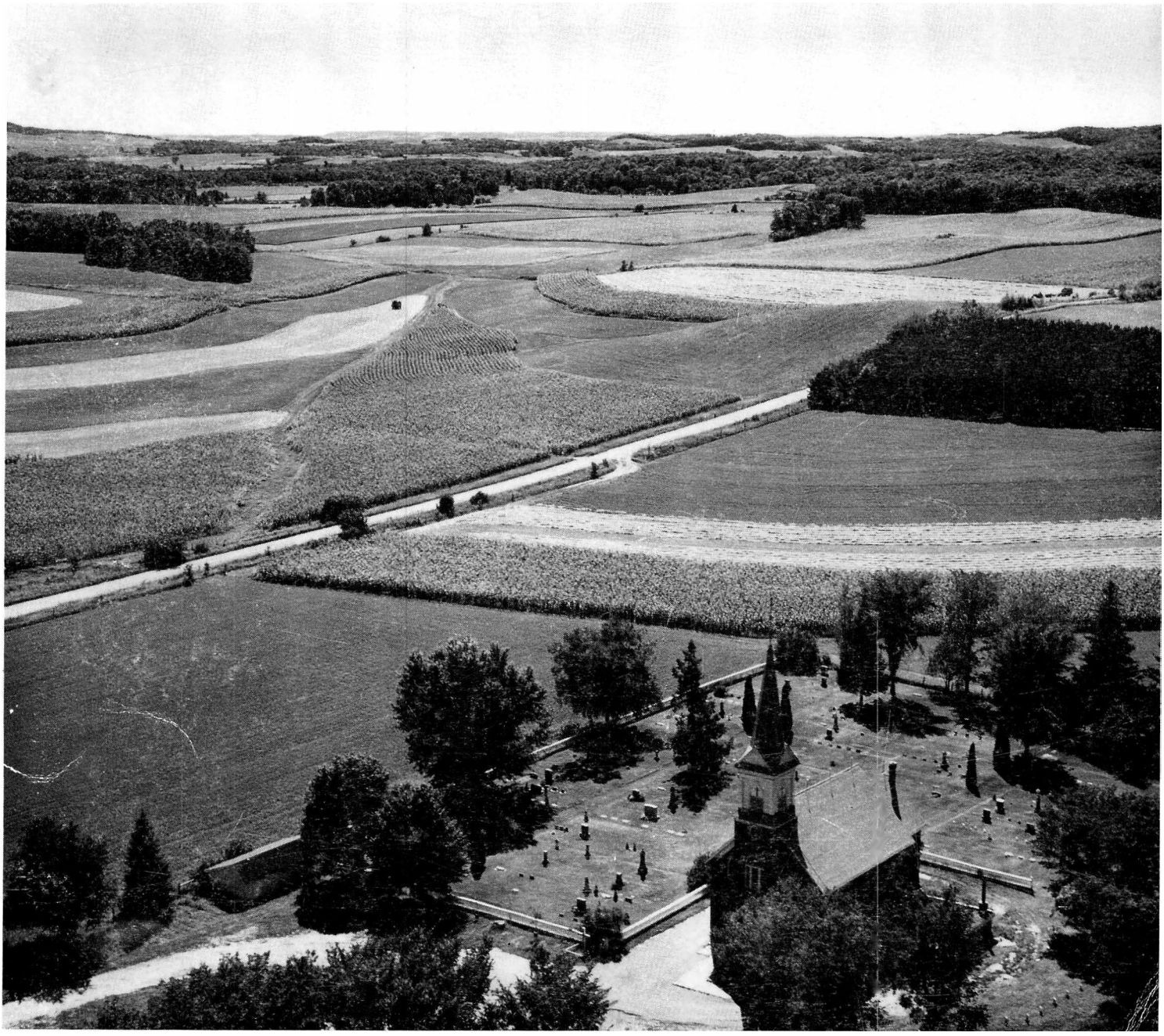
United States Department of Agriculture

Soil Conservation Service

In cooperation with the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

Soil Survey of Chippewa County, Wisconsin



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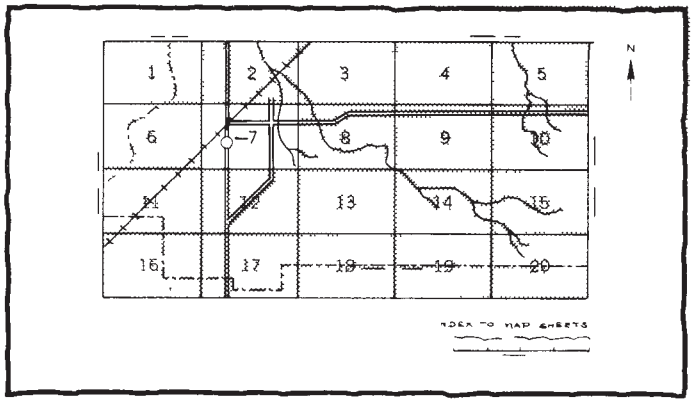

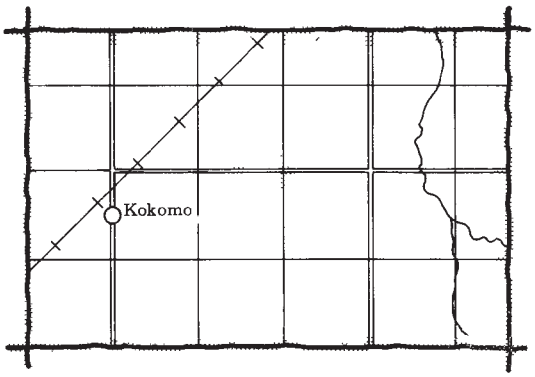

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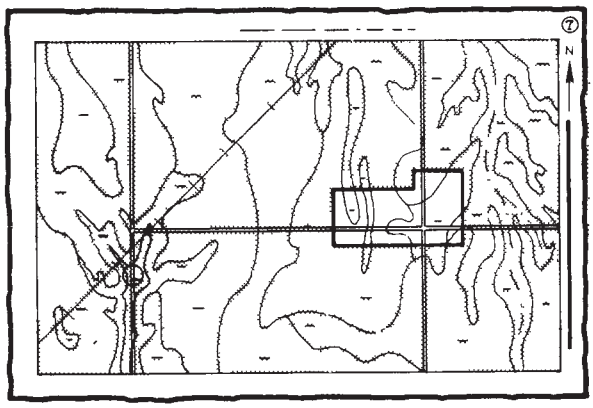

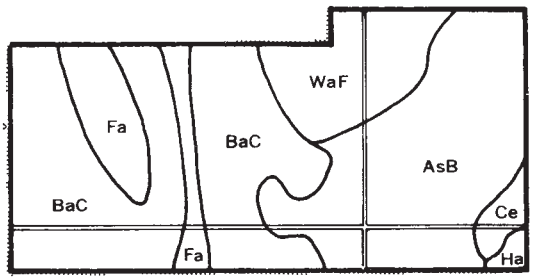

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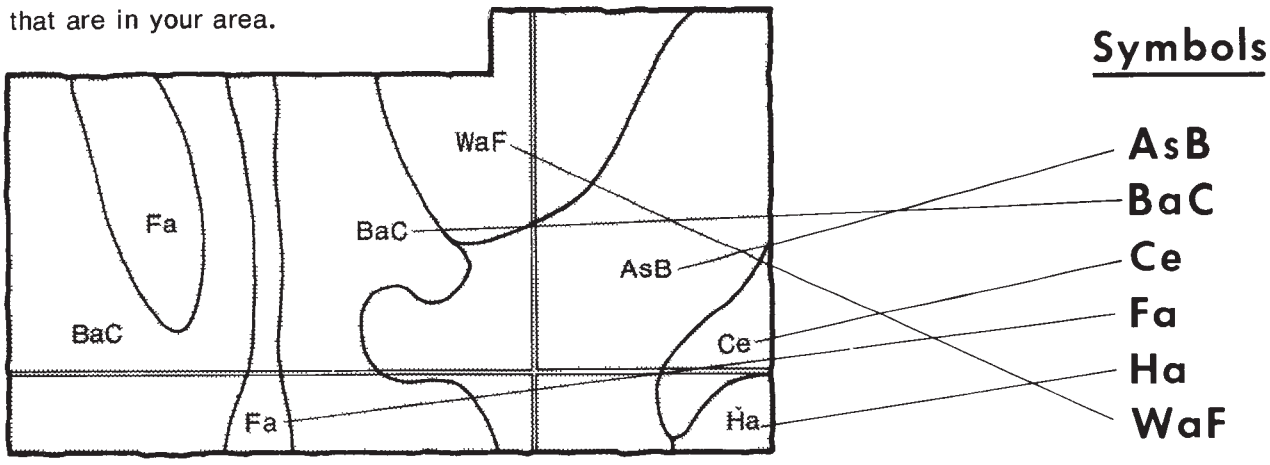
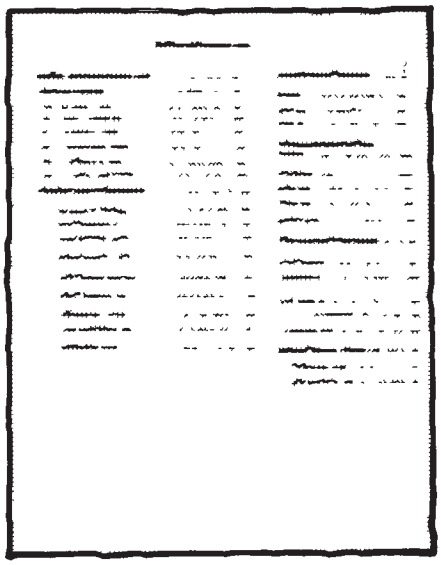
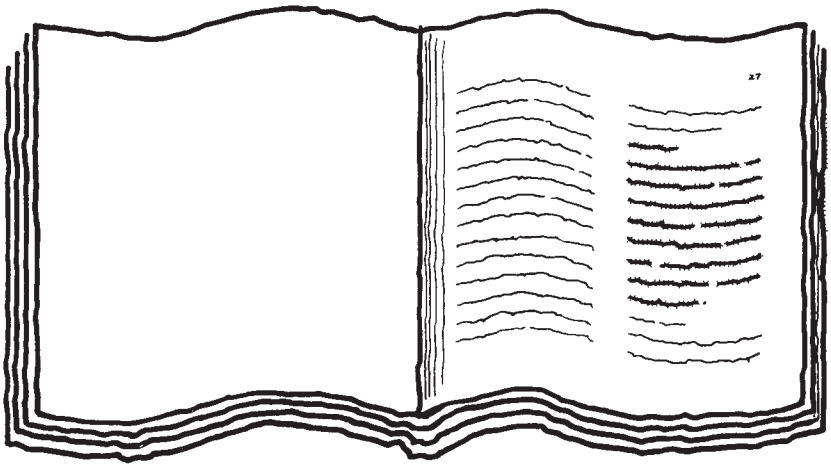


