition of the forest land, by timber type, in 1983 was about 36 percent aspen-white birch, 26 percent sugar maple-basswood-birch, 19 percent pine, 12 percent spruce-fir and other conifers, 4 percent oak, and 3 percent elm-ash and other lowland hardwoods. The trend is toward more conifers and fewer oaks, lowland hardwoods, and upland hardwoods. In recent years the acreage of the aspen-birch type has slightly decreased.

The growing stock had a volume of 6,000,000 cords, an annual growth of 174,000 cords, and an annual removal of 128,000 cords in 1983. Sawtimber had a volume of 1,158,000,000 board feet, an annual growth of 42,900,000 board feet, and an annual removal of 25,100,000, board feet.

In 1980, the county had about 23,760 acres of conifer plantations more than 5 acres in size. These plantations included about 11,350 acres of red pine, 9,650 acres of jack pine, 1,380 acres of white spruce, 860 acres of white pine, and 520 acres of balsam fir and other species. About 75 percent of the plantations are 20 years old or older.

Management of the different kinds of soil in Vilas County for wood crops varies. It should be based on the species in the stand, the suitability of the soils for the species, and the objectives of the landowners. The best alternative generally is selective harvesting that favors any hardwood species or even-aged management that favors any aspen or birch species. Even-aged management that favors pine species and northern red oak is desirable if the stands have significant amounts of these species. Other management alternatives can favor northern white-cedar for the production of posts and piles or balsam fir as a pulpwood species. Management should include controlling erosion, planting trees where natural regeneration is unreliable, controlling plant competition, improving seedling survival, minimizing windthrow on the wetter sites, timely harvesting, controlling the damage caused by insects and diseases, removing cull trees and undesirable species, and maintaining an optimum basal area.

Soil erosion can occur as a result of site preparation and cutting if the soil is exposed along logging roads and skid trails and on landings. Burned areas also are subject to erosion. Erosion is generally a hazard on forest land if the slope is 15 percent or more. The areas that are susceptible to erosion include some areas of the Champion, Gogebic, Keweenaw, Padus, Pence, Rubicon, and Sayner soils. Carefully selecting sites for logging roads and skid trails minimizes erosion.

Soil wetness is the result of a high water table, flooding, or ponding. It causes seedling mortality, limits the use of equipment, increases the extent of undesirable plants following harvest, and increases the windthrow hazard by restricting the rooting depth of some trees. Wetness is a problem in forested areas of poorly drained and very poorly drained soils, including Cable, Kinross, Markey, and Seelyeville soils. In many areas of these soils, trees can be harvested only when the ground is frozen or has an adequate snow cover. Wetness during the tree-planting season limits reforestation to natural regeneration or hand planting. Planting large, vigorous nursery stock on prepared ridges or on cradle-knolls helps to control seedling mortality on wet soils. Shelter-wood or strip-cut harvest methods help to ensure natural regeneration of trees and help to prevent windthrow of the remaining trees. After a harvest, competing vegetation can be controlled by applications of suitable herbicides or by mechanical removal.

Water ponds in small swales between cradle-knolls in some areas of somewhat poorly drained soils, including Gaastra and Monico soils. Seedling mortality is high in the swales. The trees should be planted by hand on the cradle-knolls or by machine on prepared ridges if natural regeneration is unreliable.

Soil droughtiness can cause seedling mortality. The steeper south- and west-facing slopes can be especially droughty because of high soil temperatures and the evaporation rate. Droughtiness is a problem in Croswell and Rubicon soils. Seedling survival during dry periods can be improved by planting large, vigorous nursery stock if natural regeneration is unreliable. Reinforcement planting may be needed. Containerized planting stock may be needed on very dry sites.

Slope can limit the use of forestry equipment if it is 15 percent or more. Hand planting is needed in areas where the slope prohibits machine planting. Harvesting equipment cannot be operated safely on the steepest slopes. Special systems are needed on these slopes.

Soil productivity is so high in most of the forested areas in the county that the growth of undesirable plants is a problem when openings are made in the tree canopy. Competition from unwanted plants can hinder or prevent regeneration of the more desirable species. It can be controlled by applications of suitable herbicide, by mechanical removal, or by selective cutting that maintains most of the tree canopy.

Table 6 and 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. Table 6 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 6, *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, fire lanes, and 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, the potential for frost action, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

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

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

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

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

Trees to plant are those that are suitable for commercial wood production. Further information about these trees is available in the local office of the Soil Conservation Service.

Table 7 gives information about operating harvesting or thinning equipment in logging areas and on skid trails, log landings, and haul roads. Limitations are given for the most limiting season and for the preferred season. The *most limiting season* in Vilas County generally is spring or late fall. The *preferred operating season* is the period when harvesting or thinning causes the least amount of soil damage. This period generally is when the soil is not too wet or when the ground is frozen or partly frozen or has an adequate snow cover.

In table 7 a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high floatation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Logging areas and skid trails include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid trails, which generally are within the logging area, are roads or trails over which the logs are dragged or hauled from the stump to a log landing.

Log landings are areas where logs are assembled for transportation. Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Haul roads are access roads leading from primary or surfaced roads to the logging areas. The haul roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved roads. Some are graveled.

Additional information about woodland management and productivity can be obtained from the Wisconsin Department of Natural Resources, the local office of the Soil Conservation Service, or the Cooperative Extension Service.

Forest Habitat Types

The information in this section is derived from a field guide developed for the Upper Peninsula of Michigan and for northeast Wisconsin (*5*). The system of habitat classification used in the guide is based on the concept that plants occur in predictable patterns or communities and that these communities reflect differences in site characteristics.

Besides identifying the various habitat types by means of vegetative keys, the guide also provides information about the different possible successional stages for most of the habitat types. The successional stages depend largely on how the forest has been disturbed. They include the succession after logging in the original climax stands, the succession after logging in second-growth stands, and the succession in stands that have been both logged and burned.

The guide gives the suggested forest management for each of the successional stages. This management includes methods of thinning and harvest, site preparation, and measures that improve regeneration of the stands. The potential productivity, in terms of a site index and the mean annual volume in cubic feet per acre per year, is given for most of the habitat types. The development of the descriptive or interpretative information for some of the habitat types, however, is based on limited data and thus should be used with caution.

Habitat types have been determined for each map unit in Vilas County. The primary habitat type is the one that is most common on the map unit. The secondary habitat type is less common. Habitat types are specified at the end of the descriptions in the section "Detailed Soil Map Units."

The following paragraphs describe the habitat types in the county. They provide information about the potential climax species, some of the common understory species, and, if known, the potential productivity of the habitat type.

AQVac—Acer-Quercus-Vaccinium habitat type. This habitat type has a potential climax overstory dominated by red maple and red oak. Other species include eastern hemlock, white pine, balsam fir, and white spruce. The dominant ground flora includes low sweet blueberry, Canada blueberry, brackenfern, wintergreen, bigleaf aster, and beaked hazelnut. The potential productivity is moderately low for northern hardwoods, moderate for aspen, and moderately high for red pine and jack pine.

ATD—Acer-Tsuga-Dryopteris habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include eastern hemlock, American basswood, and American beech. Yellow birch, red maple, and American elm are in some areas. The dominant ground flora includes spinulose shield fern, twistedstalk, hairy Solomons-seal, elderberry, and wild lily-of-the-valley. The potential productivity is moderately high for northern hardwoods and high for aspen. The potential productivity for red pine plantations is high if plant competition is controlled.

AVO—Acer-Viola-Osmorhiza habitat type. This habitat type has a potential climax overstory dominated by sugar maple. Other species include American basswood, white ash, yellow birch, eastern hophornbeam, eastern hemlock, and American elm. The dominant ground flora includes Canada white violet, sweet cicely, spinulose shield fern, ladyfern, hairy Solomons-seal, and rosy twistedstalk. The potential productivity is high for northern hardwoods and aspen. It also is high for red pine plantations if plant competition is controlled.

FI—Fraxinus-Impatiens habitat type. This habitat type has a potential climax overstory dominated by white ash and red maple. Other species include sugar maple, black ash, and balsam fir. The dominant, ground flora consists of jewelweed, sedge, enchanter's nightshade, spinulose shield fern, ladyfern, elderberry, and mint. The potential productivity for northern hardwoods is moderate.

FMC—Fraxinus-Mentha-Carex habitat type. This habitat type has a potential climax overstory dominated by black ash and American elm. Other species include red maple and balsam fir. The dominant ground flora consists of sedge, mint, elderberry, and jewelweed.

PCS—Picea-Chamadaphne-Sphagnum habitat type. This habitat type has a potential climax overstory dominated by black spruce and tamarack. The dominant ground flora consists of leatherleaf, bog rosemary, pale laurel, sphagnum moss, Labrador tea, sedge, and Canada blueberry.

QAE—Quercus-Acer-Epigaea habitat type. This habitat type has a potential climax overstory dominated by red oak and red maple. Other species are white spruce and white pine. The dominant ground flora consists of brackenfern, trailing arbutus, wintergreen, low sweet blueberry, mosses, and Canada blueberry. The potential productivity is moderately low for aspen and moderate for red pine and jack pine.

TM—Tsuga-Malanthemum habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock, sugar maple, and red maple. Other species include yellow birch, white spruce, balsam fir, white pine, red oak, northern white-cedar, and American basswood. The dominant ground flora includes wild lily-of-the-valley, brackenfern, sedge, starflower, and wild sarsaparilla. The potential productivity is moderate for northern hardwoods, moderately high for aspen, and high for red pine and jack pine.

TMC—Tsuga-Malanthemum-Coptis habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Sugar maple and yellow birch are common. Balsam fir, white spruce, and northern white-cedar are in some stands. The dominant ground flora consists of wild lily-of-the-valley, goldthread, yellow beadlily, bunchberry, starflower, and spinulose shield fern. The potential productivity for northern hardwoods is moderate.

TMV—Tsuga-Malanthemum-Vaccinium habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and red maple. Other species include red oak, white pine, balsam fir, and white spruce. The dominant ground flora includes Canada blueberry, wild sarsaparilla, brackenfern, wild lily-of-the-valley, low sweet blueberry, yellow beadlily, and wood betony. The potential productivity is moderate for northern hardwoods, moderately high for aspen, and high for red pine and jack pine.

TTS—Tsuga-Thuja-Sphagnum habitat type. This habitat type has a potential climax overstory dominated by eastern hemlock and northern white-cedar. Other species include balsam fir and black spruce. Red maple is in some stands. The dominant ground flora includes sphagnum moss, goldthread, bunchberry, sedge, wild lily-of-the-valley, starflower, and wood sorrel.

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 Soil 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 "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 5,000 acres in Vilas County was used for crops and pasture in 1982. Of this total, about 650 acres was used for row crops, mainly potatoes; 250 acres for small grain, mainly oats; and 2,550 acres for hay and pasture. The rest was native pasture or idle cropland.

The potential of the soils in the county for increased production of some crops, especially potatoes, is good. A short growing season limits cropping mainly to forage and small grain crops and to adapted vegetables. Food production also can be increased by extending the latest technology to all cropland in the county. The paragraphs that follow describe the main concerns in managing the cropland and pasture in the county. These concerns are water erosion, soil blowing, drainage, fertility, and tilth.

Water erosion is a problem on some of the cropland and pasture in the county. It is a hazard if the slope is more than 2 percent. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Erosion is especially damaging on soils that are only moderately deep over sand and gravel, such as Padus soils, and on soils that tend to be droughty, such as Karlin, Pence, and Sayner soils. Second, erosion on farmland can result in sedimentation of streams and lakes, thus decreasing the quality of water for recreation and for fish and wildlife.

Erosion can generally be controlled by measures that provide a protective vegetative cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to an amount that will not reduce yields.

Conservation tillage systems that leave protective amounts of crop residue on the surface, such as no-till, till-plant, chisel planting, and disc planting, increase the rate of water infiltration and reduce the runoff rate and the susceptibility to erosion. These systems can be applied on most of the soils in the county. Contour farming and contour stripcropping slow runoff and thus help to control erosion. They are practical only on soils with smooth, uniform slopes, such as the Champion soils. Grassed waterways help to prevent excessive erosion in channels and increase the infiltration rate by slowing runoff.

Soil blowing is a hazard on the sandy Au Gres, Croswell, Karlin, Kinross, Rubicon, and Sayner soils and on the organic Dawson and Loxley soils. It also is a hazard on Keweenaw, Manitowish, Pence, and Worcester Variant soils. Soil blowing can damage these soils and the crops growing on them in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining a plant cover, mulching, wind stripcropping, and establishing field windbreaks minimize soil blowing on these soils.

Further information about the design of erosion-control practices for each kind of soil can be obtained at the local office of the Soil Conservation Service.

Soil drainage is a major problem on only a small part of the acreage used for crops and pasture in the county. The poorly drained Cable and Kinross soils are naturally so wet that they generally cannot be used for the crops commonly grown in the county unless they are drained. In most areas of poorly drained soils, crops can be damaged by frost because of a low position on the landscape. The number of frost-free days per growing season is commonly fewer on these soils than on the adjacent upland soils because of cold air drainage to the lowlands. Unless drained, the somewhat poorly drained Au Gres, Monico, and Worcester Variant soils are so wet that crops can be damaged during most years.

The design of both surface and subsurface drainage systems varies with the kind of soil and the site conditions. Diversions are needed in some areas to divert the runoff from the adjacent uplands. Adequate outlets are not available in many areas of Au Gres, Kinross, and Worcester Variant soils. Further information about the design of drainage systems for each kind of soil can be obtained at the local office of the Soil Conservation Service.

Soil fertility varies in the soils of Vilas County, depending in part on the cropping history. All of the soils are naturally acid. If the soils have never been limed, applications of lime generally are needed to raise the pH to the desired level for the crop. Available potash levels are naturally low in many of the soils. Additions of lime and fertilizer to any soil should be based on the results of soil tests, on the needs of the crop, and on the desired level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Soil tilth affects the germination of seeds, the emergence of seedlings, and the infiltration of water into the soil. Soils with good tilth are granular and porous. Tilling or grazing when the soil is too wet can cause poor tilth, especially on soils that have a silt loam surface layer. If the surface is bare during periods of heavy rainfall, a crust can form on the surface. The crust reduces the infiltration rate and increases the runoff rate and the susceptibility to erosion. Returning crop residue to the soil and regularly adding manure or other organic material improve soil structure and tilth in the surface layer and help to prevent surface crusting.

Field crops suited to the soils in the county are limited by the short growing season. Very little of the acreage is used for corn. The corn is used for silage. Oats is the most commonly grown small grain. Wheat, barley, and buckwheat are grown on a small acreage in some years. Because of a few beef herds in the county, hay is an important crop. Mixtures of alfalfa and bromegrass and of red clover and timothy are the dominant hay crops, but alsike clover also is grown.

Renovation is needed on most of the *pastures* in the uplands. A good seedbed should be prepared and a suitable mixture of grasses and legumes seeded. Forage yields on the droughty Croswell, Karlin, Rubicon, and Sayner soils are generally somewhat limited. Planting early in spring, before the surface layer has a chance to dry out, helps to overcome the droughtiness. Overgrazing results in a deterioration of the plant cover and can result in erosion and soil blowing. Applications of fertilizer, pasture renovation, and controlled grazing help to maintain the plant cover. On the wetter soils, such as Au Gres, Cable, and Monico soils, restricted grazing during wet periods also helps to keep the pasture in good condition.

The *specialty crops* grown commercially in the county are potatoes (fig. 11) and cranberries. Most of the potato crop is used for certified seed. In 1981, about 400 acres near Manitowish Waters was used for cranberries. The bogs in this area are highly productive. Information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

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 8. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered (*6*).

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

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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

Crops other than those shown in table 8 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local

Figure 11.—A field of potatoes in an area of the Keweenaw-Karlin complex, 0 to 6 percent slopes.

office of the Soil 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 (*12*). 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 and for engineering purposes.

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is 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 each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Recreation

Vilas County provides many opportunities for outdoor recreation. Recreation and the facilities associated with recreation are an integral part of the local economy. The major recreation resources are the numerous lakes and streams and the large tracts of wooded public land.

The soils of the survey area are rated in table 9 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 sewerlines. 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 recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

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

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes 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 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

Thomas P. Thrall, biologist, Soil Conservation Service, helped prepare this section.

Wildlife species in Vilas County generally are those characteristic of the northern forested areas. The common mammals are black bear, white-tailed deer, coyote, porcupine, beaver, red fox, snowshoe hare, otter, raccoon, skunk, gray squirrel, red squirrel, mink, muskrat, and many small animals. The rare mammals include fisher, pine marten, bobcat, and timber wolf.

Ruffed grouse and woodcock are the common upland game birds. Although the county is not on a principal flyway, ducks and geese migrate through the county. Wood ducks, mallards, black ducks, and blue-winged teal are throughout the county. Mergansers, loons, and herons are common. Good populations of bald eagles and ospreys and several species of hawks, owls, woodpeckers, and songbirds also inhabit the county.

The abundance of the wildlife species depends on the timber types and the stages of tree growth. Timber- and pulp-cutting practices play a large role in determining the dominant tree species and the mixture of growth stages and thus the wildlife species that can thrive.

Soil affects wildlife habitat through its effect on tree species. The following paragraphs specify the species of trees and wildlife characteristic of the soil associations described under the heading "General Soil Map Units." Each association has a distinctive pattern of soils, relief, and drainage that generally affects the wildlife inhabiting the association.

The vegetation in the Rubicon-Sayner-Karlin association is dominantly pine, northern red oak, and aspen. Because of this combination, the association provides some of the best deer range in the county. Populations are estimated at 20 to 25 deer per square mile. Coyote populations are quite high. Retention of native jack pine in the stands and regeneration of aspen through clearcutting can improve the habitat for deer, grouse, and other wildlife species.

The Padus-Pence association has a wide range of timber types, including sugar maple, northern red oak, pine, American basswood, and birch. It is generally considered good deer range. Some of the best grouse habitat is in areas where tree cutting has fostered young stands of aspen and hardwoods. Creating openings in the tree canopy improves the habitat for deer and grouse.

The main timber types in the Gogebic-Pence-Fence association are sugar maple, American basswood, pine, and birch. Balsam fir and spruce grow in the wetter areas. The deer population is estimated at 15 deer per square mile. It is limited because snowfall is heavier in this association than in other parts of the county and because the hardwood stands are more mature and do not provide available browse. The association provides fairly good habitat for bear, coyote, and fisher.

The vegetation in the Champion association is almost exclusively hardwoods of sapling and pole size. This association produces some of the best timber in the county. It is not good deer range. The transition zone to other kinds of wildlife areas is the most productive habitat for deer. Fishers inhabit the association. The habitat for bear and bobcat is good, particularly in areas that include swamps.

The Loxley-Dawson association generally supports wetland plants, such as black spruce, tamarack, sphagnum, and leatherleaf. Its overall value as wildlife habitat is uncertain. The association supports some rare and interesting plants and some wildlife species that rely specifically on this type of habitat.

The Keweenaw-Karlin association has a wide range of timber types. Northern pin oak and northern red oak provide valuable mast for squirrels, deer, and other wildlife.

The sandy Croswell and Au Gres soils in the Croswell-Dawson-Au Gres association commonly support pine, aspen, balsam fir, and spruce, which provide good deer range. The habitat for grouse is good in areas where tree cutting has fostered young stands of aspen and in areas along the edges of wetlands. The organic Dawson soils in this association generally support wetland plants, such as black spruce, tamarack, sphagnum and leatherleaf. The overall value of areas of these soils as wildlife habitat is uncertain. The soils support some interesting plants and some wildlife species that rely specifically on this type of habitat.

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

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

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

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. 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, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, 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 flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are lambsquarters, ragweed, and common yarrow.

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, aspen, cherry, beaked hazelnut, dogwood, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are highbush cranberry, gray dogwood, and beaked hazelnut.

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, cedar, and hemlock.

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

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are 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. The wildlife attracted to these areas include red-tailed hawk, meadowlark, field sparrow, 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, 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. The ratings are given in the following tables: 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 need to 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, 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 kind 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 (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

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

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by 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 the 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, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 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. 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, and the available water capacity in the upper 40 inches affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. 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, and flooding affect absorption of the effluent. Large stones 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 are less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of 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 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 needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type 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 type 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 the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help 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, 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 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 the depth to the water table is 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. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source.

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, 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 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 or stones, 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 or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, 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 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 of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to 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 potential frost action. Excavating and grading and the stability of ditchbanks are affected by large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity in the root zone. 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. 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 reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, and large stones 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, and slope 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. These results are reported in table 18.

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 characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "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. 12). "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.

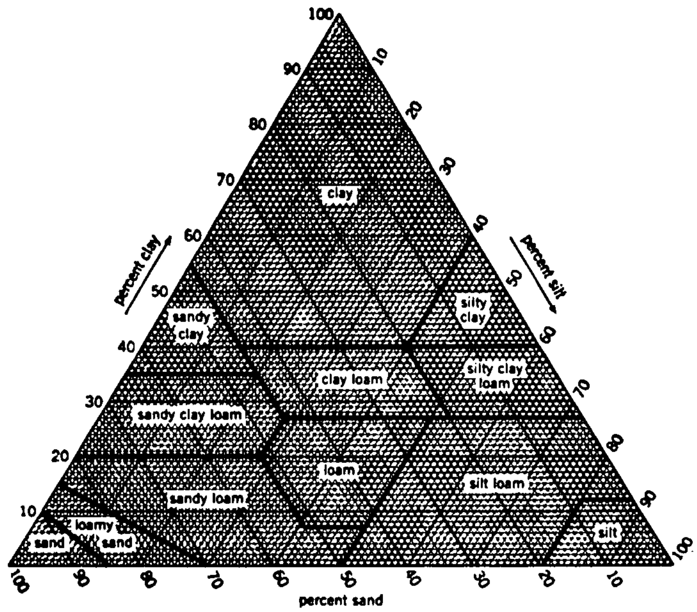

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

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 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and 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 1/3 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, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

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 change is based on the soil fraction less than 2 millimeters in diameter. 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. Sands, coarse 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 sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse 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 loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, 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. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

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 absence of distinctive horizons that form in soils that are not subject to flooding.

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 depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected total subsidence, which usually is a result of drainage and oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

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 creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Wisconsin Department of Transportation, Division of Highways and Transportation Facilities.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*13*). 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. Ten 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 Spodosol.

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 Aquod (*Aqu*, meaning water, plus *od*, from Spodosol).

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 Haplaquods (*Hapl*, meaning minimal horizonation, plus *aquod*, the suborder of the Spodosols that has an aquic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly 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 Typic Haplaquods.

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

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* (*11*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*13*). 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."

Alcona Series

The Alcona series consists of well drained soils on glacial lake plains, outwash plains, and moraines. These soils formed in stratified, loamy and sandy lacustrine deposits. Permeability is moderately rapid in the subsoil and moderate in the substratum. Slope ranges from 0 to 15 percent.

Typical pedon of Alcona fine sandy loam, in an area of Fence-Alcona complex, 0 to 6 percent slopes, 1,000 feet north and 280 feet east of the southwest corner of sec. 1, T. 43 N., R. 6 E.

A—0 to 3 inches; dark reddish brown (5YR 3/2) fine sandy loam, reddish gray (5YR 5/2) dry; moderate medium granular structure; friable; many fine and medium roots; very strongly acid; clear smooth boundary.

E—3 to 5 inches; reddish gray (5YR 5/2) fine sandy loam; moderate medium subangular blocky structure; friable; many fine and medium roots; very strongly acid; abrupt smooth boundary.

Bs1—5 to 11 inches; dark reddish brown (5YR 3/4) fine sandy loam; moderate medium subangular blocky structure; friable; common fine and medium roots; very strongly acid; gradual wavy boundary.

Bs2—11 to 18 inches; reddish brown (5YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; common fine and medium roots; strongly acid; clear wavy boundary.

Bs3—18 to 25 inches; yellowish red (5YR 4/6) loamy fine sand; weak thick platy structure parting to moderate medium subangular blocky; friable; few fine roots; medium acid; clear wavy boundary.

B/E—25 to 31 inches; reddish brown (5YR 4/4) loamy fine sand (Bt); coatings of dark reddish gray (5YR 4/2) loamy fine sand (E); weak thick platy structure parting to moderate fine and medium subangular blocky; very friable; strongly acid; clear wavy boundary.

Bt—31 to 36 inches; dark reddish brown (2.5YR 3/4) sandy loam; weak fine and medium subangular blocky structure; friable; common distinct dark reddish brown (2.5YR 3/4) clay films on faces of peds; strongly acid; abrupt smooth boundary.

C—36 to 60 inches; yellowish red (5YR 5/6) and reddish brown (5YR 4/4) stratified silt loam, very fine sandy loam, and fine sand; massive; very friable; medium acid.

The solum ranges from 24 to 45 inches in thickness. The A horizon is 1 to 3 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is fine sandy loam, sandy loam, or loamy fine sand. The E' horizon, if it occurs, and the E part of the E/B or B/E horizon have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. They are loamy sand, loamy fine sand, or fine sandy loam.

The Bt horizon and the Bt part of the E/B or B/E horizon have hue of 2.5YR, 5YR, or 7.5YR and value and chroma of 3 or 4. They are dominantly sandy loam, fine sandy loam, or very fine sandy loam. In some pedons, however, they have thin strata of silt loam, loamy fine sand, or loamy very fine sand.

The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is dominantly stratified fine sandy loam, very fine sandy loam, loamy sand, loamy fine sand, fine sand, or silt loam. Some pedons have thin strata of sand or clay loam. The strata vary widely in thickness.

Au Gres Series

The Au Gres series consists of somewhat poorly drained, rapidly permeable soils on outwash plains and stream terraces. These soils formed in sandy glacial outwash. Slope ranges from 0 to 2 percent.

The Au Gres soils in Vilas County have a ratio of free iron to carbon that is higher than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Au Gres sand, 0 to 2 percent slopes, 550 feet north and 1,000 feet east of the southwest corner of sec. 14, T. 42 N., R. 10 E.

Oe—2 inches to 0; black (N 2/0) partly decomposed forest litter.

E—0 to 4 inches; brown (7.5YR 5/2) sand; weak fine subangular blocky structure; very friable; common fine and medium roots; extremely acid; clear wavy boundary.

Bhs—4 to 6 inches; dark reddish brown (5YR 3/3) loamy sand; few fine prominent dark red (2.5YR 3/6) mottles; weak fine subangular blocky structure; very friable; common fine and medium roots; very strongly acid; clear wavy boundary.

Bs1—6 to 14 inches; dark reddish brown (5YR 3/4) sand; few fine distinct dark red (2.5YR 3/6) and common fine prominent yellowish red (5YR 4/8) mottles; weak medium subangular blocky structure; very friable; few fine and medium roots; strongly acid; clear wavy boundary.

Bs2—14 to 32 inches; reddish brown (5YR 4/4) sand; few fine distinct dark red (2.5YR 3/6) and few fine prominent yellowish red (5YR 4/8) mottles; weak coarse subangular blocky structure; very friable; strongly acid; clear wavy boundary.

C1—32 to 40 inches; reddish brown (5YR 4/4) sand; single grain; loose; strongly acid; clear wavy boundary.

C2—40 to 60 inches; reddish brown (5YR 4/4) sand; many coarse distinct yellowish red (5YR 4/6) mottles; single grain; loose; strongly acid.

The solum ranges from 20 to 40 inches in thickness. Some pedons have an A horizon. This horizon is 1 to 4 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 5 or 6. The Bhs horizon is sand or loamy sand. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. Some pedons have a BC horizon. This horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 3 to 6. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 4 to 8.

Cable Series

The Cable series consists of poorly drained soils on moraines. These soils formed in silty and loamy deposits and in the underlying loamy glacial till. Permeability is moderately slow. Slope ranges from 0 to 3 percent.

Typical pedon of Cable silt loam, 0 to 3 percent slopes, 50 feet west and 775 feet north of the southeast corner of sec. 1, T. 40 N., R. 11 E.

Oe—2 inches to 0; black (N 2/0) partly decomposed leaf litter.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine and medium roots; about 2 percent pebbles and 3 percent cobbles; strongly acid; clear wavy boundary.

Eg—5 to 8 inches; dark brown (7.5YR 4/2) silt loam; common medium faint brown (7.5YR 5/2) mottles; moderate fine subangular blocky structure; friable; many fine and medium roots; about 2 percent pebbles and 3 percent cobbles; strongly acid; clear wavy boundary.

Bg1—8 to 21 inches; brown (7.5YR 5/2) silt loam; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; common fine and medium roots; about 2 percent pebbles and 3 percent cobbles; strongly acid; clear wavy boundary.

2Bg2—21 to 31 inches; reddish gray (5YR 5/2) fine sandy loam; many medium distinct strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; few fine roots; about 5 percent pebbles and 3 percent cobbles; strongly acid; clear wavy boundary.

2BC—31 to 38 inches; brown (7.5YR 5/4) sandy loam; common medium faint pale brown (10YR 6/3) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; about 8 percent pebbles and 3 percent cobbles; strongly acid; clear wavy boundary.

2C—38 to 60 inches; brown (7.5YR 5/4) sandy loam; few medium distinct reddish gray (5YR 5/2) and common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; about 8 percent pebbles and 3 percent cobbles; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. The content of pebbles ranges from 0 to 15 percent in the A, Eg, and Bg horizons and from 0 to 25 percent in the 2BC and 2C horizons. The content of cobbles and stones ranges from 0 to 15 percent throughout the profile.

The A horizon is 2 to 6 inches thick. It has value of 2 or 3 and chroma of 0 to 2. The Eg horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 or 2. The Bg horizon has hue of 7.5YR or 10YR and value of 4 to 6. It is silt loam, loam, fine sandy loam, or sandy loam. The 2BC and 2C horizons have value of 4 or 5 and chroma of 2 to 4. They are sandy loam or gravelly sandy loam.

Champion Series

The Champion series consists of moderately well drained soils on drumlins and moraines. These soils formed in a thin mantle of loess and in the underlying sandy and loamy glacial till. They have a fragipan. Permeability is slow in the fragipan and moderate or moderately rapid in the substratum. Slope ranges from 1 to 20 percent.

Typical pedon of Champion silt loam, 1 to 6 percent slopes, 2,370 feet east and 15 feet north of the southwest corner of sec. 27, T. 42 N., R. 11 E.

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

E—2 to 5 inches; reddish gray (5YR 5/2) silt loam; weak medium platy structure parting to weak very fine subangular blocky; very friable; common fine and medium roots; about 2 percent pebbles; strongly acid; gradual wavy boundary.

Bs—5 to 18 inches; reddish brown (5YR 4/4) silt loam; weak very fine subangular blocky structure; friable; common fine and medium roots; about 2 percent pebbles; strongly acid; clear wavy boundary.

2E/Bx—18 to 26 inches; reddish gray (5YR 5/2) loamy sand (Ex) surrounding peds of reddish brown (5YR 4/4) sandy loam (Btx); few medium prominent yellowish red (5YR 5/8) mottles; weak medium platy structure parting to weak very fine subangular blocky; firm; dense; few fine roots; about 8 percent pebbles and 5 percent cobbles; strongly acid; abrupt wavy boundary.

2B/Ex—26 to 39 inches; reddish brown (5YR 4/4) sandy loam (Btx) and reddish gray (5YR 5/2) loamy sand (Ex); weak medium platy structure; firm; dense; about 8 percent pebbles and 5 percent cobbles; medium acid; clear wavy boundary.

2BC—39 to 45 inches; brown (7.5YR 5/4) gravelly loamy sand; weak medium platy structure; friable; slightly hard; about 16 percent pebbles and 5 percent cobbles; medium acid; abrupt wavy boundary.

2C—45 to 60 inches; brown (7.5YR 5/4) gravelly loamy sand; massive; very friable; about 16 percent pebbles and 8 percent cobbles; medium acid.

The thickness of the solum ranges from 30 to 50 inches. The depth to the fragipan ranges from about 16 to 24 inches and generally is the same as the depth to the 2Ex, 2E/Bx, or 2B/Ex horizon. The content of pebbles ranges from 0 to 10 percent in the A, E, and Bs horizons and from 5 to 35 percent in the 2Ex, 2E/Bx, 2B/Ex, 2BC, and 2C horizons. The content of cobbles and stones ranges from 0 to 5 percent in the A, E, and Bs horizons and from 5 to 15 percent in the 2Ex, 2E/Bx, 2B/Ex, 2BC, and 2C horizons.

The A horizon is 1 to 3 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has hue of 5YR, or 7.5YR and value of 4 or 5. The Bs horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. It is silt loam, loam, or fine sandy loam.

The 2Ex horizon, if it occurs, and the E part of the 2E/Bx and 2B/Ex horizons have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. They are sandy loam, loamy sand, gravelly sandy loam, or gravelly loamy sand. The 2Bt horizon, if it occurs, and the B part of the 2E/Bx and 2B/Ex horizons have hue of 5YR or 7.5YR. They are loam, sandy loam, gravelly loam, or gravelly sandy loam. The 2BC and 2C horizons have value of 4 or 5. They are sandy loam, loamy sand, gravelly sandy loam, or gravelly loamy sand.

Croswell Series

The Croswell series consists of moderately well drained soils on outwash plains and stream terraces. These soils formed in sandy glacial outwash. They commonly are rapidly permeable throughout. The loamy substratum phase, however, is rapidly permeable in the upper part and moderately slowly permeable in the lower part. Slope ranges from 0 to 3 percent.

Typical pedon of Croswell sand, 0 to 3 percent slopes, 1,450 feet east and 1,100 feet north of the southwest corner of sec. 14, T. 42 N., R. 10 E.

Oe—2 inches to 0; black (N 2/0) partly decomposed leaf litter.

E—0 to 4 inches; brown (7.5YR 5/2) sand; weak fine subangular blocky structure; very friable; many fine and medium roots; very strongly acid; clear wavy boundary.

Bs1—4 to 6 inches; dark reddish brown (5YR 3/4) sand; weak medium subangular blocky structure; very friable; common fine and medium roots; strongly acid; clear wavy boundary.

Bs2—6 to 12 inches; reddish brown (5YR 4/4) sand; weak medium subangular blocky structure; very friable; common fine and medium roots; strongly acid; clear wavy boundary.

Bs3—12 to 25 inches; yellowish red (5YR 4/6) sand; weak coarse subangular blocky structure; very friable; few fine roots; medium acid; clear wavy boundary.

C1—25 to 31 inches; reddish brown (5YR 5/4) sand; single grain; loose; slightly acid; gradual wavy boundary.

C2—31 to 60 inches; reddish brown (5YR 5/4) sand; common medium prominent yellowish red (5YR 5/8) mottles; single grain; loose; slightly acid.

The solum ranges from 20 to 36 inches in thickness. Some pedons have an A horizon. This horizon is 1 to 3 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs1 horizon has hue of 5YR or 7.5YR and chroma of 3 or 4. The Bs2 and Bs3 horizons have hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 3 to 6. In some pedons more than 2 feet of stratified silt loam, very fine sandy loam, or very fine sand is below a depth of 40 inches.

Dawson Series

The Dawson series consists of very poorly drained soils on outwash plains, glacial lake plains, and moraines. These soils formed in herbaceous organic material 16 to 51 inches deep over sandy deposits. Permeability is moderately rapid in the organic material and rapid in the substratum. Slope is 0 to 1 percent.

Typical pedon of Dawson peat, in an area of Loxley and Dawson peats, 0 to 1 percent slopes, 1,000 feet south and 810 feet west of the northeast corner of sec. 34, T. 42 N., R. 10 E.

Oi—0 to 11 inches; dark reddish brown (5YR 3/3), broken face, fibric material, dark brown (7.5YR 4/4) rubbed; about 95 percent fiber, 90 percent rubbed; massive; very friable; primarily sphagnum moss fibers; extremely acid (pH 4.0 by the Truog method); abrupt smooth boundary.

Oa—11 to 35 inches; very dark gray (5YR 3/1) broken face, sapric material, dark reddish brown (5YR 2/2) rubbed; about 30 percent fiber, less than 5 percent rubbed; weak thick platy structure; very friable; primarily herbaceous fibers; extremely acid (pH 4.0 by the Truog method); abrupt smooth boundary.

Cg—35 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; very strongly acid (pH 4.8 by the Truog method).

The depth to the Cg horizon ranges from 16 to 51 inches. The fibric surface layer ranges from 8 to 14 inches in thickness. The upper 1 to 4 inches commonly is live sphagnum moss; however, the lower part has undergone some decomposition. The surface tier has hue of 5YR, 7.5YR, or 10YR, value of 3 to 6, and chroma of 2 to 4. The subsurface tier has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly sapric material, but thin layers of hemic or fibric material are in some pedons.

The Cg horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 2 to 4. It ranges from very strongly acid to sightly acid. Some pedons have a thin layer of loamy or silty material directly above the sandy Cg horizon.

Fence Series

The Fence series consists of well drained and moderately well drained, moderately slowly permeable soils on glacial lake plains, outwash plains, and moraines. These soils formed in stratified, silty and loamy lacustrine deposits. Slope ranges from 0 to 15 percent.

Typical pedon of Fence silt loam, in an area of Fence-Alcona complex, 0 to 6 percent slopes, 1,840 feet south and 710 feet west of the northeast corner of sec. 34, T. 44 N., R. 5 E.

A—0 to 4 inches; dark reddish brown (5YR 3/2) silt loam, pinkish gray (7.5YR 6/2) dry; weak fine granular structure; very friable; common fine and medium roots; very strongly acid; clear wavy boundary.

Bs—4 to 14 inches; reddish brown (5YR 4/4) silt loam; weak fine subangular blocky structure; friable; common fine and medium roots; very strongly acid; clear wavy boundary.

E/B—14 to 26 inches; reddish brown (5YR 5/3) silt loam (E); weak fine and medium subangular blocky structure; friable; about 65 percent of the horizon occurring as tongues extending into or completely surrounding isolated remnants of reddish brown (2.5YR 4/4) silt loam (Bt); weak fine and medium subangular blocky structure; friable; few distinct dark reddish brown (2.5YR 3/4) clay films on faces of peds in the B part; few fine roots; strongly acid; clear irregular boundary.

Bt—26 to 43 inches; reddish brown (2.5YR 4/4) silt loam; common fine prominent light brownish gray (10YR 6/2) and few fine prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; friable; few fine roots; common distinct dark reddish brown (2.5YR 3/4) clay films on faces of peds; medium acid; clear smooth boundary.

C—43 to 60 inches; reddish brown (5YR 4/4) silt loam that has strata of very fine sand; medium plates as result of different textural strata; friable; strongly acid.

The solum ranges from 28 to 49 inches in thickness. Some pedons do not have mottles.

The A horizon is 2 to 4 inches thick. It has hue of 5YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Some pedons have an E horizon. This horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is silt loam or very fine sandy loam.

Some pedons have an E' or B/E horizon. The E' horizon and the E part of the E/B or B/E horizon have hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. They are silt loam, very fine sandy loam, or silt. The Bt horizon and the B part of the E/B or B/E horizon have hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. They are silt loam or very fine sandy loam.

The C horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6. It is silt loam or very fine sandy loam or is stratified with these textures and with common thin layers of very fine sand or fine sand.

Gaastra Series

The Gaastra series consists of somewhat poorly drained, moderately slowly permeable soils on glacial lake plains, outwash plains, and moraines. These soils formed in stratified, silty and loamy lacustrine deposits. Slope ranges from 0 to 2 percent.

Typical pedon of Gaastra silt loam, 0 to 2 percent slopes, 1,320 feet south and 820 feet east of the northwest corner of sec. 35, T. 44 N., R. 5 E.

Oe—2 inches to 0; black (N 2/0) partly decomposed leaf litter.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine and medium roots; very strongly acid; abrupt smooth boundary.

E—4 to 6 inches; brown (7.5YR 4/2) silt loam; common medium prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very friable; many fine and medium roots; very strongly acid; clear wavy boundary.

Bs—6 to 17 inches; reddish brown (2.5YR 4/4) silt loam; common medium faint dark reddish brown (2.5YR 3/4) mottles; weak medium platy structure parting to weak fine subangular blocky; friable; few fine and medium roots; strongly acid; clear smooth boundary.

B/E—17 to 38 inches; reddish brown (5YR 4/4) silt loam (Bt); tongues of brown (7.5YR 5/2) silt loam (E); few medium prominent grayish brown (10YR 5/2) and few fine distinct red (2.5YR 4/6) mottles; weak medium subangular blocky structure; friable; few faint reddish brown (5YR 4/4) clay films on faces of peds in the B part; medium acid; abrupt smooth boundary.

C—38 to 60 inches; reddish brown (5YR 4/4) stratified silt loam and very fine sandy loam; common fine distinct yellowish red (5YR 4/6) mottles; massive; friable; slightly acid.