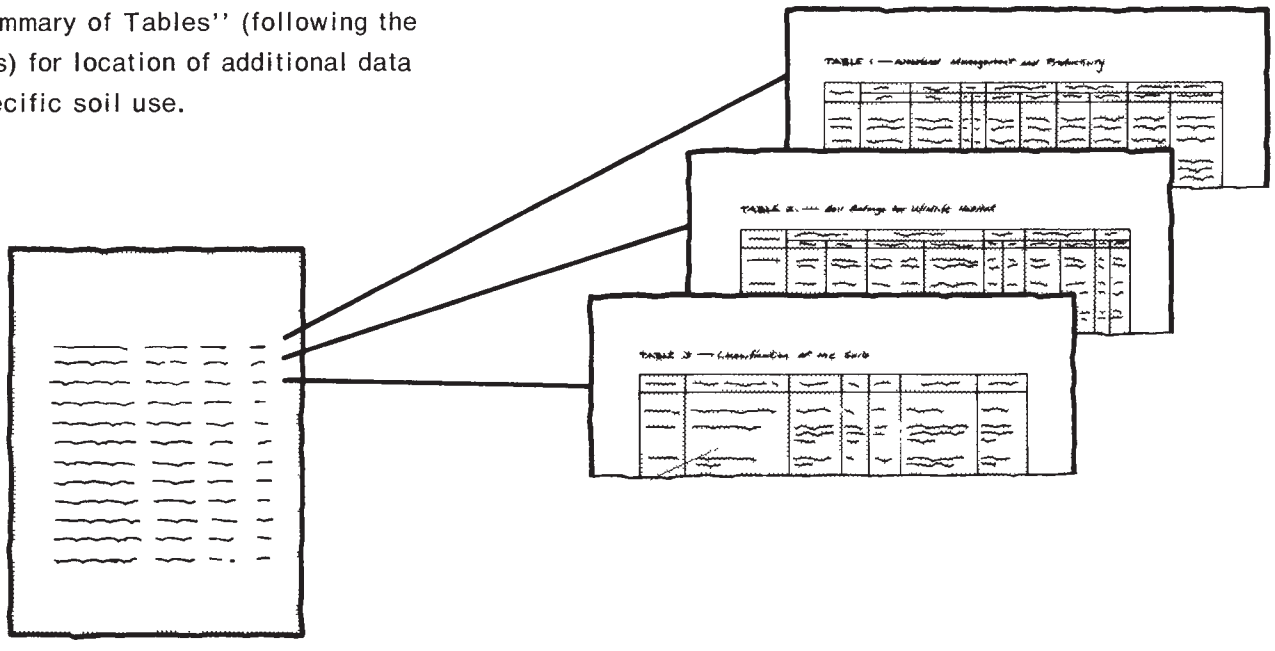
THIS SOIL SURVEY

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 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This survey was made cooperatively by the Soil Conservation 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 Chippewa County Land Conservation Committee, 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: Contour strips of corn, oats, and alfalfa on Billett and Northfield soils. Contour stripcropping is an important erosion-control measure in Chippewa County.

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Foreword

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

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

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

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Soil Survey of Chippewa County, Wisconsin

By Dale E. Jakel and Roger A. Dahl, Soil Conservation Service

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

CHIPPEWA COUNTY is in the west-central part of Wisconsin (fig. 1). It is 30 miles from south to north and 36 miles from east to west. It has a total acreage of 666,464 acres, or about 1,041 square miles. In 1980, the county population was estimated at 52,004 (*6*). Chippewa Falls, in an area along the Chippewa River in the southwestern part of the county, is the county seat.

Approximately 63 percent of the total acreage is farmland. The county is among the leading Wisconsin counties in dairying (*17*). Urban and industrial developments are expanding. More people are employed in manufacturing than in agriculture. The county provides opportunities for a wide variety of recreational activities.

General Nature of the County

This section describes some of the physical and cultural characteristics of the county These characteristics include history and development; climate; physiography, relief, and drainage; water supply; and transportation facilities and industry.

History and Development

Louis Hennepin and his companions were the first Europeans to traverse the survey area. They journeyed up the Chippewa River in 1680. The first permanent settlement in the area was established in 1822, when a sawmill was built along the Chippewa River. Soon after that date, the valley of the Chippewa River became an important lumber region (*4*). White pine was abundant in the virgin forests. In 1837, the largest sawmill in the world was built at Chippewa Falls.

The survey area at one time was part of the Territory of Michigan. In 1836, the Territory of Wisconsin was established. It had three counties—Crawford, Milwaukee, and Brown. In 1845, Chippewa County was formed from part of Crawford County. Chippewa Falls was declared the county seat. Chippewa County originally included about one-fourth of Wisconsin. Following 1845, numerous counties were detached from the original county. Chippewa County derives its name from the Indian word "Ojibewa," the name of an Indian tribe.

The early settlers included Canadians and French and some English, Irish, and Scots. German and Norwegian settlers came somewhat later. They were farmers. Dairying became the predominant farm activity by the turn of the century. The county has become one of the cheese-making centers of the nation.

Climate

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

Winters in Chippewa County are very cold, and summers are short and fairly warm. Precipitation is fairly well distributed throughout the year, reaching a slight peak 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 Holcombe in the period 1951 to 1981. Table 2 shows probable dates of

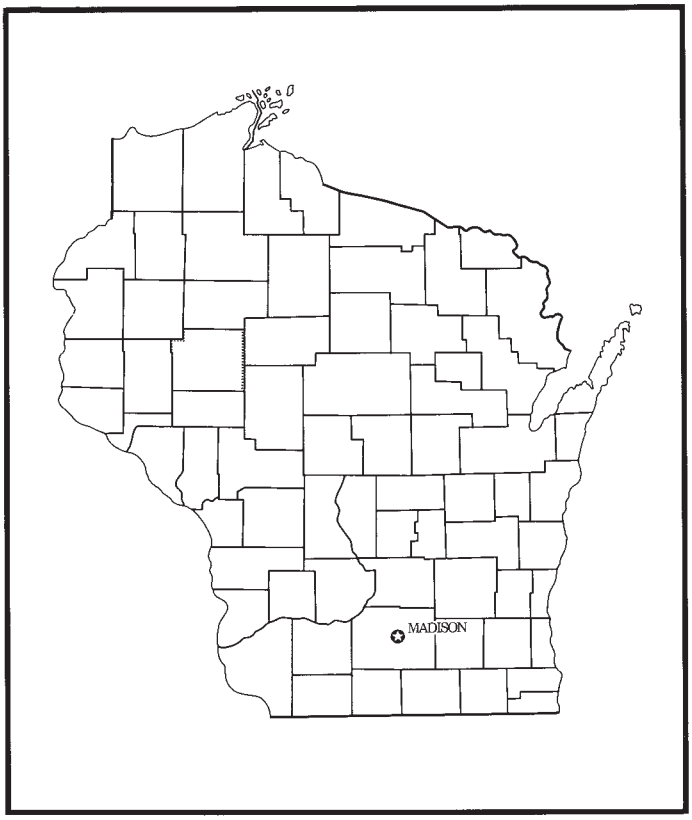

Figure 1.—Location of Chippewa County in Wisconsin.

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 15 degrees F, and the average daily minimum temperature is 5 degrees. The lowest temperature on record, which occurred at Holcombe on January 9, 1977, is -44 degrees. In summer the average temperature is 68 degrees, and the average daily maximum temperature is 80 degrees. The highest recorded temperature, which occurred at Holcombe on August 2, 1964, is 100 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 33 inches. Of this, about 25 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 5.85 inches at Holcombe on July 9, 1959. Thunderstorms occur on about 38 days each year.

The average seasonal snowfall is 43 inches. The greatest snow depth at any one time during the period of record was 38 inches. On the average, 62 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 12 miles per hour, in spring.

Physiography, Relief, and Drainage

Chippewa County is divided into two physiographic areas. A terminal moraine is in the northeastern part of the county. This area is characterized by rolling or hilly topography, kettle holes, bogs, irregularly shaped lakes, and numerous swamps. Drainage patterns are poorly defined, and geologic erosion has leveled the surface very little The southwestern part of the county is rolling and hilly. It has numerous sandstone and shale outcrops. It has well defined drainage patterns and few swamps. Several broad outwash plains are in this area.

Chippewa County is about 795 to 1,550 feet above sea level. The highest point in the county is Flambeau Ridge, in an area in Birch Creek Township near Holcombe Flowage. This ridge is a narrow quartzite monadnock about 3.5 miles long. It rises 300 to 400 feet above the surrounding areas.

The surface water in Chippewa County is within the drainage system of the Chippewa River. This river crosses the county from northeast to southwest, falling from an elevation of 993 feet above sea level at Cornell to 936 feet at Jim Falls and 839 feet at Chippewa Falls. Chippewa Falls is on the "Fall Line," where the rivers of northern Wisconsin leave the areas of resistant rocks of the Laurentian Shield and enter areas of softer sandstone. The Fall Line is an area of rapids or low cascades and is a good location for water-power dams. The Chippewa, Jump, Fisher, Yellow, and Wolf Rivers are the main streams draining the eastern part of the county. Sand, O'Neil, Duncan, and Elk Creeks are the major streams draining the western part.

Water Supply

Chippewa County has 21,037 acres of surface water. Of this total, 19,335 acres occurs as lakes and 1,702 acres as streams. The county has about 70 miles of trout streams (*9*). The chemical quality of the streams and lakes in the basin of the Chippewa River is generally good. The water is soft, and most streams are relatively unpolluted.

A large supply of good-quality water is available from the ground water reservoir in most parts of the county. Aquifers throughout the county provide water to wells and springs and replenish the streams and lakes through seepage and spring discharge. The ground water supply is likely to meet the domestic, agricultural, municipal, and industrial needs in the county. The ground water is generally soft. Minor water-use problems are caused by locally high concentrations of iron (*11*).

Probable well yields from the bedrock aquifers is 0 to 10 gallons per minute in the Precambrian crystalline rocks in the northeastern part of the county and 10 to 100 gallons per minute in the Cambrian sandstone in the southwestern part. Well yields from glacial deposits are estimated at 0 to 10 gallons per minute in the southwestern part of the county, 10 to 100 gallons per minute in the northeastern part, and 100 to 500 gallons per minute on the outwash plains in the central part (*19*).

Transportation Facilities and Industry

The principal north-south roads in the county are U.S. Highway 53 and State Highways 27, 178, 124, and 40. The main east-west roads are State Highways 64 and 29. Rail service is provided by two railroads. Scheduled air service is provided by an airport at Eau Claire

The main agricultural enterprise in the county is dairying Most of the milk is used in making cheese or is sold on the grade-A fluid milk market. Many food products also are processed, including meat, cheese, and vegetables. A brewery is located at Chippewa Falls.

The only commercial mineral resources in Chippewa County are sand and gravel. Saw logs and pulpwood are important forest products. Several wood-working plants are located in the county. Most of the pulpwood is used outside the county.

Chippewa County ranks high in diversified industry. Some of the manufactured items include plastics, leather products, aluminum products, wood products, brass castings and pumps, module homes, computers, filter elements, corrugated shipping containers, machinery, tools and dies, and insulated building panels (*3*).

The recreation industry also is important in Chippewa County. Recreational developments consist of state, county, city, and privately owned campgrounds, hiking and nature trails, and snowmobile trails. Other activities include cross-country skiing, golf, boating, canoeing, water skiing, and hunting and fishing (*16*).

How This Survey Was Made

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

The general soil map of Chippewa County joins with the general soil maps of Dunn and Eau Claire Counties. Because of differences in the extent of the major soils, some of the names of the associations in Chippewa County do not agree with those in Dunn and Eau Claire Counties. The soils in these associations have similar potentials for land uses. The differences in association names do not significantly affect the use of these maps for general planning.

Soil Descriptions

1. Menahga-Friendship Association

Deep, nearly level to sloping, excessively drained and moderately well drained, sandy soils on outwash plains and stream terraces

These soils are in areas on outwash plains and stream terraces where small hills and depressions are dissected by streams and small drainageways. Slopes are long and are plane or slightly convex. They generally are 0 to 6 percent but range from 0 to 12 percent.

This association makes up about 12 percent of the county. It is about 65 percent Menahga or similar soils, 15 percent Friendship or similar soils, and 20 percent soils of minor extent.