The solum ranges from 26 to 40 inches in thickness. The A horizon is 2 to 4 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is silt loam or very fine sandy loam.

Some pedons have an E' or E/B horizon. The E' horizon and the E part of the E/B or B/E horizon have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Some pedons have a Bt horizon. This horizon and the Bt part of the E/B or B/E horizon have hue of 2.5YR, 5YR, or 7.5YR, value of 4 or 5, and chroma of 3 to 5. The E', E/B, B/E, and Bt horizons are silt loam, very fine sandy loam, or fine sandy loam.

The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is silt loam, very fine sandy loam, fine sandy loam, or sandy loam or is stratified with these textures and with common thin layers of silt, very fine sand, or fine sand.

Gogebic Series

The Gogebic series consists of well drained and moderately well drained soils on moraines. These soils formed in loamy glacial till. They have a fragipan. Permeability is slow in the fragipan and moderate in the substratum. Slope ranges from 0 to 30 percent.

Typical pedon of Gogebic fine sandy loam, in an area of Gogebic-Fence-Pence complex, 3 to 15 percent slopes, 1,330 feet west and 880 feet north of the southeast corner of sec. 24, T. 43 N., R. 5 E.

A—0 to 3 inches; dark brown (7.5YR 3/2) fine sandy loam, brown (7.5YR 5/2) dry; weak fine granular structure; friable; common fine and medium roots; about 3 percent cobbles; very strongly acid; clear wavy boundary.

Bs1—3 to 8 inches; dark reddish brown (5YR 3/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; about 6 percent pebbles and 3 percent cobbles; very strongly acid; clear wavy boundary.

Bs2—8 to 22 inches; reddish brown (5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 6 percent pebbles; strongly acid; clear irregular boundary.

Ex—22 to 26 inches; reddish gray (5YR 5/2) fine sandy loam; few medium prominent yellowish red (5YR 5/8) mottles; weak fine and medium subangular blocky structure; firm; dense; about 8 percent pebbles and 3 percent cobbles; strongly acid; clear wavy boundary.

E/Bx—26 to 32 inches; reddish gray (5YR 5/2) fine sandy loam (Ex); weak medium and coarse subangular blocky structure; firm; dense; about 65 percent of the horizon occurring as tongues extending into or completely surrounding isolated remnants of reddish brown (2.5YR 4/4) fine sandy loam (Btx); common fine prominent yellowish red (5YR 5/8) mottles; weak medium and coarse subangular blocky structure; firm; dense; about 8 percent pebbles and 5 percent cobbles; medium acid; clear wavy boundary.

Bt—32 to 57 inches; reddish brown (2.5YR 4/4) loam; weak medium and coarse subangular blocky structure; firm; common prominent weak red (2.5YR 5/2) clay films on faces of peds; about 8 percent pebbles and 5 percent cobbles; medium acid; clear wavy boundary.

C—57 to 60 inches; reddish brown (2.5YR 4/4) sandy loam; massive; friable; about 8 percent pebbles and 5 percent cobbles; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The depth to the fragipan ranges from about 20 to 35 inches and generally is the same as depth to the Ex or E/Bx horizon. Some pedons do not have mottles. The content pebbles ranges from 0 to 15 percent throughout the profile, and the content of cobbles and stones ranges from 3 to 15 percent.

The A horizon is 1 to 4 inches thick. It has hue of 5YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Some pedons do not have an A horizon. Some pedons have an E horizon. This horizon has hue of 5YR, value of 4 or 5, and chroma of 2. It is fine sandy loam.

The Bs1 horizon has value and chroma of 3 or 4. The Bs2 horizon has hue of 2.5YR or 5YR and value and chroma of 3 or 4. Some pedons have a B/Ex horizon. The Ex horizon and the E part of the E/Bx or B/Ex horizon have value of 4 or 5 and chroma of 2 or 3. The Bt horizon and the B part of the E/Bx or B/Ex horizon have hue of 2.5YR or 5YR. The Bs, Ex, E/Bx, and B/Ex horizons are fine sandy loam, sandy loam, or loam.

The C horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy loam or fine sandy loam. Lenses or pockets of silty clay loam, loam, silt, loamy sand, or gravel are common in some pedons.

Karlin Series

The Karlin series consists of somewhat excessively drained soils on outwash plains and moraines. These soils formed in sandy glacial outwash. Permeability is moderately rapid in the subsoil and rapid in the substratum. Slope ranges from 0 to 15 percent.

Typical pedon of Karlin loamy fine sand, 0 to 6 percent slopes, 1,450 feet north and 530 feet east of the southwest corner of sec. 5, T. 40 N., R. 11 E.

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; many fine roots; very strongly acid; clear smooth boundary.

E—2 to 3 inches; brown (7.5YR 5/2) loamy fine sand; weak fine granular structure; very friable; many fine roots; very strongly acid; clear smooth boundary.

Bs1—3 to 7 inches; reddish brown (5YR 4/3) loamy fine sand; weak medium subangular blocky structure;

very friable; common fine and medium roots; strongly acid; clear wavy boundary.

Bs2—7 to 21 inches; dark brown (7.5YR 4/4) loamy fine sand; weak medium subangular blocky structure; very friable; common fine and medium roots; medium acid; abrupt wavy boundary.

BC—21 to 28 inches; brown (7.5YR 5/4) fine sand; weak coarse subangular blocky structure; very friable; few fine roots; slightly acid; clear wavy boundary.

C—28 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 3 percent pebbles; slightly acid.

The solum ranges from 20 to 36 inches in thickness. The A horizon is 1 to 3 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has hue of 5YR or 7.5YR and value of 4 or 5. The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 and BC horizons have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The Bs1 and Bs2 horizons are loamy fine sand, fine sand, or loamy sand. The BC horizon is fine sand, loamy sand, or sand. The C horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6.

Keweenaw Series

The Keweenaw series consists of well drained and moderately well drained soils on drumlins and water-worked moraines. These soils formed in loamy glacial drift and in the underlying sandy glacial till. Permeability is moderate or moderately rapid. Slope ranges from 0 to 30 percent.

Typical pedon of Keweenaw sandy loam, in an area of Keweenaw-Karlin-complex, 0 to 6 percent slopes, 1,850 feet west and 50 feet north of the southeast corner of sec. 18, T. 39 N., R. 10 E.

A—0 to 2 inches; dark brown (7.5YR 3/2) sandy loam, brown (7.5YR 5/2) dry; moderate fine granular structure; friable; common fine and medium roots; about 3 percent pebbles; very strongly acid; clear wavy boundary.

E—2 to 5 inches; reddish gray (5YR 5/2) sandy loam; moderate fine granular structure; friable; common fine and medium roots; about 3 percent pebbles; very strongly acid; clear wavy boundary.

Bs—5 to 16 inches; reddish brown (5YR 4/4) sandy loam; moderate fine and medium subangular blocky structure; friable; common fine and medium roots; about 5 percent pebbles; strongly acid; abrupt smooth boundary.

2E/Bx—16 to 32 inches; reddish brown (5YR 5/3) loamy sand (Ex) coatings on peds of reddish brown (5YR 4/4) gravelly loamy sand (Btx); few medium prominent yellowish red (5YR 5/8) mottles; weak medium platy structure parting to weak very fine subangular blocky; firm; few fine roots; about 15 percent pebbles; strongly acid; clear wavy boundary.

2Bt—32 to 44 inches; reddish brown (5YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; few fine roots; discontinuous distinct reddish brown (5YR 4/4) clay films on faces of peds; about 18 percent pebbles; strongly acid; clear wavy boundary.

2C—44 to 60 inches; brown (7.5YR 5/4) gravelly loamy sand; massive; very friable; about 18 percent pebbles; strongly acid.

The thickness of the solum ranges from 30 to 50 inches. The thickness of the loamy mantle ranges from 6 to 20 inches. The content of pebbles ranges from 0 to 15 percent in the A, E, and Bs horizons and from 0 to 25 percent in the 2Ex, 2E/Bx, 2B/Ex, 2Bt, 2BC, and 2C horizons. The content of cobbles and stones ranges from 0 to 15 percent throughout the profile.

The A horizon is 1 or 2 inches thick. It has hue of 5YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has hue of 5YR or 7.5YR and value of 4 or 5. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is sandy loam or loamy sand.

The 2Ex horizon, if it occurs, and the E part of the 2E/Bx or 2B/Ex horizon have hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. They are sand, loamy sand, or gravelly loamy sand. The 2Bt horizon and the B part of the 2E/Bx or 2B/Ex horizon have hue of 2.5YR, 5YR, or 7.5YR and value and chroma of 3 or 4. They are loamy sand, gravelly loamy sand, sandy loam, or gravelly sandy loam.

The 2C horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It ranges from uniform till of loamy sand or gravelly loamy sand to water-worked till of interbedded sand and loamy sand that has some bands or pockets of sandy loam.

Kinross Series

The Kinross series consists of poorly drained, rapidly permeable soils on outwash plains. These soils formed in a thin layer of organic material and in the underlying sandy glacial outwash. Slope ranges from 0 to 2 percent.

The Kinross soils in Vilas County have a ratio of free iron to carbon that is higher than is definitive for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Kinross mucky sand, 0 to 2 percent slopes, 2,320 feet east and 2,600 feet north of the southwest corner of sec. 14, T. 42 N., R. 10 E.

Oa—0 to 4 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 20 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; very friable; common fine and medium roots; very strongly acid; abrupt smooth boundary.

E—4 to 10 inches; reddish gray (5YR 5/2) sand; weak fine and medium subangular blocky structure; very friable; common fine and medium roots; strongly acid; abrupt wavy boundary.

Bhs—10 to 16 inches; dark reddish brown (5YR 3/3) sand; common medium faint dark reddish brown (2.5YR 2/4) mottles; weak fine subangular blocky structure; very friable; common fine and medium roots; very strongly acid; clear wavy boundary.

Bs1—16 to 21 inches; reddish brown (5YR 4/4) sand; few coarse distinct yellowish red (5YR 4/6) and common medium faint dark reddish brown (2.5YR 3/4) mottles; weak medium subangular blocky structure; very friable; few fine roots; strongly acid; clear wavy boundary.

Bs2—21 to 34 inches; yellowish red (5YR 4/6) sand; many coarse prominent dark reddish brown (2.5YR 3/4) mottles; weak coarse subangular blocky structure; very friable strongly acid; clear wavy boundary.

C—34 to 60 inches; dark brown (7.5YR 4/4) sand; common fine distinct yellowish red (5YR 4/6) and common medium distinct dark reddish gray (5YR 4/2) mottles; single grain; loose; strongly acid.

The solum ranges from 24 to 40 inches in thickness. The Oa horizon is 2 to 6 inches thick. It has hue of 5YR, 7.5YR, or 10YR and value of 2 or 3. Some pedons have an A horizon. This horizon is sand 1 to 5 inches thick. It has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR, 7.5YR, or 10YR and value of 5 or 6. The Bhs horizon has hue of 5YR or 7.5YR and chroma of 2 or 3. The Bs horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. Some pedons have a BC horizon. This horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 4 to 6. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 2 to 4. It has thin strata of gravel in some pedons.

Loxley Series

The Loxley series consists of very poorly drained, moderately rapidly permeable soils on moraines, outwash plains, and glacial lake plains. These soils formed in herbaceous organic material more than 51 inches thick. Slope is 0 to 1 percent.

Typical pedon of Loxley peat, in an area of Loxley and Dawson peats, 0 to 1 percent slopes, 1,320 feet north and 2,420 feet east of the southwest corner of sec. 25, T. 41 N., R. 8 E.

Oi—0 to 12 inches; brown (7.5YR 4/4), broken face and rubbed, fibric material; about 95 percent fiber, 85 percent rubbed; weak thick platy structure; very friable; primarily sphagnum fibers; extremely acid (pH 4.0 by the Truog method); abrupt smooth boundary.

Oa1—12 to 17 inches; dark brown (7.5YR 3/2), broken face, sapric material, dark reddish brown (5YR 3/2) rubbed; about 30 percent fiber, 10 percent rubbed; weak very thick platy structure parting to weak coarse subangular blocky; very friable; primarily herbaceous fibers; extremely acid (pH 4.2 by the Truog method); clear smooth boundary.

Oa2—17 to 37 inches; dark brown (7.5YR 3/2), broken face, sapric material, dark reddish brown (5YR 3/2) rubbed; about 20 percent fiber, 5 percent rubbed; massive; very friable; primarily herbaceous fibers; extremely acid (pH 4.2 by the Truog method); clear smooth boundary.

Oa3—37 to 60 inches; dark reddish brown (5YR 2/2), broken face, sapric material, dark reddish brown (5YR 3/2) rubbed; about 15 percent fiber, 5 percent rubbed; massive; friable; primarily herbaceous fibers; extremely acid (pH 4.4 by the Truog method).

The organic material is more than 51 inches thick. It is derived primarily from herbaceous material and sphagnum.

The fibric surface layer is 6 to 15 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5 and chroma of 2 to 4. The Oa horizon has hue of 5YR, 7.5YR, or 10YR, value of 2 to 5, and chroma of 2 to 4. The subsurface and bottom tiers are dominantly sapric material, but thin layers of hemic or fibric material are in some pedons.

Manitowish Series

The Manitowish series consists of moderately well drained soils on outwash plains and stream terraces. These soils formed in loamy deposits and in the underlying glacial outwash of sand and gravel. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 3 percent.

Typical pedon of Manitowish sandy loam, 0 to 3 percent slopes, 1,180 feet west and 1,600 feet south of the northeast corner of sec. 33, T. 43 N., R. 5 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; common fine and medium roots; about 1 percent pebbles; strongly acid; abrupt wavy boundary.

E—3 to 4 inches; brown (7.5YR 5/2) sandy loam; weak fine subangular blocky structure; very friable; common fine and medium roots; about 1 percent pebbles; strongly acid; abrupt wavy boundary.

Bs1—4 to 6 inches; dark reddish brown (5YR 3/4) sandy loam; weak fine subangular blocky structure; very friable; common fine and medium roots; about 2 percent pebbles; medium acid; abrupt smooth boundary.

Bs2—6 to 16 inches; reddish brown (5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; common fine and medium roots; about 2 percent pebbles; strongly acid; clear wavy boundary.

2BC—16 to 19 inches; reddish brown (5YR 4/4) loamy coarse sand; weak medium subangular blocky structure; very friable; few fine roots; about 4 percent pebbles; medium acid; abrupt wavy boundary.

2C1—19 to 35 inches; strong brown (7.5YR 5/6) coarse sand; single grain; loose; about 12 percent pebbles; medium acid; clear wavy boundary.

2C2—35 to 60 inches; dark brown (7.5YR 4/4) stratified coarse sand and gravel; common medium prominent strong brown (7.5YR 5/8) mottles; single grain; loose; about 20 percent pebbles; slightly acid.

The thickness of the solum ranges from 18 to 28 inches. The thickness of the loamy mantle ranges from 10 to 20 inches. The content of pebbles ranges from 0 to 10 percent in the A, E, and Bs horizons and from 0 to 35 percent in the 2BC and 2C horizons. The content of cobbles ranges from 0 to 5 percent throughout the profile.

The A horizon is 1 to 5 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has hue of 5YR or 7.5YR and value of 4 or 5. The Bs horizon has hue of 5YR or 7.5YR and chroma of 3 or 4. The 2BC horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sand, loamy sand, loamy coarse sand, gravelly sand, or gravelly loamy sand. The 2C horizon has hue of 5YR or 7.5YR and chroma of 4 to 6. It is sand, coarse sand, gravelly sand, stratified coarse sand and gravel, or stratified sand and gravel.

Markey Series

The Markey series consists of very poorly drained soils on outwash plains, glacial lake plains, and moraines. These soils formed in herbaceous organic material 16 to 51 inches deep over sandy deposits. Permeability is moderately rapid in the organic material and rapid in the substratum. Slope is 0 to 1 percent.

Typical pedon of Markey muck, in an area of Seelyeville and Markey mucks, 0 to 1 percent slopes, 1,540 feet south and 560 feet east of the northwest corner of sec. 31, T. 43 N., R. 5 E.

Oa1—0 to 5 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 10 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; very friable; primarily herbaceous fibers; strongly acid (pH 5.5 by the Truog method); abrupt smooth boundary.

Oa2—5 to 25 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 50 percent fiber, less than 5 percent rubbed; moderate medium platy structure; very friable; primarily herbaceous fibers; strongly acid (pH 5.5 by the Truog method); abrupt smooth boundary.

Oa3—25 to 37 inches; dark brown (7.5YR 3/2), broken face, sapric material, very dark brown (10YR 2/2) rubbed; about 30 percent fiber, less than 5 percent rubbed; massive; very friable; primarily herbaceous fibers; medium acid (pH 5.7 by the Truog method); abrupt wavy boundary.

Oa4—37 to 40 inches; black (10YR 2/1), broken face and rubbed, sapric material; less than 5 percent fiber unrubbed and rubbed; massive; very friable; primarily herbaceous fibers; about 5 percent mineral soil material; medium acid (pH 5.7 by the Truog method); abrupt smooth boundary.

Cg—40 to 60 inches; brown (7.5YR 4/2) sand; single grain; loose; medium acid.

The depth to the Cg horizon ranges from 16 to 51 inches. The fibers in the organic material are derived mostly from herbaceous plants, but some layers have moss fibers. In some pedons the content of woody fragments is as much as 15 percent throughout the organic part of the profile.

The organic material has hue of 5YR, 7.5YR, or 10YR or is neutral in hue. It has chroma of 0 to 2. The Cg horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Some pedons have a thin layer of loamy material directly above the sandy Cg horizon.

Monico Series

The Monico series consists of somewhat poorly drained, moderately permeable soils on moraines and in drainageways between drumlins. These soils formed in silty and loamy deposits and in the underlying loamy or sandy glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Monico silt loam, 0 to 3 percent slopes, 160 feet south and 415 feet west of northeast corner of sec. 34, T. 42 N., R. 11 E.

A—0 to 4 inches; dark brown (7.5YR 3/2) silt loam, pinkish gray (7.5YR 6/2) dry; moderate fine granular structure; friable; many fine and coarse roots; about 5 percent pebbles and 8 percent cobbles; very strongly acid; abrupt wavy boundary.

E—4 to 7 inches; brown (7.5YR 4/2) silt loam; weak medium platy structure parting to moderate very fine subangular blocky; friable; many fine and coarse roots; about 5 percent pebbles and 8 percent cobbles; very strongly acid; abrupt wavy boundary.

Bs1—7 to 13 inches; reddish brown (5YR 4/4) fine sandy loam; few medium prominent yellowish red (5YR 5/8) mottles; moderate fine and medium subangular blocky structure; friable; common fine and medium roots; common fine soft rounded accumulations (iron and manganese oxides); about 5 percent pebbles and 8 percent cobbles; strongly acid; clear wavy boundary.

Bs2—13 to 21 inches; brown (7.5YR 4/4) fine sandy loam; common medium prominent yellowish red (5YR 5/8) mottles; moderate fine and medium subangular blocky structure; friable; few fine roots; common fine soft rounded accumulations (iron and manganese oxides); about 5 percent pebbles and 8 percent cobbles; strongly acid; clear wavy boundary.

2BC—21 to 36 inches; brown (7.5YR 5/4) sandy loam; few medium prominent yellowish red (5YR 5/8) mottles; weak medium and coarse subangular blocky structure; friable; few fine roots; stratified with a few lenses of loamy sand less than 5 millimeters thick; about 10 percent pebbles and 4 percent cobbles; medium acid; clear wavy boundary.

2C—36 to 60 inches; brown (7.5YR 5/4) gravelly loamy sand; few medium distinct yellowish red (5YR 5/6) mottles; massive; friable; about 10 percent pebbles and 6 percent cobbles; slightly acid.

The thickness of the solum ranges from 24 to 50 inches. The content of pebbles ranges from 0 to 20 percent in the A, E, and Bs horizons and from 5 to 25 percent in the 2BC and 2C horizons. The content of cobbles and stones ranges from 0 to 15 percent throughout the profile.

The A horizon is 2 to 5 inches thick. It has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR, 7.5YR, or 10YR and value of 4 to 6. The Bs horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. It is silt loam, loam, fine sandy loam, or sandy loam. The 2BC and 2C horizons have value of 3 to 5. They are sandy loam, gravelly sandy loam, loamy sand, or gravelly loamy sand.

Padus Series

The Padus series consists of well drained soils on outwash plains, stream terraces, and moraines. These soils formed in loamy deposits and in the underlying outwash of stratified sand and gravel. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 35 percent.