Menahga soils are nearly level to sloping and are excessively drained. They are on broad flats and side slopes on outwash plains. Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is sand about 32 inches thick. The upper part is dark yellowish brown and very friable, and the lower part is strong brown and yellowish brown and is loose. The substratum to a depth of about 60 inches is brownish yellow sand.

Friendship soils are nearly level and gently sloping and are moderately well drained. They are in plane areas on outwash plains and stream terraces. Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is sand about 28 inches thick. It is dark brown and very friable in the upper part and brown, mottled, and loose in the lower part. The substratum to a depth of about 60 inches is strong brown and light yellowish brown, mottled sand.

Some of the minor soils in this association are the Burkhardt, Markey, Meehan, and Newson soils. Burkhardt soils are excessively drained and somewhat excessively drained and are in landscape positions similar to those of the major soils. They formed in thin deposits of loamy material and are underlain by stratified sand and gravel. Markey soils are very poorly drained and are in depressions. They formed in organic material over sand. Meehan and Newson soils are sandy throughout. Meehan soils are somewhat poorly drained and are in shallow depressions. Newson soils are poorly drained and very poorly drained and are in depressions and drainageways.

Most areas of this association are used as cropland or pasture. The major soils are suited to cultivated crops, but soil blowing and drought are hazards. These soils are suited to trees.

The Menahga soils that have a slope of less than 6 percent are suited to dwellings. The wetness of the Friendship soils is a problem on sites for dwellings with basements. Septic tank absorption fields can function satisfactorily on both soils, but the effluent can pollute ground water because of rapid permeability in the substratum. Also, Friendship soils are poorly suited to septic tank absorption fields because of wetness.

2. Amery-Santiago Association

Deep, gently sloping to very steep, well drained, loamy and silty soils on moraines

These soils are on moraines characterized by many knolls, hills, and depressions. Slopes are short and

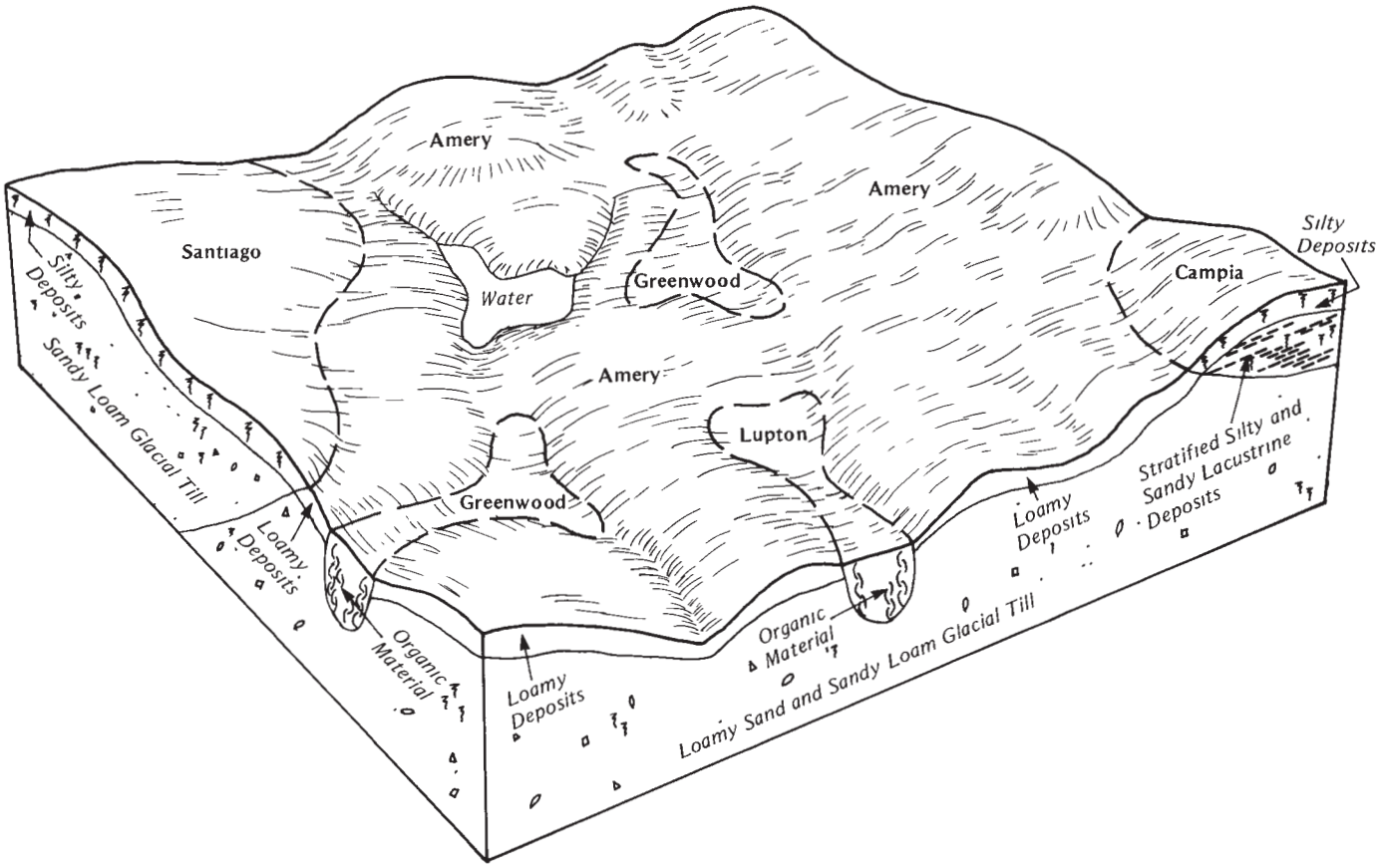

Figure 2.—Pattern of soils and parent material in the Amery-Santiago association.

convex. They generally are 6 to 25 percent but range from 2 to 45 percent.

This association makes up about 10 percent of the county. It is about 75 percent Amery soils, 10 percent Santiago soils, and 15 percent soils of minor extent (fig. 2).

Amery soils are gently sloping to very steep. They are on ridgetops, side slopes, and knolls on moraines. Typically, the surface layer is very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 9 inches thick. The subsoil is mostly reddish brown, friable sandy loam about 21 inches thick. The substratum to a depth of about 60 inches is reddish brown loamy sand.

Santiago soils are gently sloping to moderately steep. They are on side slopes and knolls on ground moraines. Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsurface layer is mostly brown silt loam about 6 inches thick. The subsoil is about 17 inches thick. The upper part is mostly dark yellowish brown and dark brown, friable silt loam; the next part is dark brown, friable loam; and the lower part is reddish brown, friable sandy loam. The substratum to a depth of about 60 inches is dark reddish brown sandy loam.

Some of the minor soils in this association are the Campia, Chetek, Greenwood, Lupton, and Magnor soils. Campia soils are well drained and are on glacial lake plains and terraces. They formed in silty deposits and in the underlying stratified silty and sandy deposits. Chetek soils are somewhat excessively drained and are on outwash plains, stream terraces, and pitted moraines. They formed in thin deposits of loamy material and are underlain by stratified sand and gravel. Greenwood and Lupton soils are very poorly drained and are in depressions. They formed in organic material. Magnor soils are somewhat poorly drained and are on side slopes and in drainageways. They formed in silty deposits and in the underlying sandy loam glacial till.

Most areas of the Amery soils are wooded, but some of the less sloping areas are used as cropland. Most areas of the Santiago soils are used as cropland or pasture. The less sloping major soils are suited to cultivated crops, but water erosion is a hazard. Because slopes are extremely uneven, most areas are not

suitable for stripcropping or terracing. The major soils are suited to trees.

The major soils that have a slope of less than 6 percent are suited to dwellings. They are only moderately suited or poorly suited to septic tank absorption fields because of moderate or moderately slow permeability.

3. Spencer-Magnor-Almena Association

Deep, nearly level to sloping, moderately well drained and somewhat poorly drained, silty soils on moraines

These soils are on ground moraines and terminal moraines. Slopes are long and slightly convex. They generally are 2 to 6 percent but range from 1 to 12 percent.

This association makes up about 44 percent of the county. It is about 25 percent Spencer or similar soils, 20 percent Magnor or similar soils, 15 percent Almena or similar soils, and 40 percent soils of minor extent (fig. 3).

Spencer soils are nearly level to sloping and are moderately well drained. They are on side slopes, foot slopes, and knolls on ground moraines and terminal moraines. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is mostly brown silt loam about 6 inches thick. The subsoil is mottled, friable silt loam about 22 inches thick. It is mostly dark yellowish brown in the upper part and dark brown in the lower part. The upper 5 inches of the substratum is dark yellowish brown, mottled silt loam. The lower part to a depth of about 60 inches is yellowish red sandy loam. In some areas the substratum is sand and gravel below a depth of 40 inches.

Magnor soils are nearly level and gently sloping and are somewhat poorly drained. They are on side slopes and in drainageways on ground moraines. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly grayish brown, mottled silt loam about 6 inches thick. The subsoil is about 18 inches thick. It is mottled and friable. The upper part is mostly dark brown silt loam, the next part is dark brown sandy loam, and the lower part is reddish brown loam. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam.

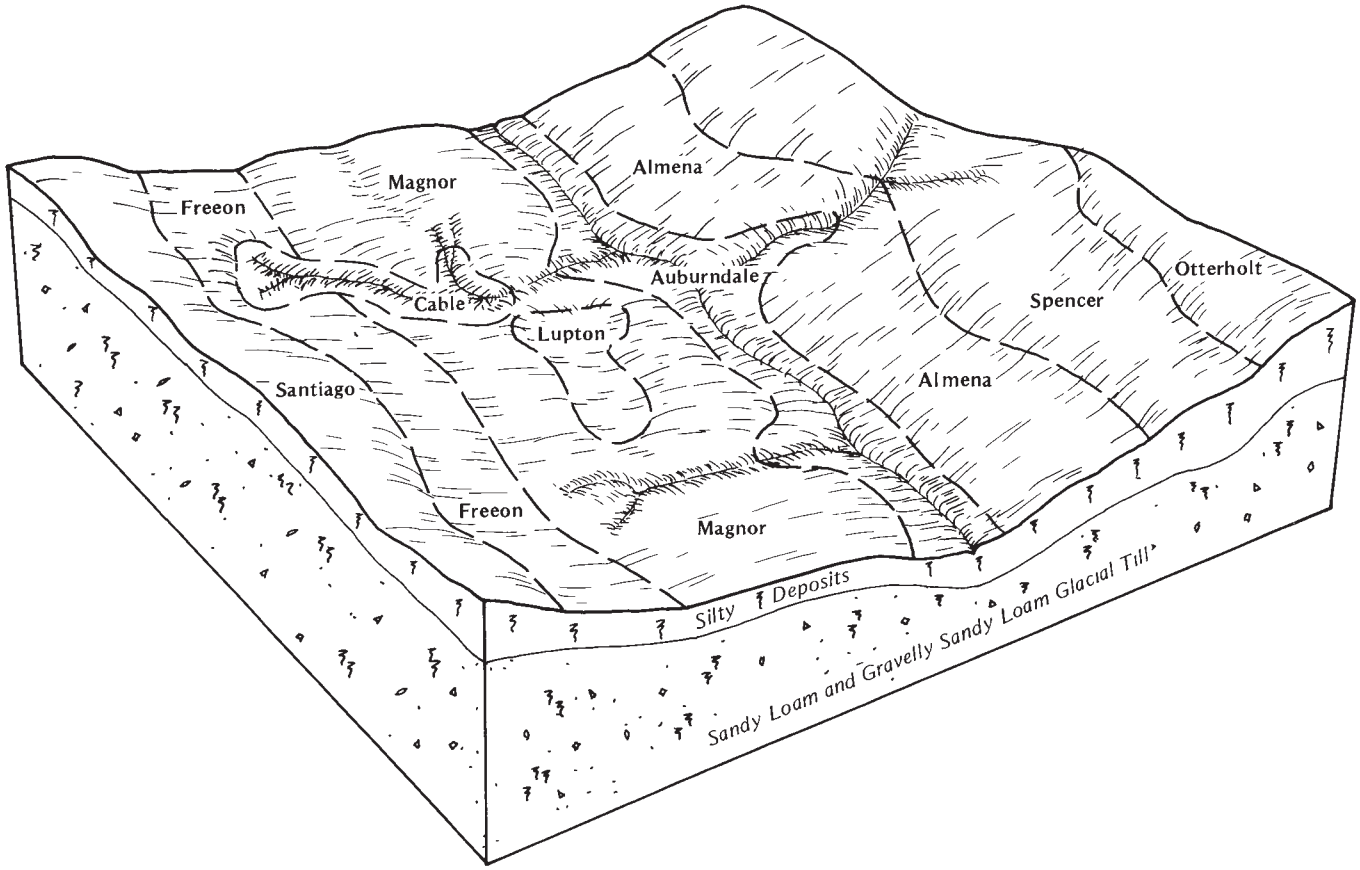

Figure 3.—Pattern of soils and parent material in the Spencer-Magnor-Almena association.