Typical pedon of Padus fine sandy loam, 0 to 6 percent slopes, 700 feet north and 240 feet east of the southwest corner of sec. 5, T. 40 N., R. 7 E.

A—0 to 1 inch; dark brown (7.5YR 3/2) fine sandy loam, brown (7.5YR 5/2) dry; weak fine granular structure; very friable; common fine and medium roots; very strongly acid; abrupt smooth boundary.

E—1 to 4 inches; reddish gray (5YR 5/2) fine sandy loam; weak fine subangular blocky structure; very friable; common fine and medium roots; very strongly acid; clear wavy boundary.

Bs1—4 to 6 inches; dark reddish brown (5YR 3/4) fine sandy loam; weak fine subangular blocky structure; friable common fine and medium roots; strongly acid; clear wavy boundary.

Bs2—6 to 14 inches; dark brown (7.5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; about 3 percent pebbles; strongly acid; clear wavy boundary.

E'—14 to 20 inches; brown (7.5YR 5/4) sandy loam; weak fine subangular blocky structure; friable, hard; common fine roots; about 7 percent pebbles; strongly acid; clear wavy boundary.

E/B—20 to 24 inches; brown (7.5YR 5/4) sandy loam (E); weak fine and medium subangular blocky structure; friable; about 70 percent of the horizon occurring as tongues extending into or completely surrounding isolated remnants of reddish brown (5YR 4/4) sandy loam (Bt); moderate fine subangular blocky structure; friable; common distinct reddish brown (5YR 4/4) clay films on faces of peds in the B part; common fine roots; about 8 percent pebbles; strongly acid; clear wavy boundary.

B/E—24 to 31 inches; reddish brown (5YR 4/4) sandy loam (Bt); moderate fine subangular blocky structure; friable; thin continuous clay films on faces of peds; about 30 percent of the horizon occurring as tongues of brown (7.5YR 5/4) sandy loam (E); moderate fine subangular blocky structure; very friable; common distinct reddish brown (5YR 4/4) clay films on faces of peds in the B part; few fine roots; about 8 percent pebbles; strongly acid; clear wavy boundary.

2BC—31 to 35 inches; reddish brown (5YR 4/4) gravelly loamy sand; single grain; loose; few fine roots; about 20 percent pebbles; medium acid; clear smooth boundary.

2C—35 to 60 inches; strong brown (7.5YR 5/6) stratified sand and gravel; single grain; loose; about 25 percent pebbles; medium acid.

The thickness of the solum ranges from 24 to 40 inches. The thickness of the loamy mantle ranges from 20 to 36 inches. The content of pebbles ranges from 0 to 15 percent in the A, E, Bs, E', and E/B, and B/E horizons and from 0 to 35 percent in the 2BC and 2C horizons. The content of cobbles ranges from 0 to 5 percent throughout the profile.

The A horizon is 1 to 4 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 of 3, and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6.

The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. The Bs1 and Bs2 horizons are silt loam, loam, fine sandy loam, or sandy loam. The E' horizon and the E part of the E/B and B/E horizons have hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. They are silt loam, loam, fine sandy loam, or sandy loam. In some pedons the E', E/B, or B/E horizon displays weak characteristics of a fragipan. Some pedons have a Bt horizon. This horizon and the Bt part of the E/B and B/E horizons have hue of 5YR or 7.5YR and chroma of 3 or 4. They are loam, fine sandy loam, or sandy loam.

The 2BC horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6. It is loamy sand, gravelly loamy sand, sand, or gravelly sand. The 2C horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 4 to 6. It is sand, gravelly sand, or stratified sand and gravel.

Pence Series

The Pence series consists of well drained soils on outwash plains, stream terraces, eskers, kames, and moraines. These soils formed in loamy deposits and in the underlying glacial outwash of stratified sand and gravel. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 35 percent.

Typical pedon of Pence sandy loam, 0 to 6 percent slopes, 1,200 feet west and 1,900 feet north of the southeast corner of sec. 29, T. 43 N., R. 7 E.

Oe—2 inches to 0; very dark brown (10YR 2/2) partly decomposed forest litter.

E—0 to 3 inches; reddish gray (5YR 5/2) sandy loam; weak thick platy structure parting to weak fine subangular blocky; very friable; many fine roots; about 2 percent pebbles; very strongly acid; abrupt wavy boundary.

Bs1—3 to 8 inches; dark reddish brown (5YR 3/4) sandy loam; weak fine subangular blocky structure; friable; many fine and medium roots; about 2 percent pebbles; strongly acid; clear wavy boundary.

Bs2—8 to 16 inches; reddish brown (5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; common fine and medium roots; about 4 percent pebbles; strongly acid; clear wavy boundary.

2BC—16 to 23 inches; reddish brown (5YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; few fine roots; about 7 percent pebbles; medium acid; clear wavy boundary.

2C—23 to 60 inches; strong brown (7.5YR 5/6) stratified sand and gravel; single grain; loose; about 25 percent pebbles; slightly acid.

The thickness of the solum ranges from 15 to 30 inches. The thickness of the loamy mantle ranges from 10 to 20 inches. The content of pebbles ranges from 0 to 15 percent in the A and E horizons and from 0 to 35 percent in the Bs, 2BC, and 2C horizons. The content of cobbles ranges from 0 to 5 percent throughout the profile.

Some pedons have an A horizon. This horizon is 1 to 4 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. It is sandy loam, gravelly sandy loam, loamy sand, or gravelly loamy sand. The 2BC and 2C horizons have hue of 5YR or 7.5YR and value and chroma of 4 to 6. The 2BC horizon is loamy sand, gravelly loamy sand, sand, or gravelly sand. The 2C horizon is sand, gravelly sand, or stratified sand and gravel.

Rubicon Series

The Rubicon series consists of excessively drained, rapidly permeable soils on outwash plains and stream terraces. These soils formed in sandy glacial outwash. Slope ranges from 0 to 35 percent.

Typical pedon of Rubicon sand, 0 to 6 percent slopes, 1,550 feet south and 1,900 feet west of the northeast corner of sec. 25, T. 41 N., R. 9 E.

Oe—2 inches; to 0; black (5YR 2/1) partly decomposed leaf litter.

E—0 to 1 inch; dark reddish gray (5YR 4/2) sand; weak fine subangular blocky structure; very friable; common very fine and fine roots; very strongly acid; clear wavy boundary.

Bs1—1 to 7 inches; dark reddish brown (5YR 3/4) sand; weak fine subangular blocky structure; very friable; common fine and medium roots; very strongly acid; clear wavy boundary.

Bs2—7 to 15 inches; reddish brown (5YR 4/4) sand; weak medium subangular blocky structure; very friable; few fine and medium roots; strongly acid; clear wavy boundary.

BC—15 to 24 inches; strong brown (7.5YR 5/6) sand; single grain; loose; few fine roots; about 4 percent pebbles; medium acid; clear wavy boundary.

C—24 to 60 inches; strong brown (7.5YR 5/6) sand; single grain; loose; about 4 percent pebbles; medium acid.

The solum ranges from 20 to 36 inches in thickness. Some pedons have an A horizon. This horizon is sand 1 to 3 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. The BC horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 3 to 6.

Sayner Series

The Sayner series consists of excessively drained soils on outwash plains, stream terraces, kames, eskers, and moraines. These soils formed in sandy deposits and in the underlying glacial outwash of stratified sand and gravel. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 35 percent.

Typical pedon of Sayner loamy sand, in an area of Sayner-Rubicon complex, 6 to 15 percent slopes, 1,000 feet west and 1,900 feet north of the southeast corner of sec. 29, T. 41 N., R. 9 E.

Oe—2 inches to 0; black (5YR 2/1) partly decomposed forest litter.

E—0 to 1 inch; dark reddish gray (5YR 4/2) loamy sand; weak medium subangular blocky structure; very friable; many fine roots; about 3 percent pebbles; very strongly acid; clear wavy boundary.

Bs1—1 to 6 inches; dark reddish brown (5YR 3/4) loamy sand; weak fine and medium subangular blocky structure; very friable; many fine and medium roots; about 4 percent pebbles; very strongly acid; clear wavy boundary.

Bs2—6 to 16 inches; reddish brown (5YR 4/4) loamy sand; weak fine and medium subangular blocky structure; very friable; common fine and medium roots; about 4 percent pebbles; strongly acid; clear wavy boundary.

Bs3—16 to 19 inches; reddish brown (5YR 4/4) gravelly sand; single grain; loose; common fine and medium roots; about 25 percent pebbles; strongly acid; clear wavy boundary.

BC—19 to 28 inches; yellowish red (5YR 4/6) gravelly sand; single grain; loose; few fine roots; about 30 percent pebbles; medium acid; clear wavy boundary.

C—28 to 60 inches; strong brown (7.5YR 5/6) stratified sand and gravel; single grain; loose; about 30 percent pebbles; medium acid.

The thickness of the solum ranges from 14 to 30 inches. The content of pebbles ranges from 0 to 15 percent in the A and E horizons, from 0 to 35 percent in the Bs and BC horizons, and from 15 to 35 percent in the C horizon. The content of cobbles ranges from 0 to 10 percent throughout the profile.

Some pedons have an A horizon. This horizon is loamy sand 1 to 3 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 5YR or 7.5YR and value of 4 to 6. The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 and Bs3 horizons have hue of 5YR or 7.5YR, value of 3 or 4, and chroma of 3 to 6. The Bs1, Bs2, and Bs3 horizons are loamy sand, sand, gravelly loamy sand, or gravelly sand. The BC horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is sand or gravelly sand. The C horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 4 to 6. It is stratified sand and gravel or gravelly sand.

Seelyeville Series

The Seelyeville series consists of very poorly drained, moderately rapidly permeable soils on outwash plains, glacial lake plains, and moraines. These soils formed in herbaceous organic material more than 51 inches thick. Slope is 0 to 1 percent.

Typical pedon of Seelyeville muck, in an area of Seelyeville and Markey mucks, 0 to 1 percent slopes, 1,400 feet west and 720 feet north of the southeast corner of sec. 31, T. 44 N., R. 5 E.

Oa1—0 to 6 inches; black (5YR 2/1), broken face and rubbed, sapric material; about 15 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; very friable; primarily herbaceous fibers; very strongly acid (pH 5.0 by the Truog method); clear wavy boundary.

Oa2—6 to 20 inches; black (10YR 2/1), broken face, and very dark brown (10YR 2/2), rubbed, sapric material; about 30 percent fiber, less than 5 percent rubbed; weak medium platy structure parting to weak very fine subangular blocky; very friable; primarily herbaceous fibers; strongly acid (pH 5.3 by the Truog method); clear smooth boundary.

Oa3—20 to 60 inches; black (10YR 2/1), broken face and rubbed, sapric material; about 20 percent fiber, less than 5 percent rubbed; massive; very friable; primarily herbaceous fibers; strongly acid (pH 5.3 by the Truog method).

The organic material is more than 51 inches thick. It is derived primarily from herbaceous material.

The sapric layers have hue of 5YR, 7.5YR, or 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2. Thin layers of hemic material are in the subsurface or bottom tiers of some pedons.

Worcester Variant

The Worcester Variant consists of somewhat poorly drained soils on outwash plains and stream terraces. These soils formed in loamy deposits and in the underlying glacial outwash of sand and gravel. Permeability is moderately rapid in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 2 percent.

Typical pedon of Worcester Variant sandy loam, 0 to 2 percent slopes, 260 feet south and 2,100 feet west of the northeast corner of sec. 30, T. 43 N., R. 5 E.

Oe—1 inch to 0; black (7.5YR 2/0) partly decomposed forest litter.

A—0 to 1 inch; very dark grayish brown (10YR 3/2) sandy loam; weak fine granular structure; very friable; many fine roots; very strongly acid; abrupt smooth boundary.

E—1 to 5 inches; reddish gray (5YR 5/2) sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; about 2 percent pebbles; very strongly acid; clear smooth boundary.

Bhs—5 to 7 inches; dark reddish brown (5YR 3/3) sandy loam; weak very fine subangular blocky structure; friable; common fine and medium roots; about 2 percent pebbles; very strongly acid; abrupt wavy boundary.

Bs1—7 to 14 inches; reddish brown (5YR 4/4) sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; about 2 percent pebbles; medium acid; clear wavy boundary.

Bs2—14 to 18 inches; reddish brown (5YR 4/4) sandy loam; common fine prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; friable; few fine roots; about 8 percent pebbles; medium acid; clear wavy boundary.

2C—18 to 60 inches; brown (7.5YR 4/4) gravelly sand; few medium distinct pinkish gray (7.5YR 6/2) and common medium prominent strong brown (7.5YR 5/8) mottles; single grain; loose; about 25 percent pebbles; slightly acid.

The thickness of the solum ranges from 14 to 24 inches. The thickness of the loamy mantle ranges from 6 to 20 inches. The content of pebbles ranges from 0 to 10 percent in the A, E, Bhs, and Bs horizons and from 0 to 35 percent in the 2BC and 2C horizons. The content of cobbles ranges from 0 to 5 percent throughout the profile.

The A horizon is 1 to 5 inches thick. It has hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has hue of 5YR or 7.5YR and value of 4 or 5. The Bs horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. Some pedons have a 2BC horizon. This horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6. It is loamy sand, sand, gravelly loamy sand, or gravelly sand. The 2C horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand, gravelly sand, or stratified sand and gravel.

Formation of the Soils

This section describes the geology and underlying material in Vilas County. It also relates the factors of soil formation to the soils in the county and explains the processes of soil formation.

Geology and Underlying Material

Robert N. Cheetham, geologist, Soil Conservation Service, helped prepare this section.

The land surface of Vilas County is strongly affected by thick glacial deposits (*3*). It is underlain by bedrock that is a complex of folded, faulted Precambrian igneous and metamorphic rocks and metasediments that are part of the Canadian Shield. A bedrock geology map published by the University of Wisconsin shows the distribution of the rock types (*8*).

Bedrock is at or near the surface in only a few areas in the county. Glacially smoothed granite crops out in the Grassy Lake area north of Boulder Junction. Gneiss and hornblende schist crop out on the north sides of Fishtrap and High Lakes. Northwest of Anvil Lake, in the Nicolet National Forest, is an area that has scattered test pits and a shaft. This area is near Blackjack Creek. The rock in this area is mostly a quartz feldspar porphyry with vein quartz and fault breccia.

The mineral composition of the glacial deposits resembles that of the bedrock in the county (*7*). Mechanical analyses show that igneous rocks—granite, porphyry, gabbro, and fine greenstone—make up 65 to 75 percent of the rock material. The rest is schist, quartzite, sandstone, iron formations or other metamorphic and sedimentary rocks, and quartz sand.

Glacial deposits are glacial till, glacial outwash, and stratified glaciolacustrine deposits. Glacial till is a heterogeneous mixture deposited by the ice with little or no sorting action by glacial meltwater. As a result of different advances of the ice sheets and weathering, glacial till differs in color and texture from one area to another. In the eastern part of the county, the till is mostly brown loamy sand or gravelly loamy sand of Middle Woodfordian or Cary Age. The till in the northwestern part of the county is reddish brown fine sandy loam or sandy loam. It is Late Woodfordian or younger in age.

In most areas the landscape in Vilas County is a broad, nearly level, pitted outwash plain formed by glacial meltwater streams that sorted the glacial material. The outwash deposits are sand or stratified sand and gravel.

Glaciolacustrine deposits indicate the former extent of lakes during glacial recession. They generally border present lakes or streams or occur as scattered spots within the till area in the northwestern part of the county. The deposits range from silt to fine sand and have essentially no gravel.

Factors of Soil Formation

The factors that determine the kind of soil that forms at any given point are composition of the parent material; the climate under which the soil material has accumulated and weathered; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They alter the accumulated parent material and bring about the development of genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the parent material to form into a soil. Usually, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the unweathered material in which a soil forms. It largely determines the chemical and mineralogical composition of the soil. Vilas County is in the glaciated area of north-central Wisconsin. Most of the soils formed in glacial till, glacial outwash, or glaciolacustrine deposits. Some formed in organic material.

The glacial till is unstratifed, unsorted glacial debris made up of clay, silt, sand, gravel, stones, and boulders. The different ages of the till in Vilas County are distinguished primarily by the texture and color of the till and by the overlying soil material. Cable, Champion, and Monico soils formed in a thin mantle of loess or silty and loamy deposits and in the underlying brown, sandy or loamy till. Gogebic soils formed in reddish brown, loamy till. Keweenaw soils formed in loamy glacial drift and in the underlying brown, sandy till.

Glacial outwash is material deposited by glacial meltwater. It is dominantly stratified sand and gravel. Some outwash, however, is almost exclusively sandy. Soils that formed in sandy deposits include Au Gres, Croswell, Karlin, Kinross, and Rubicon soils. Sayner soils formed in sandy deposits and in the underlying stratified sand and gravel. Manitowish, Padus, Pence, and Worcester Variant soils formed mainly in loamy deposits underlain by sand, gravelly sand, or stratified sand and gravel.

Glaciolacustrine deposits were laid down in still water in former glacial lake basins. These deposits are characterized by stratified layers of silt, silt loam, very fine sandy loam, loamy very fine sand, very fine sand, loamy fine sand, or fine sand. Alcona soils formed mainly in stratified, loamy and sandy lacustrine deposits. Fence and Gaastra soils formed mainly in stratified, silty and loamy lacustrine deposits.

Some of the soils in the county formed in organic material. This material consists mainly of herbaceous plants in advanced stages of decomposition. Dawson and Markey soils formed in organic material 16 to 51 inches deep over sand. Loxley and Seelyeville soils formed in more than 51 inches of organic material. The organic soils are in the basins of former glacial lakes and in depressions and drainageways.

Climate

Climate affects soil formation through the effects of soil moisture and heat. It has a direct effect on the weathering of rocks and the alteration of parent material through the mechanical action of freezing and thawing and the chemical action generated by the leaching of water. Climate indirectly affects soil formation through its effect on plant and animal life.

Vilas County has a continental climate that favors the growth of trees and the formation of soils having a thin, light colored surface layer. Differences in climate within the county are too small to have caused any significant differences among the soils.

Plant and Animal Life

Living organisms are important factors of soil formation. Earthworms, ants, and rodents continually mix the soil. They transport subsoil material to the surface and surface material to lower layers. They also help to keep the soil porous, thus enhancing air and water movement. Plants obtain nutrients from the soil, incorporate them into their tissues, and later release them as dead leaves and twigs fall to the surface. This process recycles nutrients that were leached to the lower layers of the soil and adds organic matter to the surface layer. Bacteria and fungi decompose this organic matter. Most of the soils in Vilas County formed under forest vegetation. As a result, they have a light colored surface layer that is relatively low in content of organic matter.

Human activities significantly affect soil formation by disrupting the natural soil-forming processes. These activities include draining, flooding, clearing, burning, and cultivating.

Relief

Relief influences soil formation through its effects on the amount of precipitation absorbed by the soil, on the rate of erosion, and on the translocation of material in suspension or solution from one part of the profile to another. Generally, the solum in the steeper soils is thinner than that in gently sloping or undulating soils. Also, the profile is less well expressed. These differences occur because more water percolates through the gently sloping or undulating soils.

Relief directly affects surface and internal soil drainage. Champion, Monico, and Cable soils form a drainage sequence in Vilas County. The moderately well drained Champion soils are on the higher lying ridges and drumlins and are nearly level to moderately steep. The somewhat poorly drained Monico soils are in shallow depressions and drainageways and are nearly level and gently sloping. The poorly drained Cable soils are in depressions and drainageways and are nearly level and gently sloping.

Time

The effects of the soil-forming factors are modified by time. The longer the other soil-forming factors have interacted, the more highly developed or mature the soils can become. Fluvaquents, for example, are immature soils in Vilas County. These soils have few or no genetic differences between horizons because they have not been in place long enough for the soil-forming processes to take full effect. Gogebic soils, on the other hand, are considered mature because they have well defined horizons. The soil-forming processes have been active in these soils for thousands of years.

Processes of Soil Formation

A combination of basic processes is responsible for horizon differentiation. The main processes are gains, losses, transfers, and transformations. These processes generally do not act alone, and each one can affect all soils. Some changes promote horizon differentiation, and some retard it. The nature of the soil at any given point is the net result of all changes (*10*).

The interaction among these soil-forming processes is evident in Padus soils. These soils are well drained because they are high on the landscape and are underlain by porous outwash. They formed in loamy deposits over outwash of stratified sand and gravel. The climate favored the growth of plants. Plants and animals contributed to the accumulation of organic matter and organic acids, and they mixed the soil to some extent. These processes accelerated as more and higher forms of organisms grew in the soil and produced more organic residue and acids. The decomposed organic matter darkened the surface layer of these soils.