Almena soils are nearly level and gently sloping and are somewhat poorly drained. They are on side slopes and knolls on ground moraines. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is mostly grayish brown, mottled silt loam about 9 inches thick. The subsoil is mostly dark brown, mottled, friable silt loam about 30 inches thick. The substratum to a depth of about 60 inches is reddish brown gravelly sandy loam.

Some of the minor soils in this association are the Auburndale, Cable, Freeon, Lupton, Otterholt, and Santiago soils. Auburndale, Cable, and Lupton soils are poorly drained or very poorly drained. Auburndale and Cable soils are in drainageways and depressions. Lupton soils are in depressions. Freeon soils are moderately well drained and are in positions on the landscape similar to those of the Spencer soils. Otterholt and Santiago soils are well drained and are in the higher positions. Nearly all of the minor soils formed in silty deposits and in the underlying sandy loam or loam glacial till, but Lupton soils formed in decomposed woody organic material.

Most areas of this association are used as cropland or pasture. The major soils are suited to cultivated crops. Water erosion is a hazard, however, where the slope is more than 2 percent. Also, wetness is a limitation in areas of the Almena and Magnor soils.

The Almena and Magnor soils are poorly suited to dwellings because of wetness. The Spencer soils that have a slope of less than 6 percent are only moderately suited to dwellings with basements because of wetness and the shrink-swell potential. All of the major soils are poorly suited to septic tank absorption fields because of wetness and because of moderately slow permeability in the substratum

4. Elkmound-Plainbo-Eleva Association

Shallow and moderately deep, gently sloping to very steep, well drained to excessively drained, loamy and sandy soils on uplands, outwash plains, and stream terraces

These soils are on uplands underlain by sandstone and on outwash plains and stream terraces. Slopes are moderately long and are mainly convex. They generally are 6 to 20 percent but range from 2 to 45 percent.

This association makes up about 10 percent of the county. It is about 30 percent Elkmound or similar soils, 20 percent Plainbo or similar soils, 20 percent Eleva or similar soils, and 30 percent soils of minor extent (fig. 4).

Elkmound soils are shallow, are gently sloping to very steep, and are well drained. They are on ridgetops, side slopes, and foot slopes in the uplands. Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is about 12 inches thick. It is yellowish brown and dark yellowish brown, friable sandy loam in the upper part and yellowish brown, very friable loamy fine sand in the lower part. Partially weathered sandstone is at a depth of about 19 inches.

Plainbo soils are moderately deep, are gently sloping to moderately steep, and are excessively drained. They are on foot slopes and side slopes in the uplands and on outwash plains and stream terraces. Typically, the surface layer is dark grayish brown loamy sand about 6 inches thick. The subsoil is yellowish brown, very friable and loose sand about 14 inches thick. The substratum is brownish yellow channery sand about 8 inches thick. Poorly cemented sandstone is at a depth of about 28 inches.

Eleva soils are moderately deep, are gently sloping to moderately steep, and are well drained and somewhat excessively drained. They are on ridgetops, side slopes, and foot slopes in the uplands. Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 27 inches thick. It is friable. It is dark yellowish brown loam in the upper part and yellowish brown sandy loam in the lower part. The substratum is yellowish brown sand about 4 inches thick. Poorly cemented sandstone is at a depth of about 40 inches.

Some of the minor soils in this association are the Boone, Gale, Menahga, and Northfield soils. Boone soils are excessively drained and are in the higher positions on the landscape. They formed in sandy residuum over sandstone. Gale soils are well drained and are in landscape positions similar to those of the major soils. They formed in silty deposits and in a thin layer of sandy residuum. Menahga soils are excessively drained and are in the lower landscape positions. They formed in sandy deposits. Northfield soils are well drained and are in landscape positions similar to those of the major soils. They formed in thin deposits of silty material and are underlain by sandy residuum and sandstone.

Most areas of the less sloping major soils are used as cropland or pasture. Many areas are wooded. The less sloping major soils are suited to cultivated crops, but water erosion, soil blowing, and drought are hazards. The Plainbo soils are suited to trees, but the Eleva and Elkmound soils are poorly suited because of their limited depth to sandstone.

Because of the limited depth to sandstone, the major soils that have a slope of less than 6 percent are poorly suited or only moderately suited to dwellings with basements. They are poorly suited to septic tank absorption fields because of the depth to sandstone in all three soils and moderately rapid or rapid permeability in the Eleva and Plainbo soils.

5. Billett-Rosholt-Oesterle Association

Deep, nearly level to sloping, well drained to somewhat poorly drained, loamy soils on outwash plains and stream terraces

These soils are in plane or slightly convex areas on outwash plains and stream terraces. Slopes are long. They generally are 0 to 6 percent but range from 0 to 12 percent.

This association makes up about 10 percent of the county. It is about 30 percent Billett soils, 30 percent Rosholt soils, 15 percent Oesterle or similar soils, and 25 percent soils of minor extent.

Billett soils are nearly level to sloping and are well drained and moderately well drained. They are in plane or slightly convex areas on outwash plains. Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 25 inches thick. It is dark brown. It is friable sandy loam in the upper part and very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown and yellowish brown, stratified fine sand and sand.

Rosholt soils are nearly level to sloping and are well drained. They are in plane areas and on convex side slopes and knolls on stream terraces and outwash plains. Typically, the surface layer is dark brown sandy loam about 8 inches thick The subsoil is about 24 inches thick. It is mostly dark brown, friable sandy loam in the upper part and dark brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, stratified sand and gravel.

Oesterle soils are nearly level and are somewhat poorly drained. They are in drainageways on stream terraces and outwash plains. Typically, the surface layer is very dark brown sandy loam about 7 inches thick. The subsurface layer is mostly dark grayish brown sandy loam about 10 inches thick. The subsoil is about 17 inches thick. It is mottled. It is dark brown, friable sandy loam in the upper part and dark yellowish brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand and gravel.

Some of the minor soils in this association are the Lows, Meridian, and Sattre soils. Lows soils are poorly drained and are in drainageways. They formed in loamy and silty deposits underlain by sand Meridian and Sattre soils are well drained and are in landscape positions

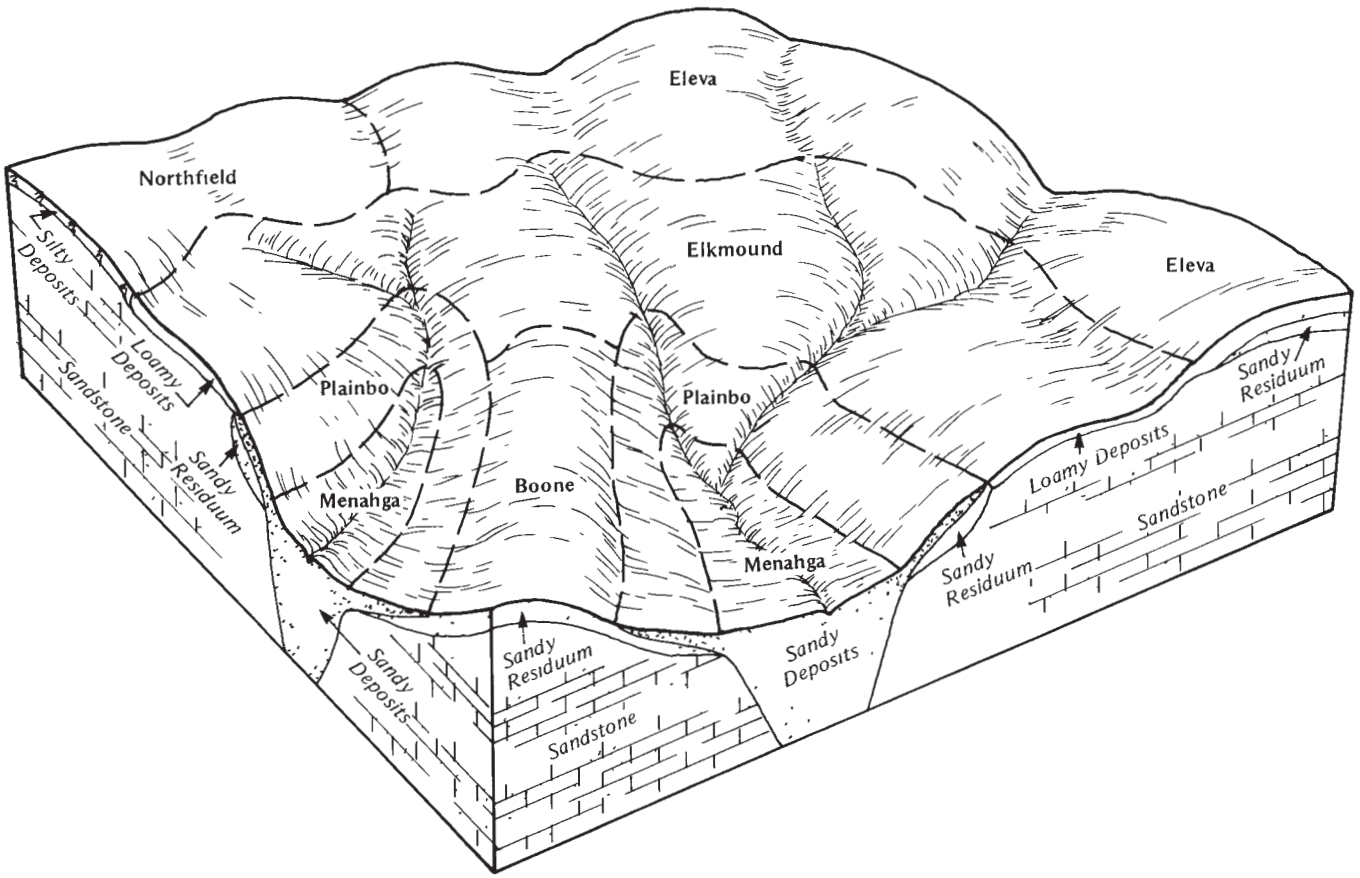

Figure 4.—Pattern of soils and parent material in the Elkmound-Plainbo-Eleva association.

similar to those of the Billett and Rosholt soils. They formed in loamy deposits over sandy material or sand and gravel.

Most areas of the Billett and Rosholt soils are used as cropland. Most areas of the Oesterle soils are wooded. The major soils are suited to cultivated crops, but drought and soil blowing are hazards. Also, wetness is a limitation in areas of the Oesterle soils. The major soils are suited to trees.