While organic matter was being decomposed, minerals within the Padus soils were being chemically weathered by organic acids. Also, iron was being oxidized, giving the soils a reddish color. Percolating water then translocated the weathered minerals, oxidized iron, and some organic matter to the lower parts of the profile. The result was the formation of a thin, bleached subsurface layer and a subsoil of accumulated reddish minerals.

The percolating water also translocated suspended particles of clay downward. As a result, the middle part of subsoil has more clay than other parts of the profile. The underlying glacial outwash, which typically is at a depth of about 35 inches, is unweathered. It has changed little since it was deposited.

The processes that were active in the formation of the Padus soils were gains in organic matter in the surface layer, loss of weathered minerals and clay from the upper part of the soil and the subsequent transfer of these to the upper and middle parts of the subsoil, and the transformation of iron compounds in the subsoil. All of these processes have been active in the soils of Vilas County. The kinds of parent material and the relief to a great extent have determined the kinds of processes that are dominant in the formation of all the soils. These processes, in turn, largely determine the differences and similarities among the soils.

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Glossary

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.

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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (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 (7.5 to 25 centimeters) in diameter.

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.

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.

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.

Cradle-knoll. A knoll made up of soil material that temporarily clung to the roots when a tree was uprooted.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

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.

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 the activities of man or other animals 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.

Fine textured soil. Sandy clay, silty clay, and clay.

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.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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.

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.

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.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

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.

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 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.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

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.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

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 wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and 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.

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 colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

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. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

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. The slope classes recognized in this survey area are—

	Percent
Nearly level	0 to 2
Gently sloping or undulating	2 to 6
Sloping or rolling	6 to 12
Moderately steep or hilly	12 to 20
Steep	20 to 30
Very steep	more than 30

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
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.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

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.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tiers. Layers in the control section of organic soils. The organic material is divided into three tiers. The surface tier is the upper 12 inches; the subsurface tier is the next 24 inches; and the bottom tier is the lower 16 inches.

Till plain. An extensive flat to undulating area underlain by glacial till.

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.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Rest Lake, Wisconsin)

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----	19.2	-.6	9.3	41	-35	0	1.15	0.57	1.65	4	17.5
February---	25.0	2.1	13.6	47	-32	0	.97	.41	1.43	3	13.9
March------	35.7	13.2	24.5	58	-23	0	1.73	.73	2.57	4	13.9
April------	52.0	28.8	40.4	82	4	13	2.42	1.23	3.44	6	4.6
May--------	66.3	40.7	53.5	88	22	190	4.11	2.48	5.55	8	.9
June-------	73.5	50.6	62.1	90	30	363	4.48	2.81	5.99	8	.0
July-------	77.4	55.4	66.4	91	39	508	4.52	2.69	6.14	8	.0
August-----	74.7	53.7	64.2	89	36	440	5.21	2.93	7.22	8	.0
September--	65.3	45.6	55.5	85	27	177	3.77	2.08	5.26	8	.0
October----	55.4	36.1	45.8	78	17	73	2.54	1.09	3.77	6	1.2
November---	37.3	22.4	29.9	62	-8	0	2.10	1.22	2.88	6	12.6
December---	24.4	8.2	16.3	46	-25	0	1.47	.79	2.06	5	19.9
Yearly:											
Average--	50.5	29.7	40.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	92	-36	---	---	---	---	---	---
Total----	---	---	---	---	---	1,764	34.47	29.48	38.78	74	84.5

* 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 1951-80 at Rest Lake, Wisconsin)

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 12	May 22	June 11
2 years in 10 later than--	May 8	May 18	June 6
5 years in 10 later than--	Apr. 29	May 10	May 28
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 6	Sept. 20	Sept. 9
2 years in 10 earlier than--	Oct. 11	Sept. 25	Sept. 14
5 years in 10 earlier than--	Oct. 21	Oct. 4	Sept. 23

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-80 at Rest Lake, Wisconsin)

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	152	127	99
8 years in 10	160	134	105
5 years in 10	174	147	117
2 years in 10	189	160	129
1 year in 10	196	167	135

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Au	Au Gres sand, 0 to 2 percent slopes	7,040	1.1
CaA	Cable silt loam, 0 to 3 percent slopes	1,520	0.2
ChB	Champion silt loam, 1 to 6 percent slopes	13,655	2.1
ChC	Champion silt loam, 6 to 20 percent slopes	22,865	3.5
CrA	Croswell sand, 0 to 3 percent slopes	19,070	2.9
CsA	Croswell sand, loamy substratum, 0 to 3 percent slopes	2,310	0.4
FeB	Fence-Alcona complex, 0 to 6 percent slopes	2,555	0.4
FeC	Fence-Alcona complex, 6 to 15 percent slopes	555	0.1
Fh	Fluvaquents, sandy, nearly level	1,600	0.2
Ga	Gaastra silt loam, 0 to 2 percent slopes	950	0.1
GoB	Gogebic-Fence-Pence complex, 0 to 6 percent slopes	8,320	1.3
GoC	Gogebic-Fence-Pence complex, 3 to 15 percent slopes	21,580	3.3
GpD	Gogebic-Pence complex, 15 to 30 percent slopes	17,235	2.6
Hp	Histosols, ponded	4,165	0.6
KaB	Karlin loamy fine sand, 0 to 6 percent slopes	20,945	3.2
KaC	Karlin loamy fine sand, 6 to 15 percent slopes	7,430	1.1
KbB	Keweenaw sandy loam, 0 to 6 percent slopes	1,405	0.2
KbC	Keweenaw sandy loam, 6 to 15 percent slopes	790	0.1
KbD	Keweenaw sandy loam, 15 to 30 percent slopes	320	*
KeB	Keweenaw-Karlin complex, 0 to 6 percent slopes	10,580	1.6
KeC	Keweenaw-Karlin complex, 6 to 15 percent slopes	7,705	1.2
KnD	Keweenaw-Sayner complex, 15 to 30 percent slopes	5,055	0.8
Kr	Kinross mucky sand, 0 to 2 percent slopes	5,565	0.9
Lo	Loxley and Dawson peats, 0 to 1 percent slopes	55,572	8.5
MaA	Manitowish sandy loam, 0 to 3 percent slopes	2,940	0.5
MoA	Monico silt loam, 0 to 3 percent slopes	2,340	0.4
PaB	Padus fine sandy loam, 0 to 6 percent slopes	18,570	2.9
PaC	Padus fine sandy loam, 6 to 15 percent slopes	13,700	2.1
PaD	Padus fine sandy loam, 15 to 25 percent slopes	2,070	0.3
PeC	Padus-Pence complex, 6 to 15 percent slopes	4,615	0.7
PeD	Padus-Pence complex, 15 to 35 percent slopes	8,085	1.2
PnB	Pence sandy loam, 0 to 6 percent slopes	23,140	3.6
PnC	Pence sandy loam, 6 to 15 percent slopes	19,610	3.0
PnD	Pence sandy loam, 15 to 25 percent slopes	8,335	1.3
Pt	Pits, gravel	375	0.1
RoB	Rubicon sand, 0 to 6 percent slopes	49,070	7.5
RoC	Rubicon sand, 6 to 15 percent slopes	19,245	3.0
RoD	Rubicon sand, 15 to 30 percent slopes	9,105	1.4
SaB	Sayner-Rubicon complex, 0 to 6 percent slopes	13,765	2.1
SaC	Sayner-Rubicon complex, 6 to 15 percent slopes	38,180	5.9
SaD	Sayner-Rubicon complex, 15 to 35 percent slopes	46,920	7.2
Se	Seelyeville and Markey mucks, 0 to 1 percent slopes	35,200	5.4
Wv	Worcester Variant sandy loam, 0 to 2 percent slopes	725	0.1
	Water	96,321	14.9
	Total	651,098	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

Map symbol	Soil name
ChB	Champion silt loam, 1 to 6 percent slopes
FeB	Fence-Alcona complex, 0 to 6 percent slopes
Ga	Gaastra silt loam, 0 to 2 percent slopes (where drained)
MoA	Monico silt loam, 0 to 3 percent slopes (where drained)
PaB	Padus fine sandy loam, 0 to 6 percent slopes

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: 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
Au---------------- Au Gres	6W	Slight	Moderate	Moderate	Moderate	Red pine------------ Quaking aspen-------- Bigtooth aspen------- Balsam fir----------- Paper birch--------- Red maple----------- Eastern white pine-- Northern white-cedar Jack pine----------- White spruce---------	56 70 --- 55 --- --- --- --- 56 ---	90 81 --- 107 --- --- --- --- 83 ---	White spruce, imperial Carolina poplar, eastern white pine, northern white-cedar, Norway spruce.
CaA--------------- Cable	2W	Slight	Severe	Severe	Severe	Red maple----------- Black ash----------- White ash----------- Balsam fir----------- Black spruce-------- Quaking aspen-------- White spruce---------	56 48 --- --- --- --- ---	36 24 --- --- --- --- ---	White spruce, red maple, balsam fir, black spruce.
ChB, ChC--------- Champion	3W	Slight	Moderate	Slight	Moderate	Sugar maple--------- American basswood--- Yellow birch-------- Eastern hemlock----- Balsam fir----------- Quaking aspen-------- Red maple----------- Bigtooth aspen------- Black cherry-------- Eastern hophornbeam- White spruce--------- American elm---------	63 --- 60 --- --- --- --- --- --- --- --- ---	39 --- 38 --- --- --- --- --- --- --- --- ---	White spruce, eastern white pine, jack pine.
CrA--------------- Croswell	8S	Slight	Slight	Moderate	Slight	Red pine------------ Quaking aspen-------- Jack pine----------- Northern red oak---- Black cherry-------- Eastern white pine-- Bigtooth aspen------- Red maple-----------	62 68 --- --- --- --- --- ---	107 78 --- --- --- --- --- ---	Red pine, eastern white pine, white spruce, Carolina poplar.
CsA--------------- Croswell	8S	Slight	Slight	Moderate	Slight	Red pine------------ Jack pine----------- Eastern white pine-- Northern pin oak---- Quaking aspen-------- Bigtooth aspen------- Northern red oak----	62 --- --- --- --- --- ---	107 --- --- --- --- --- ---	Red pine, eastern white pine, jack pine.
FeB**, FeC**: Fence-----------	3L	Slight	Severe	Slight	Slight	Sugar maple--------- Yellow birch-------- American basswood--- Quaking aspen-------- Bigtooth aspen-------	65 --- --- --- ---	40 --- --- --- ---	Red pine, eastern white pine, white spruce.

See footnotes at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi-nation symbol	Management concerns: Erosion hazard	Equip-ment limita-tion	Seedling mortal-ity	Wind-throw hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
FeB**, FeC**:									
Alcona	3L	Slight	Moderate	Slight	Slight	Sugar maple	61	38	White spruce, red pine, eastern white pine, Carolina poplar.
						Red maple	---	---	
						Yellow birch	---	---	
						American basswood	---	---	
						American beech	---	---	
						Northern red oak	---	---	
						Eastern white pine	---	---	
						White ash	---	---	
						Red pine	---	---	
Ga Gaastra	7W	Slight	Moderate	Slight	Moderate	White spruce	52	100	White spruce, eastern white pine.
						Sugar maple	61	38	
						Red maple	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
						Balsam fir	---	---	
						American basswood	---	---	
GoB**, GoC**:									
Gogebic	3D	Slight	Moderate	Slight	Moderate	Sugar maple	61	38	White spruce, eastern white pine, jack pine.
						Yellow birch	62	39	
						American basswood	66	41	
						Eastern hemlock	---	---	
						Balsam fir	61	120	
Fence	3L	Slight	Severe	Slight	Slight	Sugar maple	65	40	Red pine, eastern white pine, white spruce.
						Yellow birch	---	---	
						American basswood	---	---	
						Quaking aspen	---	---	
						Bigtooth aspen	---	---	
Pence	7S	Slight	Slight	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Sugar maple	59	37	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
						Northern red oak	63	46	
GpD**:									
Gogebic	3R	Moderate	Moderate	Slight	Moderate	Sugar maple	61	38	White spruce, eastern white pine, jack pine, red pine.
						Yellow birch	62	39	
						American basswood	66	41	
						Eastern hemlock	---	---	
						Balsam fir	61	120	
Pence	7R	Moderate	Moderate	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Sugar maple	59	37	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
						Northern red oak	63	46	

See footnotes at end of table.

TABLE 6.--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*	
KaB, KaC-------- Karlin	6S	Slight	Slight	Slight	Slight	Red pine------------	56	90	Red pine, eastern white pine, Carolina poplar.
						Sugar maple---------	61	38	
						Yellow birch--------	---	---	
						Bigtooth aspen------	---	---	
						Northern red oak----	58	41	
						American basswood---	---	---	
						Eastern white pine--	---	---	
KbB, KbC-------- Keweenaw	3S	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	69	51	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	
KbD------------- Keweenaw	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	69	51	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	
KeB**, KeC**:									
Keweenaw-------	3S	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	69	51	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	
Karlin---------	6S	Slight	Slight	Slight	Slight	Red pine------------	56	90	Red pine, eastern white pine, Carolina poplar.
						Sugar maple---------	61	38	
						Yellow birch--------	---	---	
						Bigtooth aspen------	---	---	
						Northern red oak----	58	41	
						American basswood---	---	---	
						Eastern white pine--	---	---	
KnD**:									
Keweenaw-------	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern red oak----	69	51	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						Black cherry--------	---	---	
						Eastern white pine--	---	---	
						Balsam fir----------	---	---	

See footnotes at end of table.

TABLE 6.--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*	
KnD**:									
Sayner	7R	Moderate	Severe	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Jack pine	---	---	
						Eastern white pine	57	112	
						Northern red oak	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Red maple	---	---	
Kr: Kinross	7W	Slight	Severe	Severe	Severe	White spruce	50	96	
						Quaking aspen	45	32	
						Black spruce	---	---	
						Tamarack	---	---	
						Northern white-cedar	---	---	
						Balsam fir	---	---	
						Red maple	---	---	
Lo**:									
Loxley	2W	Slight	Severe	Severe	Severe	Black spruce	15	23	
						Tamarack	---	---	
						Balsam fir	---	---	
Dawson	2W	Slight	Severe	Severe	Severe	Black spruce	15	23	
						Tamarack	---	---	
						Red maple	---	---	
						Northern white-cedar	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
MaA: Manitowish	3S	Slight	Slight	Slight	Slight	Sugar maple	60	38	Red pine, eastern white pine, jack pine.
						Red pine	59	99	
						Quaking aspen	---	---	
						Eastern white pine	---	---	
						Red maple	---	---	
MoA: Monico	3W	Slight	Severe	Slight	Moderate	Sugar maple	63	39	White spruce, black spruce, eastern white pine, red maple, white ash.
						American basswood	---	---	
						Yellow birch	---	---	
						Red maple	---	---	
						White ash	---	---	
PaB, PaC: Padus	3L	Slight	Moderate	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	43	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
						Eastern hemlock	---	---	
PaD: Padus	3R	Moderate	Moderate	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	43	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
						Eastern hemlock	---	---	

See footnotes at end of table.

TABLE 6.--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
PeC**:									
Padus	3L	Slight	Moderate	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	43	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
						Eastern hemlock	---	---	
Pence	7S	Slight	Slight	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Sugar maple	59	37	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
						Northern red oak	63	46	
PeD**:									
Padus	3R	Moderate	Moderate	Slight	Slight	Sugar maple	67	41	Red pine, eastern white pine, white spruce.
						Northern red oak	70	43	
						Bigtooth aspen	78	91	
						White ash	---	---	
						American basswood	---	---	
						Red pine	---	---	
						Eastern hemlock	---	---	
Pence	7R	Moderate	Moderate	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Sugar maple	59	37	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
						Northern red oak	63	46	
PnB, PnC Pence	7S	Slight	Slight	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Sugar maple	59	37	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
						Northern red oak	63	46	
PnD Pence	7R	Moderate	Moderate	Slight	Slight	Red pine	59	99	Red pine, eastern white pine, jack pine.
						Sugar maple	59	37	
						Eastern white pine	57	112	
						American basswood	---	---	
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						Yellow birch	---	---	
						Northern red oak	---	---	

See footnotes at end of table.

TABLE 6.--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*	
RoB, RoC-------- Rubicon	6S	Slight	Moderate	Moderate	Slight	Jack pine-----------	61	91	Red pine, jack pine.
						Quaking aspen-------	60	64	
						Red pine------------	50	75	
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	45	75	
RoD------------- Rubicon	6R	Moderate	Moderate	Moderate	Slight	Jack pine-----------	61	91	Red pine, jack pine.
						Quaking aspen-------	60	64	
						Red pine------------	50	75	
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	45	75	
SaB**, SaC**: Sayner---------	7S	Slight	Slight	Slight	Slight	Red pine------------	59	99	Red pine, eastern white pine, jack pine.
						Jack pine-----------	---	---	
						Eastern white pine--	57	112	
						Northern red oak----	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
Rubicon--------	6S	Slight	Moderate	Moderate	Slight	Jack pine-----------	61	91	Red pine, jack pine.
						Quaking aspen-------	60	64	
						Red pine------------	50	75	
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	45	75	
SaD**: Sayner---------	7R	Moderate	Moderate	Slight	Slight	Red pine------------	59	99	Red pine, eastern white pine, jack pine.
						Jack pine-----------	---	---	
						Eastern white pine--	57	112	
						Northern red oak----	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
Rubicon--------	6R	Moderate	Moderate	Moderate	Slight	Jack pine-----------	61	91	Red pine, jack pine.
						Quaking aspen-------	60	64	
						Red pine------------	50	75	
						Bigtooth aspen------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						Eastern white pine--	45	75	
Se**: Seelyeville----	8W	Slight	Severe	Severe	Severe	Balsam fir----------	56	109	
						Tamarack------------	47	38	
						Northern white-cedar	33	48	

See footnotes at end of table.

TABLE 6.--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*	
Se**:									
Markey----------	7W	Slight	Severe	Severe	Severe	Balsam fir----------	52	100	
						Quaking aspen-------	45	32	
						Black spruce--------	---	---	
						Tamarack------------	---	---	
						Black ash-----------	---	---	
						Northern white-cedar	41	61	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
						White spruce--------	---	---	
Wv--------------- Worcester Variant	2W	Slight	Moderate	Slight	Moderate	Red maple-----------	55	35	Eastern white pine, red maple, white spruce.
						Sugar maple---------	---	---	
						Yellow birch--------	---	---	
						Balsam fir----------	---	---	
						White spruce--------	---	---	

* 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.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND EQUIPMENT USE

(Only the soils suitable for the production of commercial trees are listed)

Soil name and map symbol	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)
Au------------------ Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.
CaA----------------- Cable	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness.	Summer, winter.
ChB----------------- Champion	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.
ChC----------------- Champion	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.
CrA----------------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
CsA----------------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
FeB*:				
Fence--------------	Severe: low strength.	Slight--------	Slight--------	Summer, fall, winter.
Alcona-------------	Moderate: low strength.	Slight--------	Slight--------	Summer, fall, winter.
FeC*:				
Fence--------------	Severe: low strength.	Moderate: slope.	Slight--------	Summer, fall, winter.
Alcona-------------	Moderate: low strength.	Moderate: slope.	Slight--------	Summer, fall, winter.
Ga------------------ Gaastra	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness.	Summer, winter.
GoB*:				
Gogebic------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.
Fence--------------	Severe: low strength.	Slight--------	Slight--------	Summer, fall, winter.
Pence--------------	Slight--------	Slight--------	Slight--------	Year round.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for the most limiting season(s): Logging areas and skid trails	Log landings	Haul roads	Preferred operating season(s)
GoC*:				
Gogebic	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.
Fence	Severe: low strength.	Moderate: slope.	Slight	Summer, fall, winter.
Pence	Slight	Moderate: slope.	Slight	Year round.
GpD*:				
Gogebic	Moderate: slope, low strength.	Severe: slope.	Moderate: slope.	Summer, fall, winter.
Pence	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
KaB Karlin	Slight	Slight	Slight	Year round.
KaC Karlin	Slight	Moderate: slope.	Slight	Year round.
KbB Keweenaw	Slight	Slight	Slight	Year round.
KbC Keweenaw	Slight	Moderate: slope.	Slight	Year round.
KbD Keweenaw	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
KeB*:				
Keweenaw	Slight	Slight	Slight	Year round.
Karlin	Slight	Slight	Slight	Year round.
KeC*:				
Keweenaw	Slight	Moderate: slope.	Slight	Year round.
Karlin	Slight	Moderate: slope.	Slight	Year round.
KnD*:				
Keweenaw	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Sayner	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Kr Kinross	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter.
Lo*:				
Loxley	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.

See footnote at end of table.

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for the most limiting season(s)			Preferred operating season(s)
	Logging areas and skid trails	Log landings	Haul roads	
Lo*:				
Dawson	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
MaA Manitowish	Slight	Slight	Slight	Year round.
MoA Monico	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness.	Summer, winter.
PaB Padus	Moderate: low strength.	Slight	Slight	Summer, fall, winter.
PaC Padus	Moderate: low strength.	Moderate: slope.	Slight	Summer, fall, winter.
PaD Padus	Moderate: slope, low strength.	Severe: slope.	Moderate: slope.	Summer, fall, winter.
PeC*:				
Padus	Moderate: low strength.	Moderate: slope.	Slight	Summer, fall, winter.
Pence	Slight	Moderate: slope.	Slight	Year round.
PeD*:				
Padus	Moderate: slope, low strength.	Severe: slope.	Moderate: slope.	Summer, fall, winter.
Pence	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
PnB Pence	Slight	Slight	Slight	Year round.
PnC Pence	Slight	Moderate: slope.	Slight	Year round.
PnD Pence	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
RoB Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
RoC Rubicon	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Year round.
RoD Rubicon	Moderate: slope, too sandy.	Severe: slope.	Moderate: slope, too sandy.	Year round.

See footnote at end of table

TABLE 7.--WOODLAND EQUIPMENT USE--Continued

Soil name and map symbol	Ratings for the most limiting season(s)			Preferred operating season(s)
	Logging areas and skid trails	Log landings	Haul roads	
SaB*:				
Sayner	Slight	Slight	Slight	Year round.
Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Year round.
SaC*:				
Sayner	Slight	Moderate: slope.	Slight	Year round.
Rubicon	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Year round.
SaD*:				
Sayner	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.
Rubicon	Moderate: slope, too sandy.	Severe: slope.	Moderate: slope, too sandy.	Year round.
Se*:				
Seelyeville	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
Markey	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter.
Wv: Worcester Variant	Severe: wetness	Severe: wetness.	Severe: wetness.	Summer, winter.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields in the N columns are for nonirrigated soils; those in the I column are for irrigated soils. 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		Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass	Irish potatoes	
	N	I	N	N	N	N	N	I
			Bu	Tons	Tons	AUM*	Cwt	Cwt
Au---------------- Au Gres	IVw	---	45	2.2	1.7	1.5	200	425
CaA--------------- Cable	VIw	---	---	---	---	1.6	---	---
ChB--------------- Champion	IIe	---	70	3.0	2.8	3.5	---	---
ChC--------------- Champion	IIIe	---	60	2.5	2.3	3.0	---	---
CrA--------------- Croswell	IVs	---	40	2.5	2.0	2.3	200	425
CsA--------------- Croswell	IVs	---	50	2.5	2.0	1.6	225	450
FeB--------------- Fence-Alcona	IIe	---	75	4.2	3.3	3.3	325	450
FeC--------------- Fence-Alcona	IIIe	---	68	3.6	2.8	2.8	300	425
Fh**-------------- Fluvaquents	Vw	---	---	---	---	---	---	---
Ga---------------- Gaastra	IIw	---	---	3.0	2.5	2.1	---	---
GoB--------------- Gogebic-Fence-Pence	IIe	---	---	---	---	---	---	---
GoC--------------- Gogebic-Fence-Pence	IIIe	---	---	---	---	---	---	---
GpD--------------- Gogebic-Pence	VIIe	---	---	---	---	---	---	---
Hp**-------------- Histosols	VIIIw	---	---	---	---	---	---	---
KaB--------------- Karlin	IIIs	---	60	3.0	2.5	1.5	225	425
KaC--------------- Karlin	IVe	---	55	2.8	2.3	1.1	200	400
KbB--------------- Keweenaw	IIIe	---	---	---	---	---	---	---
KbC--------------- Keweenaw	IVe	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass	Irish potatoes	
	N	I	N	N	N	N	N	I
			Bu	Tons	Tons	AUM*	Cwt	Cwt
KbD--------------- Keweenaw	VIIe	---	---	---	---	---	---	---
KeB--------------- Keweenaw-Karlin	IIIe	---	60	2.8	2.3	1.8	250	425
KeC--------------- Keweenaw-Karlin	IVe	---	52	2.5	2.0	1.3	225	400
KnD--------------- Keweenaw-Sayner	VIIe	---	---	---	---	---	---	---
Kr---------------- Kinross	VIw	---	---	---	---	---	---	---
Lo---------------- Loxley and Dawson	VIw	---	---	---	---	---	---	---
MaA--------------- Manitowish	IIIs	---	60	3.5	3.0	1.8	---	---
MoA--------------- Monico	IIw	---	70	4.0	3.5	3.3	---	---
PaB--------------- Padus	IIe	---	75	4.0	3.5	2.6	350	450
PaC--------------- Padus	IIIe	---	70	3.5	3.0	2.2	275	450
PaD--------------- Padus	VIe	---	---	2.5	2.0	1.2	---	---
PeC--------------- Padus-Pence	IVe	---	---	---	---	---	---	---
PeD--------------- Padus-Pence	VIIe	---	---	---	---	---	---	---
PnB--------------- Pence	IIIe	---	60	3.5	2.5	1.8	250	450
PnC--------------- Pence	IVe	---	50	3.0	2.5	1.3	225	450
PnD--------------- Pence	VIIe	---	---	2.5	2.0	1.0	---	---
Pt**. Pits								
RoB--------------- Rubicon	IVs	---	45	2.5	2.0	1.1	200	425
RoC--------------- Rubicon	VIs	---	---	2.0	---	1.0	175	425
RoD--------------- Rubicon	VIIs	---	---	1.5	---	0.9	---	---
SaB--------------- Sayner-Rubicon	IVs	---	45	2.8	2.3	1.3	200	425

See footnotes at end of table.

TABLE 8.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Oats	Bromegrass-alfalfa hay	Timothy-red clover hay	Kentucky bluegrass	Irish potatoes	
	N	I	N	N	N	N	N	I
			Bu	Tons	Tons	AUM*	Cwt	Cwt
SaC--------------- Sayner-Rubicon	VIs	---	---	2.3	1.8	1.1	175	425
SaD--------------- Sayner-Rubicon	VIIs	---	---	---	---	---	---	---
Se---------------- Seelyeville and Markey	VIw	---	---	---	---	---	---	---
Wv---------------- Worcester Variant	IIw	---	55	3.0	2.5	1.7	---	---

* 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.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Au------------------- Au Gres	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
CaA------------------ Cable	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
ChB------------------ Champion	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
ChC------------------ Champion	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: large stones, wetness, slope.
CrA, CsA------------- Croswell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
FeB*:					
Fence----------------	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight----------	Slight.
Alcona---------------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
FeC*:					
Fence----------------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Alcona---------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
Fh*. Fluvaquents					
Ga------------------- Gaastra	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
GoB*:					
Gogebic--------------	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
Fence----------------	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight----------	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
GoB*:					
Pence	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
GoC*:					
Gogebic	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: large stones, wetness, slope.
Fence	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Pence	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
GpD*:					
Gogebic	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Pence	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Hp*. Histosols					
KaB Karlin	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
KaC Karlin	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
KbB Keweenaw	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones, wetness.	Slight	Moderate: large stones, droughty.
KbC Keweenaw	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, large stones.
KbD Keweenaw	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
KeB*:					
Keweenaw	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones, wetness.	Slight	Moderate: large stones, droughty.
Karlin	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
KeC*:					
Keweenaw	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, large stones.
Karlin	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
KnD*:					
Keweenaw	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
Sayner	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: droughty, slope.
Kr Kinross	Severe: ponding, too sandy.	Severe: ponding, too sandy.	Severe: too sandy, ponding.	Severe: ponding, too sandy.	Severe: ponding, droughty.
Lo*:					
Loxley	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
Dawson	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
MaA Manitowish	Slight	Slight	Moderate: small stones.	Slight	Moderate: droughty, large stones.
MoA Monico	Severe: flooding, wetness.	Moderate: wetness, small stones.	Severe: small stones, wetness.	Moderate: wetness.	Moderate: small stones, large stones, wetness.
PaB Padus	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
PaC Padus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
PaD Padus	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
PeC*:					
Padus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
PeC*:					
Pence	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
PeD*:					
Padus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pence	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PnB Pence	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
PnC Pence	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, droughty, slope.
PnD Pence	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Pt*. Pits					
RoB Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
RoC Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
RoD Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty, slope.
SaB*:					
Sayner	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Severe: droughty.
Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
SaC*:					
Sayner	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
SaD*:					
Sayner	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: droughty, slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
SaD*:					
Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty, slope.
Se*:					
Seelyeville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Wv Worcester Variant	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Au: Au Gres	Poor	Poor	Fair	Good	Good	Poor	Very poor.	Poor	Fair	Very poor.
CaA: Cable	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
ChB: Champion	Fair	Fair	Good	Fair	Fair	Poor	Poor	Fair	Fair	Very poor.
ChC: Champion	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
CrA, CsA: Croswell	Poor	Poor	Fair	Good	Good	Poor	Very poor.	Poor	Fair	Very poor.
FeB*:										
Fence	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Alcona	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
FeC*:										
Fence	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Alcona	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Fh*. Fluvaquents										
Ga: Gaastra	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
GoB*:										
Gogebic	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Fair	Good	Very poor.
Fence	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
GoC*:										
Gogebic	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
Fence	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
GpD*:										
Gogebic	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
Pence	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Hp*. Histosols										
KaB, KaC Karlin	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KbB Keweenaw	Fair	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
KbC Keweenaw	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
KbD Keweenaw	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
KeB*:										
Keweenaw	Fair	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Karlin	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KeC*:										
Keweenaw	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Karlin	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KnD*:										
Keweenaw	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sayner	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Kr Kinross	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
Lo*:										
Loxley	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Dawson	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
MaA Manitowish	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
MoA Monico	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
PaB, PaC Padus	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
PaD: Padus	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PeC*:										
Padus	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PeD*:										
Padus	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Pence	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PnB, PnC: Pence	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
PnD: Pence	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Pt*. Pits										
RoB: Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
RoC, RoD: Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
SaB*:										
Sayner	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
SaC*:										
Sayner	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
SaD*:										
Sayner	Very poor.	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Se*:										
Seelyeville	Very poor.	Poor	Poor	Poor	Good	Good	Good	Poor	Fair	Good.
Markey	Very poor.	Poor	Poor	Poor	Good	Good	Good	Poor	Fair	Good.
Wv: Worcester Variant	Fair	Good	Good	Good	Good	Fair	Good	Good	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Au------ Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty, too sandy.
CaA------ Cable	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
ChB------ Champion	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: large stones, wetness.
ChC------ Champion	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Moderate: wetness, slope, frost action.	Moderate: large stones, wetness, slope.
CrA------ Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
CsA------ Croswell	Severe: cutbanks cave.	Slight------	Moderate: wetness.	Slight------	Slight------	Moderate: droughty, too sandy.
FeB*:						
Fence------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
Alcona------	Severe: cutbanks cave.	Slight------	Slight------	Slight------	Moderate: frost action.	Moderate: droughty.
FeC*:						
Fence------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
Alcona------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Fh*. Fluvaquents						
Ga------ Gaastra	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
GoB*:						
Gogebic------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: large stones, wetness.
Fence------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
GoB*:						
Pence	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
GoC*:						
Gogebic	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Moderate: wetness, slope, frost action.	Moderate: large stones, wetness, slope.
Fence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
GpD*:						
Gogebic	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pence	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hp*. Histosols						
KaB Karlin	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
KaC Karlin	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
KbB Keweenaw	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: large stones, droughty, wetness.
KbC Keweenaw	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, large stones.
KbD Keweenaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
KeB*:						
Keweenaw	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: large stones, droughty, wetness.
Karlin	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
KeC*:						
Keweenaw	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, large stones.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
KeC*:						
Karlin	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
KnD*:						
Keweenaw	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sayner	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Kr Kinross	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, droughty.
Lo*:						
Loxley	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
Dawson	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
MaA Manitowish	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty, large stones.
MoA Monico	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: small stones, large stones, wetness.
PaB Padus	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones, droughty.
PaC Padus	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
PaD Padus	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PeC*:						
Padus	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PeD*:						
Padus	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pence	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PnB Pence	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
PnC Pence	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
PnD Pence	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pt*. Pits						
RoB Rubicon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
RoC Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
RoD Rubicon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
SaB*:						
Sayner	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
Rubicon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
SaC*:						
Sayner	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
SaD*:						
Sayner	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Rubicon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Se*:						
Seelyeville	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, excess humus.
Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
Wv: Worcester Variant	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: large stones, wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "poor," 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
Au: Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
CaA: Cable	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: seepage, small stones, ponding.
ChB: Champion	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Severe: wetness.	Poor: seepage, small stones.
ChC: Champion	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, wetness.	Severe: wetness.	Poor: seepage, small stones.
CrA: Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
CsA: Croswell	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
FeB*:					
Fence	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
Alcona	Slight	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
FeC*:					
Fence	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Alcona	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
Fh*. Fluvaquents					
Ga: Gaastra	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
GoB*:					
Gogebic	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
GoB*:					
Fence	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
Pence	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
GoC*:					
Gogebic	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Fence	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Pence	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
GpD*:					
Gogebic	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Pence	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Hp*. Histosols					
KaB Karlin	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KaC Karlin	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KbB Keweenaw	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, small stones.
KbC Keweenaw	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
KbD Keweenaw	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
KeB*:					
Keweenaw	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, small stones, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KeB*:					
Karlin	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KeC*:					
Keweenaw	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
Karlin	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KnD*:					
Keweenaw	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Sayner	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Kr Kinross	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Lo*:					
Loxley	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
Dawson	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
MaA Manitowish	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
MoA Monico	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: seepage, small stones, wetness.
PaB Padus	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PaC Padus	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PaD-----------------Padus	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
PeC*:					
Padus--------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Pence--------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PeD*:					
Padus--------------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pence--------------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
PnB-----------------Pence	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PnC-----------------Pence	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PnD-----------------Pence	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pt*. Pits					
RoB-----------------Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
RoC-----------------Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
RoD-----------------Rubicon	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SaB*:					
Sayner	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SaC*:					
Sayner	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SaD*:					
Sayner	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Rubicon	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Se*:					
Seelyeville	Severe: ponding, subsides.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Markey	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Wv: Worcester Variant	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Au------------------- Au Gres	Poor: wetness.	Probable-------------	Improbable: too sandy.	Poor: too sandy.
CaA------------------ Cable	Poor: wetness.	Probable-------------	Probable-------------	Poor: area reclaim, small stones, wetness.
ChB, ChC------------- Champion	Fair: wetness.	Probable-------------	Improbable: too sandy.	Poor: small stones, area reclaim.
CrA------------------ Croswell	Fair: wetness.	Probable-------------	Improbable: too sandy.	Poor: too sandy.
CsA------------------ Croswell	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
FeB*:				
Fence----------------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Alcona---------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
FeC*:				
Fence----------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Alcona---------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Fh*. Fluvaquents				
Ga------------------- Gaastra	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
GoB*:				
Gogebic--------------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Fence----------------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pence----------------	Good-----------------	Probable-------------	Probable-------------	Poor: small stones, area reclaim.
GoC*:				
Gogebic--------------	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Fence----------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
GoC*:				
Pence	Good	Probable	Probable	Poor: small stones, area reclaim.
GpD*:				
Gogebic	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Pence	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Hp*. Histosols				
KaB, KaC Karlin	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
KbB Keweenaw	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
KbC Keweenaw	Good	Probable	Probable	Poor: small stones, area reclaim.
KbD Keweenaw	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
KeB*:				
Keweenaw	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
Karlin	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
KeC*:				
Keweenaw	Good	Probable	Probable	Poor: small stones, area reclaim.
Karlin	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
KnD*:				
Keweenaw	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Sayner	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Kr: Kinross	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Lo*:				
Loxley	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
Dawson	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
MaA: Manitowish	Good	Probable	Probable	Poor: small stones, area reclaim, too sandy.
MoA: Monico	Fair: wetness.	Probable	Probable	Poor: area reclaim, small stones.
PaB, PaC: Padus	Good	Probable	Probable	Poor: small stones, area reclaim.
PaD: Padus	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
PeC*:				
Padus	Good	Probable	Probable	Poor: small stones, area reclaim.
Pence	Good	Probable	Probable	Poor: small stones, area reclaim.
PeD*:				
Padus	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Pence	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
PnB, PnC: Pence	Good	Probable	Probable	Poor: small stones, area reclaim.
PnD: Pence	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Pt*. Pits				
RoB, RoC Rubicon	Good	Probable	Improbable: too sandy.	Poor: too sandy.
RoD Rubicon	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
SaB*, SaC*:				
Sayner	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Rubicon	Good	Probable	Improbable: too sandy.	Poor: too sandy.
SaD*:				
Sayner	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Rubicon	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
Se*:				
Seelyeville	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Markey	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
Wv Worcester Variant	Fair: wetness.	Probable	Probable	Poor: area reclaim, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Au----------------- Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
CaA--------------- Cable	Slight----------	Severe: seepage, piping, ponding.	Ponding, frost action, cutbanks cave.	Ponding, droughty, rooting depth.	Large stones, erodes easily, ponding.	Large stones, wetness, erodes easily.
ChB--------------- Champion	Severe: seepage.	Severe: seepage.	Percs slowly, slope, cutbanks cave.	Slope, wetness, droughty.	Large stones, erodes easily.	Large stones, wetness.
ChC--------------- Champion	Severe: seepage, slope.	Severe: seepage.	Percs slowly, slope, cutbanks cave.	Slope, wetness, droughty.	Slope, large stones, erodes easily.	Large stones, wetness, slope.
CrA--------------- Croswell	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
CsA--------------- Croswell	Severe: seepage.	Severe: seepage.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
FeB*: Fence-------------	Moderate: slope.	Severe: piping.	Frost action, slope.	Wetness, slope.	Erodes easily, wetness.	Erodes easily.
Alcona------------	Severe: seepage.	Severe: piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
FeC*: Fence-------------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Alcona------------	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Fh*. Fluvaquents						
Ga----------------- Gaastra	Slight----------	Severe: piping.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
GoB*: Gogebic-----------	Moderate: seepage, slope.	Severe: piping.	Percs slowly, slope.	Wetness, droughty, soil blowing.	Large stones, wetness.	Large stones, wetness.
Fence-------------	Moderate: slope.	Severe: piping.	Frost action, slope.	Wetness, slope.	Erodes easily, wetness.	Erodes easily.

See footnote at end of table.

TABLE 14.--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
GoB*: Pence	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
GoC*: Gogebic	Severe: slope.	Severe: piping.	Percs slowly, slope.	Wetness, droughty, soil blowing.	Slope, large stones, wetness.	Large stones, wetness, slope.
Fence	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
GpD*: Gogebic	Severe: slope.	Severe: piping.	Deep to water	Droughty, soil blowing, percs slowly.	Slope, large stones, rooting depth.	Large stones, slope, droughty.
Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Hp*. Histosols						
KaB Karlin	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
KaC Karlin	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
KbB Keweenaw	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Large stones, wetness.	Large stones, droughty.
KbC, KbD Keweenaw	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
KeB*: Keweenaw	Severe: seepage.	Severe: seepage, piping.	Slope, cutbanks cave.	Slope, wetness, droughty.	Large stones, wetness.	Large stones, droughty.
Karlin	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
KeC*: Keweenaw	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 14.--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
KeC*:						
Karlin	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
KnD*:						
Keweenaw	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Sayner	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Kr Kinross	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
Lo*:						
Loxley	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, too acid.	Ponding	Wetness.
Dawson	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding	Ponding, soil blowing.	Wetness.
MaA Manitowish	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
MoA Monico	Moderate: seepage.	Severe: seepage, piping.	Flooding, frost action.	Wetness, droughty.	Large stones, erodes easily, wetness.	Large stones, wetness, erodes easily.
PaB Padus	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
PaC, PaD Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
PeC*, PeD*:						
Padus	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
PnB Pence	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
PnC, PnD Pence	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.

See footnote at end of table.