The Billett and Rosholt soils that have a slope of less than 6 percent are suited to dwellings, but the Oesterle soils are poorly suited because of wetness. Septic tank absorption fields can function satisfactorily on the major soils that have a slope of less than 6 percent, but the effluent can pollute ground water because of rapid or very rapid permeability in the substratum. Also, the wetness of the Oesterle soils is a limitation.

6. Seaton-Gale Association

Deep and moderately deep, nearly level to steep, moderately well drained and well drained, silty soils on uplands

These soils are on uplands underlain by sandstone and in areas of valley fill. Slopes are long and convex. They generally are 6 to 25 percent but range from 0 to 25 percent.

This association makes up about 4 percent of the county. It is about 60 percent Seaton soils, 20 percent Gale soils, and 20 percent soils of minor extent.

Seaton soils are deep, are nearly level to steep, and are well drained or moderately well drained. They are on ridgetops, side slopes, and foot slopes on uplands and in areas of valley fill. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is yellowish brown and dark yellowish brown, friable silt loam about 32 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam.

Gale soils are moderately deep, are gently sloping to moderately steep, and are well drained. They are on ridgetops and side slopes in the uplands. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 24 inches thick. It is dark brown and dark yellowish brown, friable silt loam in the upper part and yellowish brown, friable loamy fine sand in the lower part. Sandstone is at a depth of about 36 inches.

Some of the minor soils in this association are the Hixton and Northfield soils. Hixton soils are well drained and are in landscape positions similar to those of the major soils. They formed in loamy deposits underlain by sandy residuum and sandstone. Northfield soils are well drained and are on ridgetops and side slopes. They formed in thin deposits of silty material and are underlain by sandy residuum and sandstone.

Most areas of this association are used as cropland or pasture. The major soils are suited to cultivated crops, but water erosion is a hazard. These soils are suited to trees.

The well drained Seaton soils that have a slope of less than 6 percent are suited to dwellings and septic tank absorption fields. Because of the moderate depth to sandstone and the shrink-swell potential, the Gale soils that have a slope of less than 6 percent are only moderately suited to dwellings with basements. They are poorly suited to septic tank absorption fields because of the depth to sandstone and because of rapid permeability in the sandy part of the subsoil.

7. Flambeau-Fallcreek-Withee Association

Deep, nearly level to sloping, moderately well drained and somewhat poorly drained, loamy and silty soils on ground moraines

These soils are in plane or slightly convex areas on ground moraines. Slopes are long. They generally are 1 to 6 percent but range from 1 to 12 percent.

This association makes up about 9 percent of the county. It is about 35 percent Flambeau or similar soils, 20 percent Fallcreek or similar soils, 15 percent Withee soils, and 30 percent soils of minor extent (fig. 5).

Flambeau soils are gently sloping and sloping and are moderately well drained. They are on side slopes and knolls. Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is about 9 inches of brown loam and brown, mottled sandy loam. The subsoil is about 19 inches thick. It is reddish brown, mottled, and firm. It is loam in the upper part and sandy clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown loam.

Fallcreek soils are gently sloping and are somewhat poorly drained. They are on side slopes and knolls. Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mostly brown, mottled sandy loam about 12 inches thick. The subsoil is mostly reddish brown, mottled, firm loam about 20 inches thick. The substratum to a depth of about 60 inches is reddish brown loam.

Withee soils are nearly level and gently sloping and are somewhat poorly drained. They are on concave slopes. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly pale brown, mottled silt loam about 10 inches thick. The subsoil is about 24 inches thick. It is mostly brown, mottled, friable silt loam in the upper part and reddish brown, mottled, firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown loam.

Some of the minor soils in this association are the Almena, Arland, Cable, Loyal, Rib, and Spencer soils. Almena soils are somewhat poorly drained and are in landscape positions similar to those of the Fallcreek

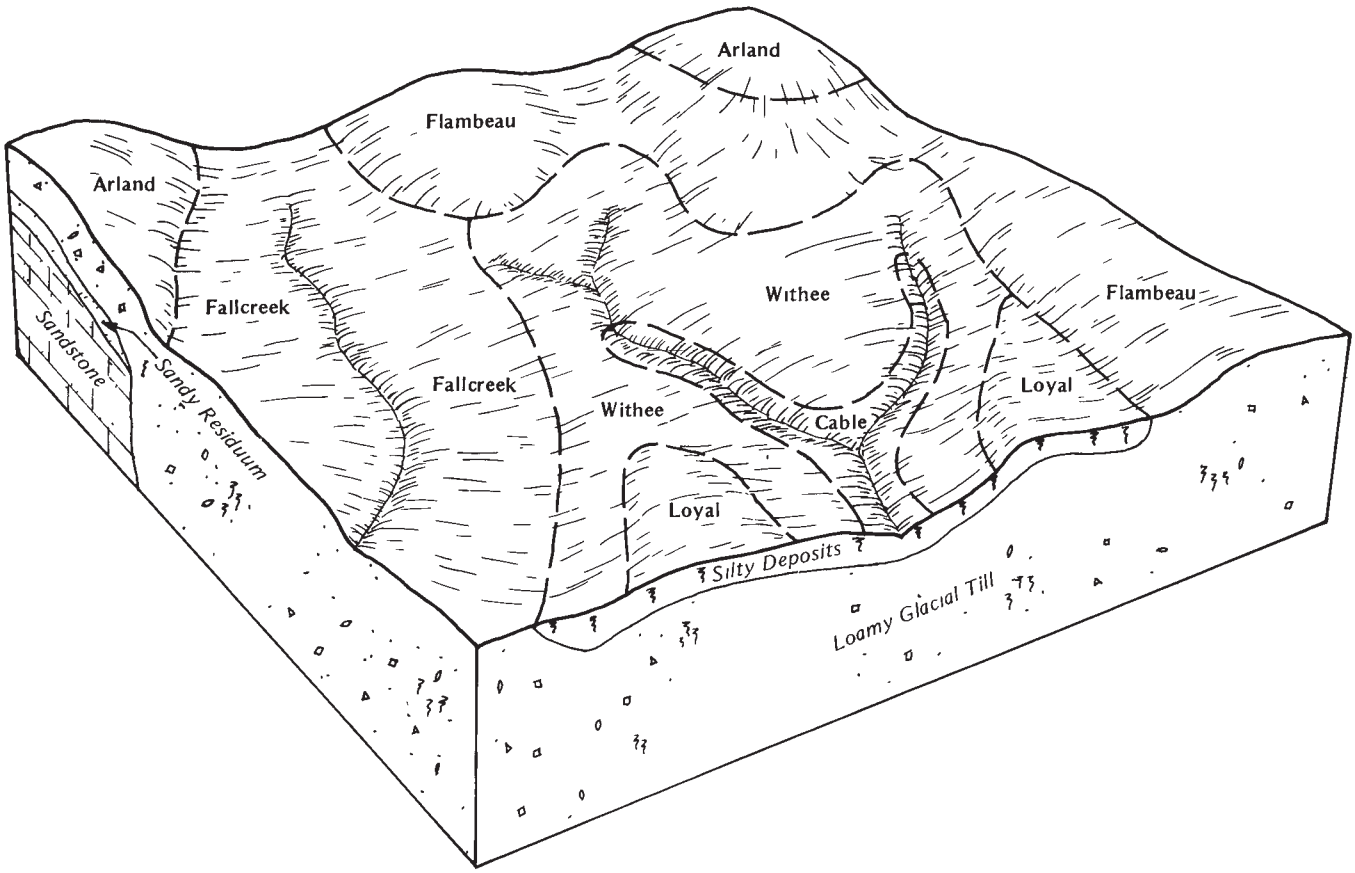

Figure 5.—Pattern of soils and parent material in the Flambeau-Fallcreek-Withee association.

soils. They formed in silty deposits over gravelly sandy loam glacial till. Arland soils are well drained and are in the slightly higher landscape positions. They formed in loamy glacial till underlain by sandy residuum and sandstone. Cable soils are poorly drained and very poorly drained and are in drainageways and depressions. They formed in silty deposits and in the underlying sandy loam glacial till. Loyal soils are moderately well drained and are slightly higher on the landscape than the Fallcreek and Withee soils. They formed in silty deposits and in the underlying loam glacial till. Rib soils are poorly drained and are in drainageways and depressions. They formed in silty and loamy deposits underlain by stratified sand and gravel. Spencer soils are moderately well drained and are in landscape positions similar to those of the Flambeau soils. They formed in silty deposits underlain by sandy loam glacial till.

Most areas of this association are used as cropland. The major soils are suited to cultivated crops, but water erosion is a hazard. Also, wetness is a limitation in areas of the Fallcreek and Withee soils. The major soils are suited to trees.

Mainly because of wetness, the Fallcreek and Withee soils are poorly suited to dwellings with basements and the Flambeau soils are only moderately suited. All of the major soils are poorly suited to septic tank absorption fields because of the wetness and moderately slow permeability.

8. Kert-Elm Lake-Vesper Association

Deep and moderately deep, nearly level and gently sloping, somewhat poorly drained and poorly drained, silty and sandy soils on uplands

These soils are on uplands underlain by sandstone and shale. Slopes are short and are plane or convex. They range from 0 to 6 percent.

This association makes up about 1 percent of the county. It is about 35 percent Kert soils, 25 percent Elm Lake soils, 15 percent Vesper soils, and 25 percent soils of minor extent.

Kert soils are deep, are nearly level and gently sloping, and are somewhat poorly drained. They are on foot slopes. Typically, the surface layer is very dark grayish

brown silt loam about 8 inches thick. The subsurface layer is mostly brown and grayish brown, mottled silt loam about 14 inches thick. The subsoil is about 18 inches thick. It is mottled and friable. It is pale olive loam in the upper part and dark brown sandy loam in the lower part. The upper part of the substratum is olive yellow and pale yellow, stratified sand and silt. The lower part to a depth of about 60 inches is reddish yellow loam.

Elm Lake soils are deep or moderately deep, are nearly level, and are poorly drained. They are in drainageways and depressions. Typically, the surface layer is black loamy sand about 4 inches thick. The substratum is about 44 inches thick. It is grayish brown, light brownish gray, and pale brown loamy sand and sand in the upper part and gray and olive gray, mottled silty clay loam in the lower part. Poorly cemented sandstone interbedded with shale is at a depth of about 48 inches.

Vesper soils are deep, are nearly level, and are poorly drained. They are in drainageways. Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 26 inches thick. It is mottled. It is dark grayish brown, friable loam in the upper part and olive gray, firm clay loam in the lower part. The substratum to a depth of about 60 inches is grayish brown, mottled, stratified sand and loam.

Some of the minor soils in this association are the Hiles, Humbird, and Merrillan soils. Hiles soils are moderately well drained and are on foot slopes. They formed in silty deposits and in the underlying material weathered from sandstone interbedded with shale. Humbird soils are moderately well drained and are in the higher landscape positions. They formed in loamy deposits and in the underlying material weathered from sandstone interbedded with shale. Merrillan soils are somewhat poorly drained and are in landscape positions similar to those of the Kert soils. They formed in loamy deposits and in the underlying material weathered from sandstone interbedded with shale.

Most areas of this association are used as cropland or pasture. Many areas of the Elm Lake soils are wooded. The major soils are suited to cultivated crops and pasture, but wetness is a limitation. If drained, the Elm Lake soils are subject to soil blowing. The Kert soils are suited to trees, but the Vesper and Elm Lake soils are poorly suited because of wetness.

The major soils are poorly suited to dwellings and septic tank absorption fields, mainly because of wetness, ponding, and slow or very slow permeability in the subsoil or substratum.