TABLE 14.--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
Pt*. Pits						
RoB----------- Rubicon	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
RoC, RoD---------- Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
SaB*:						
Sayner-----------	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Rubicon----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
SaC*, SaD*:						
Sayner-----------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Rubicon----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Se*:						
Seelyeville------	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Markey-----------	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
Wv--------------- Worcester Variant	Severe: seepage.	Severe: seepage, wetness.	Cutbanks cave	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Au----------------- Au Gres	0-4	Sand--------------	SP, SM, SP-SM	A-2-4, A-3	0	95-100	85-100	50-95	0-25	---	NP
	4-32	Sand, loamy sand	SP-SM, SP, SM	A-2-4, A-3	0	95-100	85-100	60-95	0-25	---	NP
	32-60	Sand--------------	SP, SP-SM, SM	A-3, A-2-4	0	95-100	85-100	45-95	0-25	---	NP
CaA---------------- Cable	0-5	Silt loam---------	CL, CL-ML, SC, SM-SC	A-4	0-25	75-100	75-100	60-100	35-90	<26	5-10
	5-31	Silt loam, loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4	0-25	75-100	75-100	50-100	30-90	<33	NP-10
	31-38	Loam, sandy loam, gravelly sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	65-100	60-100	35-95	20-75	<27	NP-8
	38-60	Sandy loam, gravelly sandy loam.	SM, SP-SM, ML, CL-ML	A-2, A-1, A-4	0-25	65-100	60-100	40-90	20-70	<24	NP-6
ChB, ChC---------- Champion	0-18	Silt loam---------	ML, CL-ML, SM, SM-SC	A-2-4, A-4	0-20	95-100	85-100	55-100	30-90	<25	NP-7
	18-39	Sandy loam, loamy sand, gravelly loamy sand.	SM, SM-SC, SP-SM	A-2-4, A-1-b	0-20	75-100	55-85	25-65	10-35	<25	NP-6
	39-60	Gravelly fine sandy loam, gravelly sandy loam, gravelly loamy sand.	SM, SM-SC, SP-SM	A-2-4, A-1-b, A-3	0-20	80-100	50-80	25-65	5-35	<25	NP-6
CrA---------------- Croswell	0-4	Sand--------------	SP-SM, SM, SP	A-3, A-2-4	0	90-100	85-100	50-95	0-25	---	NP
	4-60	Sand--------------	SP-SM, SM, SP	A-3, A-2-4	0	90-100	85-100	45-95	0-25	---	NP
CsA---------------- Croswell	0-3	Sand--------------	SP-SM, SM, SP	A-3, A-2	0	100	95-100	50-95	0-25	---	NP
	3-46	Sand--------------	SP-SM, SM, SP	A-3, A-2	0	100	95-100	45-95	0-25	---	NP
	46-60	Stratified fine sandy loam and silt loam.	CL, SC, SM-SC, CL-ML	A-6, A-4, A-2	0	100	90-100	65-95	20-85	20-34	4-14
FeB*, FeC*: Fence-------------	0-4	Silt loam---------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-100	20-35	NP-10
	4-14	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL, SM, SC	A-4	0	100	100	85-100	40-100	<34	NP-9
	14-43	Silt, silt loam, very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	80-100	20-30	3-9
	43-60	Stratified silt loam to very fine sand.	ML, CL-ML	A-4	0	100	100	85-100	50-100	<25	NP-7

See footnote at end of table.

TABLE 15.--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	
FeB*, FeC*:											
Alcona----------	0-3	Fine sandy loam	SM	A-4, A-2-4	0	95-100	85-100	55-90	25-45	<20	NP-4
	3-36	Loamy fine sand, sandy loam, fine sandy loam.	SM, ML	A-4, A-2-4	0	90-100	85-100	50-80	25-55	<20	NP-4
	36-60	Stratified fine sand to silt loam.	SM, ML	A-4, A-2-4	0	100	95-100	50-80	25-55	<20	NP-4
Fh*. Fluvaquents											
Ga--------------- Gaastra	0-4	Silt loam--------	CL-ML, CL, ML	A-4	0	100	100	85-100	50-90	25-35	5-10
	4-38	Silt loam, very fine sandy loam, fine sandy loam.	CL-ML, CL, ML	A-4	0	100	100	85-100	50-100	25-35	5-10
	38-60	Stratified silt loam to very fine sandy loam.	CL-ML, CL, ML	A-4	0	100	100	85-100	50-100	25-35	5-10
GoB*, GoC*:											
Gogebic---------	0-3	Fine sandy loam	SM, ML, CL, SC	A-2, A-4	5-20	80-100	75-100	60-90	30-65	<25	NP-10
	3-32	Sandy loam, fine sandy loam, loam.	SM, ML, CL, SC	A-2, A-4	5-20	80-100	75-100	55-90	25-60	<25	NP-10
	32-57	Sandy clay loam, sandy loam, loam.	SC, CL, SM, ML	A-2, A-6, A-4	5-20	80-100	75-100	65-90	30-65	10-40	NP-15
	57-60	Sandy loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4	5-20	80-100	75-100	55-90	20-60	<25	NP-10
Fence-----------	0-4	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-100	20-35	NP-10
	4-14	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL, SM, SC	A-4	0	100	100	85-100	40-100	<30	NP-9
	14-43	Silt, silt loam, very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	80-100	20-30	3-9
	43-60	Stratified silt loam to very fine sand.	ML, CL-ML	A-4	0	100	100	85-100	50-100	<25	NP-7
Pence-----------	0-3	Sandy loam-------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	3-16	Sandy loam, gravelly sandy loam, loamy sand.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	16-23	Gravelly sand, loamy sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-8	55-100	50-100	25-75	10-30	---	NP
	23-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	25-70	2-20	---	NP

See footnote at end of table.

TABLE 15.--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	
GpD*:											
Gogebic----------	0-3	Fine sandy loam	SM, ML, CL, SC	A-2, A-4	5-20	80-100	75-100	60-90	30-65	<25	NP-10
	3-32	Sandy loam, fine sandy loam, loam.	SM, ML, CL, SC	A-2, A-4	5-20	80-100	75-100	55-90	25-60	<25	NP-10
	32-57	Sandy clay loam, sandy loam, loam.	SC, CL, SM-SC, CL-ML	A-2, A-6, A-4	5-20	80-100	75-100	65-90	30-65	10-40	NP-20
	57-60	Sandy loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4	5-20	80-100	75-100	55-90	20-60	<25	NP-10
Pence------------	0-3	Sandy loam--------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	3-16	Sandy loam, gravelly sandy loam, loamy sand.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	16-23	Gravelly sand, loamy sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-8	55-100	50-100	25-75	10-30	---	NP
	23-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	25-70	2-20	---	NP
Hp*. Histosols											
KaB, KaC---------- Karlin	0-21	Loamy fine sand	SM	A-2	0	90-100	85-100	50-95	15-35	---	NP-4
	21-60	Sand, fine sand	SP-SM, SP, SM	A-3, A-1, A-2	0	80-100	70-100	40-95	0-25	---	NP
KbB, KbC, KbD---- Keweenaw	0-16	Sandy loam--------	SM, SC, SM-SC	A-2, A-4, A-1-b	0-10	80-100	75-100	45-85	20-40	<20	NP-10
	16-32	Sand, loamy sand, gravelly loamy sand.	SM, SC, SP, SP-SM	A-2, A-3, A-1-b	0-25	75-100	70-100	45-85	0-30	<20	NP-10
	32-44	Loamy sand, fine sandy loam, gravelly loamy sand.	SM, SC, SP, SM-SC	A-2, A-3, A-1-b	0-25	60-100	55-100	35-85	0-35	<30	NP-10
	44-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	60-100	50-100	30-85	10-30	<20	NP-10
KeB*, KeC*:											
Keweenaw---------	0-16	Sandy loam--------	SM, SC, SM-SC	A-2, A-4, A-1-b	0-10	80-100	75-100	45-85	20-40	<20	NP-10
	16-32	Sand, loamy sand, gravelly loamy sand.	SM, SC, SP, SP-SM	A-2, A-3, A-1-b	0-25	75-100	70-100	45-85	0-30	<20	NP-10
	32-44	Loamy sand, fine sandy loam, gravelly loamy sand.	SM, SC, SP, SM-SC	A-2, A-3, A-1-b	0-25	60-100	55-100	35-85	0-35	<30	NP-10
	44-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	60-100	50-100	30-85	10-30	<20	NP-10
Karlin-----------	0-21	Loamy fine sand	SM	A-2	0	90-100	85-100	50-95	15-35	---	NP-4
	21-60	Sand-------------	SP-SM, SP, SM	A-3, A-1, A-2	0	80-100	70-100	40-95	0-25	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
KnD*:											
Keweenaw	0-16	Sandy loam	SM, SC, SM-SC	A-2, A-4, A-1-b	0-10	80-100	75-100	45-85	20-40	<20	NP-10
	16-32	Sand, loamy sand, gravelly loamy sand.	SM, SC, SP, SP-SM	A-2, A-3, A-1-b	0-25	75-100	70-100	45-85	0-30	<20	NP-10
	32-44	Loamy sand, fine sandy loam, gravelly loamy sand.	SM, SC, SP, SM-SC	A-2, A-3, A-1-b	0-25	60-100	55-100	35-85	0-35	<30	NP-10
	44-60	Loamy sand, gravelly loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b	0-25	60-100	50-100	30-85	10-30	<20	NP-10
Sayner	0-1	Loamy sand	SM, SP-SM	A-1, A-2	0-15	80-100	75-100	35-75	10-30	---	NP
	1-28	Loamy sand, sand, gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	20-75	0-30	---	NP
	28-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	50-90	40-85	0-55	0-10	---	NP
Kr Kinross	0-10	Mucky sand	SP-SM, SM, SP	A-3, A-2-4	0	100	100	50-95	0-25	---	NP
	10-60	Sand, fine sand	SP-SM, SM, SP	A-3, A-2-4	0	100	95-100	50-95	0-25	---	NP
Lo*:											
Loxley	0-12	Fibric material	PT	A-8	0	---	---	---	---	---	---
	12-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Dawson	0-11	Fibric material	PT	A-8	---	---	---	---	---	---	---
	11-35	Sapric material	PT	A-8	---	---	---	---	---	---	---
	35-60	Sand, fine sand, gravelly sand.	SM-SC, SM, SC, SP-SM	A-2, A-3, A-1	0	90-100	50-100	25-90	0-30	<20	NP-10
MaA Manitowish	0-4	Sandy loam	SM, ML	A-4	0-7	90-100	85-100	50-85	35-55	<21	NP-4
	4-16	Sandy loam, loam, fine sandy loam.	SM, SM-SC, ML, CL-ML	A-4, A-2	0-7	85-100	85-100	45-95	30-75	<25	NP-7
	16-19	Loamy coarse sand, gravelly loamy sand, loamy fine sand.	SM, SM-SC, GM, GM-GC	A-2, A-1, A-3, A-4	0-8	55-100	50-100	20-90	5-50	<25	NP-6
	19-60	Stratified coarse sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	50-100	50-100	20-70	0-12	---	NP
MoA Monico	0-7	Silt loam	ML, CL-ML, SM, SM-SC	A-4	0-25	75-100	70-100	60-100	40-90	<25	NP-7
	7-21	Sandy loam, gravelly loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4, A-1	0-25	65-100	60-100	35-95	20-75	<30	NP-10
	21-60	Sandy loam, gravelly sandy loam, gravelly loamy sand.	SM, SM-SC, GM, GP-GM	A-1, A-2	0-25	60-100	60-100	30-85	10-35	<19	NP-4
PaB, PaC, PaD Padus	0-4	Fine sandy loam	SM	A-2, A-4, A-1-b	0-7	80-100	75-100	45-85	20-50	<25	NP-4
	4-31	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1-b	0-7	80-100	75-100	45-95	20-90	<30	NP-10
	31-35	Gravelly loamy sand, sand, gravelly sand.	SM, SP, GP, GM	A-2, A-4, A-1, A-3	0-7	50-100	45-100	25-75	2-40	<25	NP-4
	35-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP

See footnote at end of table.

TABLE 15.--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	
PeC*, PeD*:											
Padus-----------	0-4	Fine sandy loam	SM	A-2, A-4, A-1-b	0-7	80-100	75-100	45-85	20-50	<25	NP-4
	4-31	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1-b	0-7	80-100	75-100	45-95	20-90	<30	NP-10
	31-35	Gravelly loamy sand, sand, gravelly sand.	SM, SP, GP, GM	A-2, A-4, A-1, A-3	0-7	50-100	45-100	25-75	2-40	<25	NP-4
	35-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-7	30-100	25-100	10-70	1-12	---	NP
Pence-----------	0-3	Sandy loam-------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	3-16	Sandy loam, gravelly sandy loam, loamy sand.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	16-23	Gravelly sand, loamy sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-8	55-100	50-100	25-75	10-30	---	NP
	23-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	25-70	2-20	---	NP
PnB, PnC, PnD---- Pence	0-3	Sandy loam-------	SM, ML	A-4, A-2, A-1	0-7	85-100	75-100	45-85	20-55	<21	NP-4
	3-16	Sandy loam, gravelly sandy loam, loamy sand.	SM, ML, CL-ML, SM-SC	A-4, A-2, A-1	0-7	55-100	50-100	30-95	15-75	<25	NP-7
	16-23	Gravelly sand, loamy sand, sand.	SM, SP-SM, GM, GP-GM	A-2, A-1	0-8	55-100	50-100	25-75	10-30	---	NP
	23-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	25-70	2-20	---	NP
Pt*. Pits											
RoB, RoC, RoD---- Rubicon	0-1	Sand-------------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	1-24	Sand-------------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	24-60	Sand-------------	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-90	0-25	---	NP
SaB*, SaC*, SaD*:											
Sayner----------	0-1	Loamy sand-------	SM, SP-SM	A-1, A-2	0-15	80-100	75-100	35-75	10-30	---	NP
	1-28	Loamy sand, sand, gravelly sand.	SP, SM, GP, GM	A-1, A-3, A-2	0-15	50-100	50-100	20-75	0-30	---	NP
	28-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-15	50-90	40-85	0-55	0-10	---	NP
Rubicon---------	0-1	Sand-------------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	1-24	Sand-------------	SM, SP-SM, SP	A-2, A-3	0	95-100	90-100	50-90	0-25	---	NP
	24-60	Sand-------------	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-90	0-25	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Se*:											
Seelyeville-----	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Markey----------	0-40	Sapric material	PT	A-8	---	---	---	---	---	---	---
	40-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3	0	100	75-100	60-75	0-20	---	NP
Wv---------------	0-5	Sandy loam-------	SM	A-4, A-2	0-10	90-100	85-100	50-85	25-40	<21	NP-4
Worcester Variant	5-18	Sandy loam-------	SM	A-4, A-2	0-10	85-100	85-100	45-90	25-50	<21	NP-4
	18-60	Sand, gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-10	50-95	50-90	30-60	2-12	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
Au-----------------	0-4	0-8	0.65-1.55	6.0-20	0.07-0.10	3.6-6.5	Low-----------	0.15	5	1	.5-8
Au Gres	4-32	1-15	1.20-1.55	6.0-20	0.06-0.09	4.5-6.5	Low-----------	0.15			
	32-60	0-8	1.20-1.65	6.0-20	0.05-0.07	5.1-6.5	Low-----------	0.15			
CaA----------------	0-5	12-16	1.10-1.35	0.2-2.0	0.15-0.24	4.5-6.5	Low-----------	0.37	5	5	2-4
Cable	5-31	8-18	1.35-1.45	0.2-2.0	0.10-0.22	4.5-6.5	Low-----------	0.37			
	31-38	8-16	1.40-1.90	0.2-2.0	0.03-0.18	4.5-6.5	Low-----------	0.37			
	38-60	5-10	1.70-1.90	0.2-0.6	0.03-0.13	5.1-6.5	Low-----------	0.28			
ChB, ChC----------	0-18	2-15	1.10-1.65	0.6-2.0	0.09-0.20	4.5-6.0	Low-----------	0.37	4	3	1-3
Champion	18-39	2-12	1.75-2.05	0.06-0.2	0.01-0.04	4.5-6.0	Low-----------	0.20			
	39-60	1-12	1.30-1.65	0.6-6.0	0.01-0.04	5.1-6.0	Low-----------	0.20			
CrA----------------	0-4	0-10	1.25-1.55	6.0-20	0.07-0.09	4.5-6.5	Low-----------	0.15	5	1	.5-2
Croswell	4-60	0-10	1.25-1.60	6.0-20	0.05-0.07	5.1-6.5	Low-----------	0.15			
CsA----------------	0-3	0-5	1.35-1.75	6.0-20	0.07-0.09	4.5-6.0	Low-----------	0.15	5	1	.5-1
Croswell	3-46	0-5	1.45-1.70	6.0-20	0.04-0.06	5.1-6.5	Low-----------	0.15			
	46-60	10-25	1.30-1.90	0.2-0.6	0.05-0.21	5.1-6.5	Low-----------	0.24			
FeB*, FeC*:											
Fence------------	0-4	8-20	1.20-1.35	0.6-2.0	0.22-0.24	4.5-6.5	Low-----------	0.37	5	5	1-2
	4-14	5-18	1.50-1.60	0.2-0.6	0.11-0.22	4.5-6.5	Low-----------	0.37			
	14-43	8-18	1.50-1.60	0.2-0.6	0.17-0.22	4.5-6.5	Low-----------	0.37			
	43-60	5-15	1.50-1.60	0.2-0.6	0.17-0.22	5.1-6.0	Low-----------	0.37			
Alcona-----------	0-3	5-15	1.30-1.60	0.6-6.0	0.12-0.18	4.5-6.5	Low-----------	0.24	5	3	1-2
	3-36	5-20	1.35-1.70	0.6-6.0	0.10-0.14	4.5-6.5	Low-----------	0.17			
	36-60	5-18	1.50-1.70	0.6-2.0	0.08-0.13	5.1-6.5	Low-----------	0.17			
Fh*.											
Fluvaquents											
Ga-----------------	0-4	10-18	1.40-1.60	0.6-2.0	0.20-0.24	4.5-6.5	Low-----------	0.37	5	5	3-4
Gaastra	4-38	12-25	1.45-1.70	0.2-0.6	0.20-0.22	4.5-6.5	Low-----------	0.37			
	38-60	10-18	1.50-1.70	0.2-0.6	0.20-0.22	5.1-6.5	Low-----------	0.37			
GoB*, GoC*:											
Gogebic----------	0-3	2-15	1.10-1.65	0.6-2.0	0.14-0.16	4.5-6.0	Low-----------	0.24	3	3	1-3
	3-32	5-18	1.75-2.05	0.06-0.2	0.02-0.04	4.5-6.0	Low-----------	0.24			
	32-57	10-22	1.50-1.80	0.6-2.0	0.02-0.04	4.5-6.0	Low-----------	0.24			
	57-60	2-15	1.30-1.70	0.6-2.0	0.02-0.04	5.6-6.5	Low-----------	0.24			
Fence------------	0-4	8-20	1.20-1.35	0.6-2.0	0.22-0.24	4.5-6.5	Low-----------	0.37	5	5	1-2
	4-14	5-18	1.50-1.60	0.2-0.6	0.11-0.22	4.5-6.5	Low-----------	0.37			
	14-43	8-18	1.50-1.60	0.2-0.6	0.17-0.22	4.5-6.5	Low-----------	0.37			
	43-60	5-15	1.50-1.60	0.2-0.6	0.17-0.22	5.1-6.0	Low-----------	0.37			
Pence------------	0-3	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low-----------	0.24	3	3	1-3
	3-16	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.0	Low-----------	0.24			
	16-23	2-10	1.65-1.75	2.0-6.0	0.05-0.08	4.5-6.0	Low-----------	0.10			
	23-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low-----------	0.10			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
GpD*:											
Gogebic---------	0-3	2-15	1.10-1.65	0.6-2.0	0.14-0.16	4.5-6.0	Low----------	0.24	3	3	1-3
	3-32	5-18	1.75-2.05	0.06-0.2	0.02-0.04	4.5-6.0	Low----------	0.24			
	32-57	10-22	1.50-1.80	0.6-2.0	0.02-0.04	4.5-6.0	Moderate-----	0.24			
	57-60	2-15	1.30-1.70	0.6-2.0	0.02-0.04	5.6-6.5	Low----------	0.24			
Pence-----------	0-3	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low----------	0.24	3	3	1-3
	3-16	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.0	Low----------	0.24			
	16-23	2-10	1.65-1.75	2.0-6.0	0.05-0.08	4.5-6.0	Low----------	0.10			
	23-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low----------	0.10			
Hp*. Histosols											
KaB, KaC--------- Karlin	0-21	0-12	1.35-1.60	2.0-6.0	0.08-0.12	4.5-6.5	Low----------	0.17	4	2	.5-2
	21-60	0-10	1.40-1.70	6.0-20	0.02-0.04	5.6-6.5	Low----------	0.17			
KbB, KbC, KbD---- Keweenaw	0-16	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low----------	0.24	5	3	1-2
	16-32	0-15	1.25-1.60	2.0-6.0	0.05-0.11	4.5-6.5	Low----------	0.17			
	32-44	0-15	1.25-1.60	0.6-6.0	0.06-0.14	4.5-6.5	Low----------	0.17			
	44-60	2-15	1.20-1.50	2.0-6.0	0.04-0.10	5.1-6.0	Low----------	0.17			
KeB*, KeC*:											
Keweenaw--------	0-16	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low----------	0.24	5	3	1-2
	16-32	0-15	1.25-1.60	2.0-6.0	0.05-0.11	4.5-6.5	Low----------	0.17			
	32-44	0-15	1.25-1.60	0.6-6.0	0.06-0.14	4.5-6.5	Low----------	0.17			
	44-60	2-15	1.20-1.50	2.0-6.0	0.04-0.10	5.1-6.0	Low----------	0.17			
Karlin----------	0-21	0-12	1.35-1.60	2.0-6.0	0.08-0.12	4.5-6.5	Low----------	0.17	4	2	.5-2
	21-60	0-10	1.40-1.70	6.0-20	0.02-0.04	5.6-6.5	Low----------	0.17			
KnD*:											
Keweenaw--------	0-16	2-15	1.35-1.70	0.6-2.0	0.13-0.15	4.5-6.5	Low----------	0.24	5	3	1-2
	16-32	0-15	1.25-1.60	2.0-6.0	0.05-0.11	4.5-6.5	Low----------	0.17			
	32-44	0-15	1.25-1.60	0.6-6.0	0.06-0.14	4.5-6.5	Low----------	0.17			
	44-60	2-15	1.20-1.50	2.0-6.0	0.04-0.10	5.1-6.0	Low----------	0.17			
Sayner----------	0-1	1-5	1.30-1.40	2.0-6.0	0.08-0.12	4.5-6.5	Low----------	0.17	3	2	.5-1
	1-28	1-5	1.35-1.45	2.0-6.0	0.03-0.12	4.5-6.5	Low----------	0.17			
	28-60	0-3	1.55-1.80	>6.0	0.02-0.04	5.1-6.5	Low----------	0.10			
Kr--------------- Kinross	0-10	0-10	1.00-1.60	6.0-20	0.04-0.06	4.5-6.0	Low----------	0.15	5	1	4-15
	10-60	0-10	1.50-1.70	6.0-20	0.04-0.06	4.5-6.5	Low----------	0.15			
Lo*:											
Loxley----------	0-12	---	0.30-0.40	2.0-6.0	0.35-0.65	<4.5	-------------	----	2	7	70-90
	12-60	---	0.10-0.35	2.0-6.0	0.35-0.45	<4.5	-------------	----			
Dawson----------	0-11	---	0.30-0.40	2.0-6.0	0.55-0.65	3.6-4.4	-------------	----	2	7	65-85
	11-35	---	0.19-0.29	2.0-6.0	0.35-0.45	3.6-4.4	-------------	----			
	35-60	0-5	1.56-1.74	6.0-20	0.03-0.10	4.5-6.5	Low----------	----			
MaA-------------- Manitowish	0-4	4-10	1.30-1.70	2.0-6.0	0.11-0.18	4.5-6.5	Low----------	0.24	3	3	1-3
	4-16	5-15	1.40-1.70	2.0-6.0	0.10-0.19	4.5-6.5	Low----------	0.24			
	16-19	3-12	1.45-1.65	2.0-6.0	0.04-0.12	4.5-6.5	Low----------	0.10			
	19-60	0-3	1.55-1.70	>6.0	0.02-0.07	5.6-6.5	Low----------	0.10			
MoA-------------- Monico	0-7	8-15	1.10-1.40	0.6-2.0	0.18-0.24	4.5-6.5	Low----------	0.37	5	5	1-2
	7-21	3-18	1.65-1.75	0.6-2.0	0.09-0.19	4.5-6.5	Low----------	0.24			
	21-60	2-8	1.70-1.90	0.6-2.0	0.06-0.12	5.1-6.5	Low----------	0.17			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
PaB, PaC, PaD---- Padus	0-4	3-10	1.35-1.70	0.6-2.0	0.10-0.15	4.5-6.5	Low----------	0.24	4	3	1-2
	4-31	5-18	1.40-1.65	0.6-2.0	0.09-0.22	4.5-6.5	Low----------	0.24			
	31-35	2-10	1.40-1.65	0.6-6.0	0.05-0.14	4.5-6.5	Low----------	0.10			
	35-60	0-3	1.55-1.80	>6.0	0.02-0.06	5.1-6.5	Low----------	0.10			
PeC*, PeD*:											
Padus-----------	0-4	3-10	1.35-1.70	0.6-2.0	0.10-0.15	4.5-6.5	Low----------	0.24	4	3	1-2
	4-31	5-18	1.40-1.65	0.6-2.0	0.09-0.22	4.5-6.5	Low----------	0.24			
	31-35	2-10	1.40-1.65	0.6-6.0	0.05-0.14	4.5-6.5	Low----------	0.10			
	35-60	0-3	1.55-1.80	>6.0	0.02-0.06	5.1-6.5	Low----------	0.10			
Pence-----------	0-3	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low----------	0.24	3	3	1-3
	3-16	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.0	Low----------	0.24			
	16-23	2-10	1.65-1.75	2.0-6.0	0.05-0.08	4.5-6.0	Low----------	0.10			
	23-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low----------	0.10			
PnB, PnC, PnD---- Pence	0-3	3-11	1.20-1.65	2.0-6.0	0.10-0.18	4.5-6.5	Low----------	0.24	3	3	1-3
	3-16	2-12	1.35-1.45	2.0-6.0	0.10-0.15	4.5-6.0	Low----------	0.24			
	16-23	2-10	1.65-1.75	2.0-6.0	0.05-0.08	4.5-6.0	Low----------	0.10			
	23-60	0-4	1.35-1.80	>6.0	0.02-0.05	5.1-6.5	Low----------	0.10			
Pt*. Pits											
RoB, RoC, RoD---- Rubicon	0-1	0-5	1.35-1.45	6.0-20	0.05-0.09	4.5-6.0	Low----------	0.15	5	1	.5-1
	1-24	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low----------	0.15			
	24-60	0-5	1.40-1.55	6.0-20	0.04-0.06	4.5-6.5	Low----------	0.15			
SaB*, SaC*, SaD*:											
Sayner----------	0-1	1-5	1.30-1.40	2.0-6.0	0.08-0.12	4.5-6.5	Low----------	0.17	3	2	.5-1
	1-28	1-5	1.35-1.45	2.0-6.0	0.03-0.12	4.5-6.5	Low----------	0.17			
	28-60	0-3	1.55-1.80	>6.0	0.02-0.04	5.1-6.5	Low----------	0.10			
Rubicon---------	0-1	0-5	1.35-1.45	6.0-20	0.05-0.09	4.5-6.0	Low----------	0.15	5	1	.5-1
	1-24	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low----------	0.15			
	24-60	0-5	1.40-1.55	6.0-20	0.04-0.06	4.5-6.5	Low----------	0.15			
Se*:											
Seelyeville-----	0-60	---	0.10-0.25	2.0-6.0	0.35-0.45	4.5-6.5	-------------	----	2	2	>25
Markey----------	0-40	---	0.15-0.45	2.0-6.0	0.35-0.45	4.5-6.0	-------------	----	2	2	55-85
	40-60	0-10	1.40-1.65	6.0-20	0.03-0.08	4.5-6.5	Low----------	----			
Wv--------------- Worcester Variant	0-5	3-10	1.20-1.65	2.0-6.0	0.13-0.18	4.5-6.5	Low----------	0.24	4	3	1-2
	5-18	5-12	1.35-1.45	2.0-6.0	0.12-0.14	4.5-6.0	Low----------	0.24			
	18-60	0-2	1.30-1.80	>6.0	0.02-0.07	5.1-6.5	Low----------	0.10			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "occasional," "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	Hydro-logic group	Flooding			High water table			Total subsi-dence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
Au--------------- Au Gres	B	None--------	---	---	1.0-2.0	Apparent	Nov-May	---	Moderate	Low------	Moderate.
CaA-------------- Cable	B/D	None--------	---	---	+1-1.0	Apparent	Nov-May	---	High-----	High-----	High.
ChB, ChC--------- Champion	B	None--------	---	---	1.0-2.0	Perched	Nov-May	---	Moderate	Moderate	High.
CrA-------------- Croswell	A	None--------	---	---	2.0-4.0	Apparent	Nov-Apr	---	Low------	Low------	Moderate.
CsA-------------- Croswell	A	None--------	---	---	2.5-5.0	Perched	Nov-May	---	Low------	Low------	Moderate.
FeB*:											
Fence-----------	B	None--------	---	---	2.0-6.0	Perched	Nov-May	---	High-----	Low------	High.
Alcona----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Low.
FeC*:											
Fence-----------	B	None--------	---	---	>6.0	---	---	---	High-----	Low------	High.
Alcona----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Low.
Fh*. Fluvaquents											
Ga--------------- Gaastra	C	None--------	---	---	1.0-2.0	Perched	Nov-May	---	High-----	Moderate	Moderate.
GoB*:											
Gogebic---------	B	None--------	---	---	1.0-2.0	Perched	Nov-May	---	Moderate	Moderate	High.
Fence-----------	B	None--------	---	---	2.0-6.0	Perched	Nov-May	---	High-----	Low------	High.
Pence-----------	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
GoC*:											
Gogebic---------	B	None--------	---	---	1.0-2.0	Perched	Nov-May	---	Moderate	Moderate	High.
Fence-----------	B	None--------	---	---	>6.0	---	---	---	High-----	Low------	High.
Pence-----------	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Total subsi-dence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
GpD*:											
Gogebic--------	B	None--------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
Pence----------	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Hp*. Histosols											
KaB, KaC-------- Karlin	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
KbB------------- Keweenaw	A	None--------	---	---	1.0-3.0	Perched	Nov-May	---	Low------	Low------	Moderate.
KbC, KbD-------- Keweenaw	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
KeB*:											
Keweenaw-------	A	None--------	---	---	1.0-3.0	Perched	Nov-May	---	Low------	Low------	Moderate.
Karlin---------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
KeC*:											
Keweenaw-------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Karlin---------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
KnD*:											
Keweenaw-------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Sayner---------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Kr-------------- Kinross	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	---	Moderate	High-----	Moderate.
Lo*:											
Loxley---------	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	50-55	High-----	High-----	High.
Dawson---------	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	30-36	High-----	High-----	High.
MaA------------- Manitowish	B	None--------	---	---	3.0-6.0	Apparent	Nov-May	---	Low------	Low------	Moderate.
MoA------------- Monico	C	Occasional	Brief-----	Nov-May	1.0-3.0	Perched	Nov-May	---	High-----	Moderate	High.
PaB, PaC, PaD--- Padus	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	High.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Total subsi-dence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					Ft			In			
PeC*, PeD*:											
Padus----------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	High.
Pence----------	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
PnB, PnC, PnD--- Pence	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Pt*. Pits											
RoB, RoC, RoD--- Rubicon	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
SaB*, SaC*, SaD*:											
Sayner--------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
Rubicon-------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
Se*:											
Seelyeville----	A/D	None--------	---	---	+1-1.0	Apparent	Jan-Dec	50-55	High-----	High-----	Moderate.
Markey---------	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	25-30	High-----	High-----	Low.
Wv-------------- Worcester Variant	B	None--------	---	---	1.0-3.0	Apparent	Nov-May	---	Moderate	Moderate	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. MAX means maximum dry density; OPT, optimum moisture; LL, liquid limit; PI, plasticity index; UN, Unified; and NP, nonplastic)

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve*--				Percentage smaller than*--				LL	PI	Classification	
				MAX	OPT	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/ft3	Pct									Pct			
Cable silt loam: SE1/4SE1/4 sec. 1, T. 40 N., R. 11 E.	Silty and loamy deposits over loamy glacial till.	S81WI-125-															
		1-1	11-23	---	---	94	94	90	80	70	39	10	5	---	NP	A-4(8)	ML
		1-2	32-60	---	---	100	100	85	58	50	30	13	9	23.2	5.7	A-4(5)	CL-ML
Champion silt loam: SW1/4SW1/4 sec. 27, T. 42 N., R. 11 E.	Loess over sandy glacial till.	S77WI-125-															
		3-1	5-18	---	---	95	93	86	62	54	27	9	5	21.0	NP	A-4(5)	ML
		3-2	26-39	---	---	82	79	65	17	13	7	4	3	13.3	NP	A-2-4 (0)	SM
		3-3	45-60	130.7	7.1	83	80	64	18	15	10	5	3	11.8	NP	A-2-4 (0)	SM
Croswell sand: SW1/4NE1/4 sec. 21, T. 42 N., R. 5 E.	Sandy glacial outwash.	S79WI-125-															
		1-1	6-18	---	---	97	95	70	5	4	4	2	1	---	NP	A-3(0)	SM
		1-2	25-60	---	---	100	100	47	1	1	1	1	1	---	NP	A-1-b (0)	SM
Fence silt loam: NW1/4NW1/4 sec. 22, T. 40 N., R. 7 E.	Silty and loamy lacustrine deposits.	S78WI-125-															
		1-1	4-15	---	---	100	100	100	94	87	40	13	7	33.2	NP	A-4(8)	ML
		1-2	17-28	---	---	100	100	100	96	90	48	22	16	25.1	4.2	A-4(8)	CL-ML
Gogebic fine sandy loam: SE1/4SE1/4 sec. 2, T. 43 N., R. 6 E.	Loamy glacial till.	S72WI-63-															
		1-1	8-23	---	---	89	85	75	38	32	18	8	4	---	NP	A-4(1)	SM
		1-2	51-65	---	---	94	92	84	42	35	21	11	8	---	NP	A-4(1)	SM
Gogebic fine sandy loam: NW1/4NE1/4 sec. 31, T. 44 N., R. 5 E.	Loamy glacial till.	S77WI-125-															
		4-1	6-12	---	---	96	93	81	43	36	21	8	5	18.7	NP	A-4(2)	SM
		4-2	16-31	---	---	82	78	68	30	23	12	5	2	12.3	NP	A-2-4 (0)	SM
		4-3	42-51	---	---	83	78	68	35	29	19	10	7	14.6	NP	A-2-4 (0)	SM
		4-4	51-60	133.0	8.5	86	82	72	38	32	21	11	7	14.4	NP	A-4(1)	SM

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve*--				Percentage smaller than*--				LL	PI	Classification	
				MAX	OPT	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	UN
			In	Lb/ft3	Pct									Pct			
Karlin loamy fine sand: SW1/4SW1/4 sec. 5, T. 40 N., R. 11 E.	Sandy glacial outwash.	S78WI-125-2-1	7-16	---	---	98	97	91	24	21	13	5	2	---	NP	A-2-4 (0)	SM
		2-2	28-60	103.9	12.8	100	100	86	1	1	1	1	1	---	NP	A-3(0)	SP
Keweenaw sandy loam: NW1/4SW1/4 sec. 11, T. 42 N., R. 8 E.	Loamy drift over sandy glacial till.	S80WI-125-2-1	5-14	---	---	100	100	84	36	25	9	2	1	---	NP	A-4(0)	SM
		2-2	42-60	124.6	7.9	100	100	85	25	21	11	4	2	---	NP	A-2-4 (0)	SM
Manitowish sandy loam: SE1/4NE1/4 sec. 33, T. 43 N., R. 5 E.	Loamy deposits over coarse sand and gravel outwash.	S80WI-125-3-1	6-16	---	---	98	97	82	45	38	22	6	3	19.5	NP	A-4(2)	SM
		3-2	19-60	---	---	92	81	38	1	1	1	1	1	---	NP	A-1-b (0)	SP
Monico silt loam: SE1/4NE1/4 sec. 23, T. 42 N., R. 11 E.	Silty and loamy deposits over loamy or sandy glacial till.	S81WI-125-2-1	7-13	---	---	100	100	90	59	52	28	9	5	---	NP	A-4(5)	ML
		2-2	15-28	---	---	100	100	87	42	32	16	5	2	---	NP	A-4(1)	SM
		2-3	37-60	---	---	100	100	81	24	18	7	2	1	---	NP	A-2-4 (0)	SM
Padus fine sandy loam: SE1/4NE1/4 sec. 13, T. 41 N., R. 8 E.	Loamy deposits over sand and gravel outwash.	S77WI-125-2-1	3-7	---	---	92	92	86	71	62	32	12	7	23.9	NP	A-4(7)	ML
		2-2	17-35	---	---	97	92	75	33	27	17	7	4	14.1	NP	A-2-4 (0)	SM
Pence sandy loam: NE1/4NW1/4 sec. 35, T. 40 N., R. 11 E.	Loamy deposits over sand and gravel outwash.	S60WI-63-6-1	7-16	---	---	100	100	83	32	31	21	8	5	---	NP	A-2-4 (0)	SM
		6-2	28-60	---	---	80	74	54	2	2	2	1	1	---	NP	A-3(0)	SP
Pence sandy loam: SW1/4SW1/4 sec. 18, T. 40 N., R. 12 E.	Loamy deposits over sand and gravel outwash.	S60WI-63-8-1	3-12	122	12	100	100	73	30	29	18	7	4	---	NP	A-2-4 (0)	SM
		8-2	15-60	134	6	59	52	32	2	2	1	1	1	---	NP	A-1-b (0)	SP

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density: MAX	Moisture density: OPT	Percentage passing sieve*--: No. 4	No. 10	No. 40	No. 200	Percentage smaller than*--: 0.05 mm	0.02 mm	0.005 mm	0.002 mm	LL	PI	Classification: AASHTO	UN
			In	Lb/ft3	Pct									Pct			
Sayner loamy sand: SW1/4SE1/4 sec. 22, T. 40 N., R. 7 E.	Sandy deposits over stratified sand and gravel outwash.	S77WI-125-1-1	3-14	---	---	62	54	36	3	2	1	1	0	---	NP	A-1-b (0)	SP
		1-2	14-60	---	---	51	41	25	1	1	1	1	0	---	NP	A-1-a (0)	SP
Sayner loamy sand: NW1/4SE1/4 sec. 27, T. 40 N., R. 10 E.	Sandy deposits over stratified sand and gravel outwash.	S79WI-125-2-1	5-18	---	---	89	84	58	18	15	8	3	2	---	NP	A-2-4 (0)	SM
		2-2	27-60	---	---	88	83	33	1	1	1	1	1	---	NP	A-1-b (0)	SP

* Mechanical analysis according to the AASHTO Designation T88-57 (1). Results from this procedure can differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculation of grain-size fractions. The mechanical analysis data given in this table are not suitable for use in naming textural classes of soils.

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
Alcona	Coarse-loamy, mixed, frigid Alfic Haplorthods
*Au Gres	Sandy, mixed, frigid Entic Haplaquods
Cable	Coarse-loamy, mixed, nonacid, frigid Typic Haplaquepts
Champion	Coarse-loamy, mixed, frigid Typic Fragiorthods
Croswell	Sandy, mixed, frigid Entic Haplorthods
Dawson	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
Fence	Coarse-silty, mixed, frigid Alfic Haplorthods
Fluvaquents	Sandy, mixed, frigid Fluvaquents
Gaastra	Coarse-loamy, mixed, frigid Alfic Haplaquods
Gogebic	Coarse-loamy, mixed, frigid Alfic Fragiorthods
Histosols	Borosaprists
Karlin	Sandy, mixed, frigid Entic Haplorthods
Keweenaw	Sandy, mixed, frigid Alfic Haplorthods
*Kinross	Sandy, mixed, frigid Typic Haplaquods
Loxley	Dysic Typic Borosaprists
Manitowish	Sandy, mixed, frigid Entic Haplorthods
Markey	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Monico	Coarse-loamy, mixed, frigid Entic Haplaquods
Padus	Coarse-loamy, mixed, frigid Alfic Haplorthods
Pence	Sandy, mixed, frigid Entic Haplorthods
Rubicon	Sandy, mixed, frigid Entic Haplorthods
Sayner	Sandy, mixed, frigid Entic Haplorthods
Seelyeville	Euic Typic Borosaprists
Worcester Variant	Sandy, mixed, frigid Aquic Haplorthods

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