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, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Amery sandy loam, 6 to 12 percent slopes, is a phase of the Amery series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Chetek-Mahtomedi complex, 25 to 40 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. 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.

Several soils that were mapped in Chippewa County join with similar soils that have different names in Dunn and Eau Claire Counties. The similar soils were not mapped in Chippewa County because their extent was insignificant. One complex mapped in Chippewa County was not mapped in Dunn or Eau Claire County because the soil patterns were different. One complex mapped in Dunn County and three complexes mapped in Eau Claire County were not mapped in Chippewa County because their extent was insignificant or the soil patterns were different. These complexes join with a similar soil in Chippewa County. The alluvial land mapped in Eau Claire County was not mapped in Chippewa County. This land joins with recently established series in Chippewa County. Several soils mapped in Chippewa County do not join with the soils mapped in Barron County because of the age and level of detail in the soil survey of Barron County. This problem will be rectified when the survey of Barron County is updated.

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

AfB—Alban fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is in slightly concave areas on glacial lake plains and terraces. Individual areas are irregular in shape and generally range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is mostly brown fine sandy loam about 10 inches thick. The subsoil is about 20 inches thick. It is mostly dark brown, very friable and friable fine sandy loam and very fine sandy loam. It is mottled in the lower part. The substratum to a depth of about 60 inches is brown,

stratified silt, very fine sand, and fine sand. In some places the surface layer is loamy fine sand, very fine sandy loam, or loam or is thicker and darker. In other places the substratum is sandy loam till. In some areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of the well drained Antigo, excessively drained Menahga, and well drained Rosholt soils. Antigo soils are silt loam in the surface layer and in the upper part of the subsoil and are underlain by stratified sand and gravel. They are in the slightly lower positions on the landscape. Menahga and Rosholt soils are in positions similar to those of the Alban soil. Menahga soils are sandy throughout. Rosholt soils are underlain by stratified sand and gravel. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Alban soil. The available water capacity is high. The organic matter content is low or moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. A few are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing and is moderately droughty. Conservation tillage and field windbreaks help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by mounding the site with suitable filtering material. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets and by constructing the foundation on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. This limitation can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel.

The land capability classification is IIe. The woodland ordination symbol is 3A.

AfC—Alban fine sandy loam, 6 to 12 percent slopes. This deep, sloping, well drained soil is in convex areas on glacial lake plains and terraces. Individual areas are irregular in shape and generally range from 5 to 15 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 7 inches thick. The subsurface layer is mostly dark brown fine sandy loam about 11 inches thick. The subsoil is about 18 inches of dark brown, friable fine sandy loam and very fine sandy loam. The substratum to a depth of about 60 inches is brown, stratified very fine sand, fine sand, and silt. In places the surface layer is loamy fine sand, very fine sandy loam, or loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the excessively drained Menahga soils. These soils are in positions on the landscape similar to those of the Alban soil. They are sandy throughout. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Alban soil. The available water capacity is high. The organic matter content is low or moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content.

Most areas are used as cropland. A few are used as pasture or woodland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Terraces, grassed waterways, contour farming, contour stripcropping, and conservation tillage help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which

interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the moderate permeability and the slope, this soil is only moderately suited to septic tank absorption fields. The moderate permeability can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

AgB—Almena silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is on side slopes and knolls on ground moraines. Individual areas are irregular in shape and generally range from 10 to 150 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsurface layer is mostly grayish brown, mottled silt loam about 9 inches thick. The subsoil is mostly dark brown, mottled, friable silt loam about 30 inches thick. The substratum to a depth of about 60 inches is reddish brown gravelly sandy loam. In places it is loam or sandy loam. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the poorly drained Auburndale and moderately well drained Spencer soils. Auburndale soils are in drainageways and depressions on the lower parts of the landscape. Spencer soils are in the slightly higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow or moderate in the subsoil of the Almena soil and moderately slow in the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1.0 to 2.5 feet in undrained areas.

Most areas are used as cropland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration. Land smoothing, a surface drainage system, diversions, and grassed waterways help to remove excess water.

A cover of pasture plants is effective in controlling water erosion. The surface layer is subject to crusting, which restricts the emergence of small-seeded crops. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface

drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3W.

AlB—Amery sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on the tops of ridges on moraines. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 28 inches thick. The upper part is mostly dark brown, friable sandy loam; the next part is reddish brown, friable sandy loam; and the lower part is yellowish red, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish red sandy loam. In places the surface layer is loam or loamy sand. In some areas cobblestones are on the surface. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the very poorly drained Beseman, poorly drained and very poorly drained Cable, and somewhat poorly drained Magnor soils. Beseman soils formed in organic material in depressions. Cable soils are in depressions and drainageways. Magnor soils are on side slopes and in drainageways. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Amery soil. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content.

Most areas are wooded. A few are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing. Most areas have slopes that are too short and irregular to be stripcropped, terraced, or cultivated on the contour. Conservation tillage and winter cover crops help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. Because of the moderately slow permeability, however, it is poorly suited to septic tank absorption fields. This limitation can be overcome by constructing a filtering mound of suitable material and possibly by increasing the size of the absorption field.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 4A.

AlC—Amery sandy loam, 6 to 12 percent slopes. This deep, sloping, well drained soil is on ridgetops and side slopes on moraines. Individual areas are irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is black sandy loam about 1 inch thick. The subsurface layer is mostly light brownish gray and brown sandy loam about 9 inches thick. The subsoil is mostly reddish brown and yellowish red, friable sandy loam about 26 inches thick. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places the surface layer is loam. In some areas cobblestones are on the surface. In other areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Cable, moderately well drained Freeon, very poorly drained Greenwood, and somewhat poorly drained Magnor soils. Cable soils are in depressions. Freeon soils are in the slightly lower positions on the landscape. Greenwood soils formed in organic material in depressions. Magnor soils are on side slopes and in drainageways. Included soils make up 10 to 15 percent of the unit.

Permeability and the available water capacity are moderate in the Amery soil. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content.

Most areas are wooded. A few are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Most areas have slopes that are too short and irregular to be stripcropped or cultivated on the contour. Conservation tillage and winter cover crops help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the moderate permeability and the slope, this soil is only moderately suited to septic tank absorption fields. The moderate permeability can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwelling so that one side of the basement fronts on the lower part of the slope. Also, the dwelling can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

AID—Amery sandy loam, 12 to 25 percent slopes. This deep, moderately steep and steep, well drained soil is on ridgetops, side slopes, and knolls on moraines. Individual areas are irregular in shape and generally range from 10 to 150 acres in size.

Typically, the surface layer is very dark gray sandy loam about 2 inches thick. The subsurface layer is brown sandy loam about 9 inches thick. The subsoil is mostly reddish brown, friable sandy loam about 21 inches thick. The substratum to a depth of about 60 inches is reddish brown loamy sand. In places the surface layer is loam or silt loam. In some areas cobblestones are on the surface. In other areas the slope is less than 12 or more than 25 percent.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Cable, very poorly drained Greenwood, well drained Rosholt, and somewhat excessively drained Mahtomedi soils. Cable soils are in depressions. Greenwood soils formed in organic material in depressions. Rosholt and Mahtomedi soils are in positions on the landscape similar to those of the Amery soil. Rosholt soils are underlain by sand and gravel. Mahtomedi soils formed in sandy deposits over sand and gravel. Included soils make up 10 to 15 percent of the unit.

Permeability and the available water capacity are moderate in the Amery soil. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content.

Most areas are wooded. A few are used as cropland or pasture. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. Also, the soil is subject to soil blowing. Most areas have slopes that are too short and irregular to be stripcropped or cultivated on the contour. Conservation tillage, crop rotations that include grasses and legumes, and winter cover crops help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard and the equipment limitation are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the slope, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in the included areas where the slope is less than 12 percent.

Because of the slope, this soil is poorly suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwelling so that one side of the basement fronts on the lower part of the slope. Also, the dwelling can be built in the included areas where the slope is less than 12 percent.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 4R.

AlF—Amery sandy loam, 25 to 45 percent slopes. This deep, steep and very steep, well drained soil is on ridgetops, side slopes, and knolls on moraines. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is black sandy loam about 4 inches thick. The subsurface layer is mostly brown sandy loam about 9 inches thick. The subsoil is about 18 inches thick. It is dark brown, friable sandy loam in the upper part and reddish brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish red loamy sand. In some places the surface layer is loam. In other places the substratum is sandy loam. In some areas cobblestones and boulders are on the surface. In other areas the slope is less than 25 percent.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Cable, very poorly drained Greenwood, and excessively drained Mahtomedi soils. Cable soils are in depressions. Greenwood soils formed in organic material in depressions. Mahtomedi soils are in positions on the landscape similar to those of the Amery soil. They formed in sandy deposits over sand and gravel. Included soils make up 10 to 15 percent of the unit.

Permeability and the available water capacity are moderate in the Amery soil. The organic matter content is moderately low or moderate in the surface layer.

Most areas are wooded. A few are used as pasture. Because of a very severe hazard of water erosion, this soil is not suited to cultivated crops. It is poorly suited to pasture because of the hazard of erosion and the difficulty in operating machinery on these steep and very steep slopes. In some of the less sloping areas, the pasture can be renovated and improved. The native vegetation generally is of poor quality for forage.

This soil is suited to trees. The erosion hazard and the equipment limitation are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the slope. Overcoming this limitation is difficult. A better suited site should be considered.

The land capability classification is VIIe. The woodland ordination symbol is 4R.

AnB—Antigo silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is in plane or slightly convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsurface layer is mostly brown silt loam about 6 inches thick. The subsoil is about 16 inches thick. It is mostly dark yellowish brown and dark brown, friable silt loam in the upper part and reddish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In places it has little or no gravel. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the moderately well drained Brill and well drained Rosholt soils. Brill soils are in the slightly lower positions on the landscape. Rosholt soils have a loamy mantle. They are in the slightly higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Antigo soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sand and gravel substratum.

Most areas are used as cropland. A few are used as pasture or woodland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest.

This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3A.

AnC2—Antigo silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is in convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 15 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 5 inches thick. The subsurface layer is mostly brown silt loam about 8 inches thick. The subsoil is about 15 inches thick. It is dark yellowish brown, friable silt loam in the upper part and dark brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, stratified sand and gravel. In places it has little or no gravel. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Rosholt soils. These soils have a loamy mantle. They are in the slightly higher positions on the landscape. They make up 10 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Antigo soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sand and gravel substratum.

Most areas are used as cropland. A few are used as pasture or woodland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

AoA—Arenzville silt loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in plane or slightly concave areas on flood plains. It is occasionally flooded for brief periods. Individual areas are elongated and generally range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The upper substratum is brown, dark grayish brown, and very dark grayish brown silt loam about 30 inches thick. The next 12 inches is a buried layer of very dark gray silt loam. The lower substratum to a depth of about 60 inches is dark grayish

brown, mottled silt loam. In places the surface layer is loam. In some areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Orion soils in the slightly lower positions on the flood plains. These soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Arenzville soil. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Dikes and diversions help to prevent flooding. Applying streambank stabilization measures and fencing cattle from streams help to prevent streambank erosion. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth, increase the rate of water infiltration, and reduce the hazard of scouring by floodwater.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the wetness. Overcoming these limitations is difficult. A better suited site should be considered.

The land capability classification is IIw. The woodland ordination symbol is 4A.

ApB—Arland sandy loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 4 to 20 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 10 inches thick. The subsoil is about 24 inches thick. The upper part is dark yellowish brown and dark brown, friable loam; the next part is dark brown, friable sandy loam; and the lower part is reddish brown, very friable loamy sand. The substratum is yellowish red sand about 5 inches thick. Poorly cemented sandstone is at a depth of about 39 inches. In places the surface layer is loam or silt loam. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the well drained Amery soils. These soils are in positions on the landscape similar to those of the Arland soil. They are underlain by sandy loam till. They make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Arland soil and moderately rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy lower layers or by the underlying sandstone.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing. Conservation tillage, grassed waterways, and field windbreaks help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, this soil is poorly suited to septic tank absorption fields. The absorption field functions adequately if the site is mounded with suitable filtering material.

This soil is suited to local roads and streets. It also is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the depth to bedrock. This limitation can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

The land capability classification is IIe. The woodland ordination symbol is 4A.

ApC2—Arland sandy loam, 6 to 12 percent slopes, eroded. This moderately deep, sloping, well drained soil is on knolls and ridges in the uplands. Individual areas are irregular in shape and generally range from 4 to 40 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsoil is about 22 inches thick. It is dark brown and friable. The upper part is sandy loam, the next part is loam, and the lower part is sandy loam. The substratum is reddish yellow sand about 6 inches thick. Poorly cemented sandstone is at a depth of about 35 inches. In places the surface layer is silt loam or loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Amery and Elkmound soils. Amery soils are underlain by sandy loam till, and Elkmound soils are shallow over sandstone. Both of these soils are in positions on the landscape similar to those of the Arland soil. They make up 12 to 15 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Arland soil and moderately rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Conservation tillage, field windbreaks, contour farming, and contour stripcropping help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, this soil is poorly suited to septic tank absorption fields. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope, this soil is only moderately suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

ApD2—Arland sandy loam, 12 to 20 percent slopes, eroded. This moderately deep, moderately steep, well drained soil is on knolls and ridges in the uplands. Individual areas are irregular in shape and generally range from 4 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark grayish brown sandy loam about 7 inches thick. The subsoil is about 22 inches thick. The upper part is reddish brown, friable sandy loam; the next part is reddish brown, friable loam; and the lower part is strong brown, very friable loamy sand. Poorly cemented sandstone is at a depth of about 29 inches. In places the surface layer is silt loam or loam. In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the well drained Amery and Elkmound soils. Amery soils are underlain by sandy loam till, and Elkmound soils are shallow over sandstone. Both of these soils are in positions on the landscape similar to those of the Arland soil. They make up 10 to 15 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Arland soil and moderately rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in

the sandy part of the subsoil or by the underlying sandstone.

Most areas are used as cropland or pasture. A few are wooded. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a severe hazard. Also, the soil is subject to soil blowing. Contour farming, contour stripcropping, crop rotations that include grasses and legumes, and conservation tillage help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard and the equipment limitation are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the slope, this soil is poorly suited to septic tank absorption fields. The depth to bedrock can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is poorly suited to dwellings. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 4R.

AsB—Arland loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 4 to 20 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown and brown, friable loam in the upper part and strong brown, very friable loamy sand in the lower part. The substratum is reddish yellow sand about 5 inches thick. Poorly cemented sandstone is at a depth of about 34 inches. In places the subsoil is sandy clay loam. In some areas the surface layer is silt loam or sandy loam. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the well drained Northfield and Santiago soils. Northfield soils are shallow over sandstone. They are in the slightly higher positions on the landscape. Santiago soils are underlain by sandy loam till. They are in the slightly lower positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Arland soil and moderately rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy lower layers or by the underlying sandstone.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, this soil is poorly suited to septic tank absorption fields. The absorption field functions adequately if the site is mounded with suitable filtering material.

This soil is suited to local roads and streets. It also is suited to dwellings without basements, but it is only

moderately suited to dwellings with basements because of the depth to bedrock. This limitation can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

The land capability classification is IIe. The woodland ordination symbol is 4A.

AsC2—Arland loam, 6 to 12 percent slopes, eroded. This moderately deep, sloping, well drained soil is on knolls and ridges in the uplands. Individual areas are irregular in shape and generally range from 4 to 40 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown loam about 9 inches thick. The subsoil is about 17 inches thick. It is dark yellowish brown, friable loam in the upper part and dark brown, friable sandy loam in the lower part. The substratum is dark brown loamy sand about 10 inches thick. Poorly cemented sandstone is at a depth of about 36 inches. In places the subsoil is sandy clay loam. In some areas the surface layer is silt loam or sandy loam. In other areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Amery and Northfield soils in the slightly higher positions on the landscape. Amery soils are underlain by sandy loam till. Northfield soils are shallow over sandstone. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Arland soil and moderately rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, this soil is poorly suited to septic tank absorption fields. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope, this soil is only moderately suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

AsD2—Arland loam, 12 to 20 percent slopes, eroded. This moderately deep, moderately steep, well drained soil is on knolls and ridges in the uplands. Individual areas are irregular in shape and generally range from 4 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 19 inches thick. It is dark brown and dark yellowish brown, friable sandy loam in the upper part and dark yellowish brown, very friable loamy sand in the lower part. The substratum is brownish yellow sand about 13 inches thick. Poorly cemented sandstone is at a depth of about 38 inches. In places the surface layer is silt loam or sandy loam. In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the well drained Amery and Elkmound soils. Amery soils are underlain by sandy loam till, and Elkmound soils are shallow over sandstone. Both of these soils are in positions on the landscape similar to those of the Arland soil. They make up 10 to 15 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Arland soil and moderately rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy lower layers or by the underlying sandstone.

Most areas are used as cropland or pasture. A few are wooded. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. It can be controlled by contour farming, contour stripcropping, crop rotations that include grasses and legumes, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the slope, this soil is poorly suited to septic tank absorption fields. The depth to bedrock can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is poorly suited to dwellings. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 4R.

Au—Auburndale silt loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is on plane and concave slopes in drainageways and depressions on ground moraines. It is subject to ponding. Individual areas are elongated or irregular in shape and generally range from 10 to 150 acres in size.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is light brownish gray and grayish brown, mottled silt loam about 10 inches thick. The subsoil is about 29 inches thick. It is mostly grayish brown, gray, and brown, mottled, friable silt loam in the upper part and dark reddish brown, mottled, friable loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places stones are on the surface.

Included with this soil in mapping are small areas of the somewhat poorly drained Almena and poorly drained and very poorly drained Cable soils. Almena soils are in the slightly higher positions on the landscape. Cable soils are in positions similar to those of the Auburndale soil. Their silty mantle is thinner than that of the Auburndale soil. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow or moderate in the subsoil of the Auburndale soil and moderate in the substratum. The available water capacity is high. The organic matter content is high or very high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas of this soil are used as unimproved pasture or as woodland. Undrained areas generally are not suited to cultivated crops because of the wetness and the frost hazard. Drained areas are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The number of frost-free days per growing season is limited. Planting early maturing crop varieties or growing corn for silage helps to overcome the frost hazard.

This soil is poorly suited to pasture unless it is drained. Establishing or maintaining improved pasture is difficult because of the wetness. Grazing is limited to the short periods when the soil is dry. The native vegetation generally is of poor quality for forage.

This soil is suited to trees. Seedling mortality and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seeding mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can

destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 2W.

Ba—Barronett silt loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in plane or slightly concave areas on glacial lake plains. It is subject to ponding and rare flooding. Individual areas are irregular in shape and generally range from 20 to 300 acres in size.

Typically, the surface layer is very dark gray, mottled silt loam about 9 inches thick. The subsurface layer is dark gray and grayish brown, mottled silt loam about 9 inches thick. The subsoil is about 22 inches thick. It is gray and pinkish gray, mottled, friable silt loam. The substratum to a depth of about 60 inches is gray, mottled silt loam that has a few thin strata of very fine sand.

Included with this soil in mapping are small areas of the Barronett soils that are ponded for long periods and have a mucky surface layer. These soils are in the lower positions on the landscape. Also included are small areas of the somewhat poorly drained Comstock soils in the slightly higher positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow or moderate in this Barronett soil. The available water capacity is high. The organic matter content is moderate or high in the surface layer. This layer is friable but tends to crust or puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas are used as cropland. Some are used as wetland wildlife habitat. A few are used as pasture or woodland.

If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Dikes and diversions help to prevent flooding and ponding Land smoothing, diversions, and interceptor subsurface drains help to remove excess water. Restrictive soil layers may hinder the movement of water to tile drains. If drainage tile is installed, silt and fine sand enter the tile lines unless a suitable filter is used to cover the tile. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration. The number of frost-free days per growing season is limited. Planting early maturing crop varieties or growing corn for silage help to overcome the frost hazard.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Alfalfa is generally short lived because of the seasonal high water table, the flooding, and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable species. Proper stocking rates, measures that improve fertility, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees The trees grow so slowly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is IIIw in drained areas. The woodland ordination symbol is 2W.

Bb—Barronett mucky silt loam, ponded, 0 to 2 percent slopes. This deep, nearly level, very poorly drained soil is in plane or concave areas on glacial lake plains. It is subject to ponding and is frequently flooded. The ponding and flooding last for long periods. Individual areas are irregular in shape and generally range from 3 to 100 acres in size

Typically, about 1 inch of a very dark grayish brown, undecomposed organic material is at the surface. The surface layer is very dark gray, mottled mucky silt loam about 8 inches thick. The subsoil is gray, greenish gray, and light brownish gray, mottled, friable silt loam about 22 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silt loam that has strata of very fine sand less than 1 inch thick.

Included with this soil in mapping are small areas of the Barronett soils that are not ponded for long periods and have a surface layer of silt loam. These soils are in the slightly higher positions on the landscape. Also included are small areas of the very poorly drained Beseman soils, which formed in organic material in

depressions on the lower parts of the landscape. Included soils make up 1 to 5 percent of the unit.

Permeability is moderately slow or moderate in this Barronett soil. The available water capacity is very high. The organic matter content is high or very high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas are used as unimproved pasture. A few are wooded. Because of the wetness, a scarcity of suitable drainage outlets, the flooding, and the hazard of frost late in spring and early in fall, this soil generally is not suited to cultivated crops. It is poorly suited to pasture unless it is drained. Establishing or maintaining improved pasture is difficult because of the wetness. The native vegetation is generally of poor quality for forage. Grazing is limited to the short periods when the soil is dry.

This soil is poorly suited to trees. The trees grow so slowly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 2W.

Be—Beseman muck, 0 to 1 percent slopes. This deep, nearly level, very poorly drained soil is in depressions on ground moraines. It is subject to ponding and rare flooding. Individual areas are elongated and generally range from 10 to 120 acres in size.

Typically, the upper 20 inches is brown, dark brown, and black muck. The substratum to a depth of about 60 inches is gray silt loam.

Included with this soil in mapping are small areas of the very poorly drained Barronett soils that are ponded for long periods and that formed mostly in silty deposits in the slightly higher positions on the landscape. Also included are small areas of the very poorly drained Greenwood soils in positions similar to those of the Beseman soil. These soils formed in organic material more than 51 inches thick. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the organic part of the Beseman soil and moderately slow in the substratum. The available water capacity is very high. The organic matter content also is very high. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. Because of the wetness, a scarcity of suitable drainage outlets, the hazard of frost late in spring and early in fall, and an extremely acid reaction, this soil generally is not suited to cultivated crops or to pasture. If drained and cultivated, it is subject to burning and subsidence. Also, it is subject to soil blowing.

This soil is poorly suited to trees. The trees grow so poorly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is VIIw in undrained areas. The woodland ordination symbol is 2W.

BlA—Billett sandy loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in plane areas on outwash plains. Individual areas are irregular in shape and generally range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsurface layer is brown sandy loam about 3 inches thick. The subsoil is dark brown, friable sandy loam about 24 inches thick. The substratum to a depth of about 60 inches is yellowish brown sand. In places the surface layer is loam

Included with this soil in mapping are small areas of the moderately well drained Billett and well drained Meridian soils. The wetter Billett soils are in depressions. Meridian soils are in positions on the landscape similar to those of the well drained Billett soil. They have more clay in the surface layer and subsoil than the Billett soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of this Billett soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, the soil is subject to soil blowing. Also, it is moderately droughty. Conservation tillage, winter cover crops, and field windbreaks help to control soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of soil blowing.

A cover of pasture plants is effective in controlling soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. The soil is suited to dwellings. It is only moderately suited to local roads and streets because of the potential for frost action. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIs. The woodland ordination symbol is 4A.

BlB—Billett sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in slightly convex areas on outwash plains. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 25 inches thick. It is dark brown, friable sandy loam in the upper part and dark brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown and yellowish brown, stratified fine sand and sand. In places the surface layer is loam or is thinner and darker. In some areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of the moderately well drained Billett and well drained Meridian soils. The wetter Billett soils are in slight depressions on the lower parts of the landscape. Meridian soils are in positions on the landscape similar to those of the well drained Billett soil. They have more clay in the surface layer and subsoil than the Billett soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of this Billett soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing and is moderately droughty. Conservation tillage and field windbreaks help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. The soil is suited to dwellings. It is only moderately suited to local roads and streets because of the potential for frost action. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIs. The woodland ordination symbol is 4A.

BlC2—Billet sandy loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on convex side slopes and knolls on outwash plains.

Individual areas are irregular in shape and generally range from 4 to 40 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 22 inches thick. It is dark brown, friable sandy loam in the upper part and dark brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In places the surface layer is loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained and somewhat excessively drained Eleva soils. These soils are underlain by sandstone. They are in the slightly higher positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Billett soil and rapid in the substratum. The available water capacity is low. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Conservation tillage, field windbreaks, contour farming, and contour stripcropping help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action

The land capability classification is IIIe. The woodland ordination symbol is 4A.

BmA—Billett sandy loam, moderately well drained, 0 to 3 percent slopes. This deep, nearly level and gently sloping soil is in plane or slightly concave areas on outwash plains. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 6 inches thick. The subsoil is friable sandy loam about 23 inches thick. It is yellowish brown and dark yellowish brown in the upper part and dark brown and mottled in the lower part. The substratum to a depth of about 60 inches is brownish yellow, mottled sand. In places the surface layer is loam. In some areas the substratum has loamy strata as much as 1 inch thick.

Included with this soil in mapping are small areas of the well drained Billett and somewhat poorly drained Shiffer soils. The well drained Billett soils are in the slightly higher positions on the landscape. Shiffer soils are in the slightly lower positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the subsoil of this Billett soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, the soil is subject to soil blowing. Also, it is moderately droughty. Conservation tillage, winter cover crops, and field windbreaks help to control soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth,

increases the rate of water infiltration, and reduces the hazard of soil blowing.

A cover of pasture plants is effective in controlling soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. Wetness also is a limitation Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements. Because of the wetness, however, it is only moderately suited to dwellings with basements. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIs. The woodland ordination symbol is 4A.

BoE—Boone fine sand, 20 to 45 percent slopes. This moderately deep, steep and very steep, excessively drained soil is on ridgetops and the sides of valleys in the uplands. Individual areas are irregular in shape and generally range from 10 to 250 acres in size.

Typically, the surface layer is very dark gray fine sand about 2 inches thick. The substratum is about 20 inches of brown and light yellowish brown fine sand and sand. Poorly cemented sandstone is at a depth of about 22 inches.

Included with this soil in mapping are small areas of the well drained and somewhat excessively drained Eleva and well drained Elkmound and Northfield soils. Eleva soils formed mostly in loamy material and sandstone residuum. They are in the lower positions on the landscape. Elkmound and Northfield soils are on the higher ridgetops. Elkmound soils formed in loamy deposits and are shallow over sandstone. Northfield soils formed in silty deposits and are shallow over sandstone. Included soils make up 10 to 20 percent of the unit.

Permeability is rapid in the Boone soil. The available water capacity is very low. Natural fertility is low. The organic matter content is very low or low in the surface layer. The rooting depth of most plants is limited by droughtiness and by the underlying sandstone.

Most areas are wooded. Because of a very severe hazard of erosion, drought, and soil blowing, this soil is not suited to cultivated crops and is poorly suited to pasture. Operating machinery on these steep and very steep slopes is difficult In some of the less sloping areas, the pasture can be renovated and improved. The native vegetation generally is of poor quality for forage.

This soil is poorly suited to trees. The trees grow slowly and are poorly shaped. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Erosion can be controlled by planting on the contour and by carefully locating skid roads. Poor survival of planted trees during dry periods can be offset by careful planting of vigorous nursery stock. Although the production of merchantable wood on this soil may not be profitable, the trees can be very effective in controlling soil blowing and erosion.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the slope. Overcoming this limitation is difficult. A better suited site should be considered.

The land capability classification is VIIs. The woodland ordination symbol is 2R.

BpA—Brill silt loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in plane or slightly convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsurface layer is mostly brown silt loam about 5 inches thick. The subsoil is about 21 inches thick. The upper part is mostly dark yellowish brown, friable silt loam; the next part is dark yellowish brown, mottled, friable silt loam; and the lower part is brown, mottled, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is dark brown, stratified sand and gravel. In places the slope is more than 3 percent.

Included with this soil in mapping are small areas of the well drained Antigo, somewhat poorly drained Poskin, and moderately well drained Scott Lake soils. Antigo soils are in the slightly higher positions on the landscape. Poskin soils are in the slightly lower positions. Scott Lake soils are in positions similar to those of the Brill soil. They have a loamy surface layer

and subsoil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Brill soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the substratum. The depth to the seasonal high water table ranges from 2.5 to 3.5 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. Wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the shrink-swell potential, this soil is only moderately suited to dwellings. This limitation can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel; by strengthening basement walls; and by installing a subsurface drainage system at or below the basement elevation. The wetness is a limitation on sites for dwellings with basements. It can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIs. The woodland ordination symbol is 3A.

BuA—Burkhardt sandy loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, somewhat excessively drained or excessively drained soil is in plane areas on stream terraces and outwash plains. Individual areas are irregular in shape and generally range from 20 to 400 acres in size.

Typically, the surface layer is about 11 inches thick. It is very dark brown sandy loam in the upper part and dark brown coarse sandy loam in the lower part. The subsoil is about 8 inches thick. It is dark brown, friable coarse sandy loam in the upper part and dark brown, very friable gravelly coarse sand in the lower part. The substratum to a depth of about 60 inches is dark brown and strong brown, stratified coarse sand and gravel. In places the surface layer is loam. In some areas the depth to sand and gravel is more than 24 inches. In other areas the slope is more than 3 percent.

Included with this soil in mapping are small areas of the excessively drained Menahga soils. These soils are sandy throughout. They are in the slightly higher positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Burkhardt soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderate to very high in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil and in the substratum.

Most areas are used as cropland. Some have been planted to pine. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, soil blowing is a hazard. It can be controlled by conservation tillage, winter cover crops, and field windbreaks. Returning crop residue to the soil or adding other organic material reduces the amount of water lost through evaporation, increases the rate of water infiltration, helps to maintain fertility, and reduces susceptibility to soil blowing

A cover of pasture plants is effective in controlling soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local road and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs. The woodland ordination symbol is 2A.

Cb—Cable silt loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in depressions and drainageways on ground moraines. It is subject to ponding. Individual areas are irregular in shape or long and narrow and generally range from 10 to 200 acres in size.

Typically, about 2 inches of very dark grayish brown, undecomposed organic material is at the surface. The surface layer is very dark gray silt loam about 4 inches thick. The subsoil is about 20 inches thick. It is grayish brown, mottled, and friable. It is silt loam in the upper part and loam in the lower part. The substratum to a depth of about 60 inches is dark brown and reddish brown sandy loam. It is mottled in the upper part. In places the substratum is loam. In some areas the content of cobbles and stones in the surface layer is as much as 35 percent.

Included with this soil in mapping are small areas of the very poorly drained Beseman and somewhat poorly drained Magnor soils. Beseman soils formed in 16 to 51 inches of organic material. They are in depressions on the slightly lower parts of the landscape. Magnor soils are in the slightly higher positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the subsoil of the Cable soil and moderately slow in the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas of this soil are used as unimproved pasture or support native wetland vegetation. Undrained areas generally are not suited to cultivated crops because of the wetness and the frost hazard. Drained areas are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture The number of frost-free days per growing season is limited. Planting early maturing corn varieties or cutting the corn for silage helps to overcome the frost hazard.

Unless drained, this soil is poorly suited to pasture. Establishing an improved pasture is difficult because of the wetness. The quality of the native forage plants generally is poor. Grazing is limited to short periods when the soil is dry.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges is generally needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming the hazard is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 2W.

CdB—Campia silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in slightly convex areas on glacial lake plains. Individual areas are irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown silt loam about 11 inches thick. The subsoil is about 23 inches thick. It is mostly reddish brown, friable silt loam in the upper part and reddish brown, firm silty clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown silt loam.

Included with this soil in mapping are small areas of the moderately well drained Crystal Lake and Spencer and well drained Santiago soils Crystal Lake soils are in the lower positions on the landscape. Spencer and Santiago soils are in positions similar to those of the Campia soil. Spencer soils formed in silty deposits over sandy loam glacial till. Santiago soils formed in silty and loamy deposits over sandy loam glacial till. Included soils make up 5 to 10 percent of the unit

Permeability is moderate in the Campia soil. The available water capacity is very high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to

grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by terraces, grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It is only moderately suited to septic tank absorption fields because of the moderate permeability. This limitation can be overcome by constructing a mound of suitable filtering material and possibly by increasing the size of the absorption field.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or base material.

The land capability classification is IIe. The woodland ordination symbol is 3A.

CdC2—Campia silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on convex side slopes and knolls on glacial lake plains. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 10 inches thick The subsurface layer is mostly pale brown silt loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is mostly reddish brown, friable silt loam; the next part is reddish brown, firm silty clay loam; and the lower part is reddish brown, friable silt loam. The substratum to a depth of about 60 inches is reddish brown silt loam. In places the slope is less than 6 percent or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Otterholt and Santiago soils. Otterholt soils formed in silty deposits over sandy loam glacial till, and Santiago soils formed in silty and loamy deposits over sandy loam glacial till. Both of these soils are in positions on the landscape similar to those of the Campia soil. They make up 10 to 15 percent of the unit.

Permeability is moderate in the Campia soil. The available water capacity is very high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration

Because of the moderate permeability and the slope, this soil is only moderately suited to septic tank absorption fields. The moderate permeability can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing

the upper part of the soil with coarse textured base material, such as sand or gravel Low strength also can be overcome by increasing the thickness of pavement or base material.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

CdD2—Campia silt loam, 12 to 20 percent slopes, eroded. This deep, moderately steep, well drained soil is on side slopes on glacial lake plains and terraces Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 8 inches thick. The subsurface layer is mostly pinkish gray silt loam about 5 inches thick. The subsoil is about 16 inches thick. It is mostly reddish brown, firm silty clay loam in the upper part and reddish brown, friable silt loam in the lower part. The substratum to a depth of about 60 inches is reddish brown silt loam. In places it is sandy loam. In some areas the depth to sand and gravel is more than 40 inches. In other areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the well drained Santiago soils. These soils are in positions on the landscape similar to those of Campia soil. They formed in silty and loamy deposits over sandy loam glacial till. They make up 10 to 15 percent of the unit.

Permeability is moderate in the Campia soil. The available water capacity is very high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland or pasture. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. It can be controlled by contour farming, contour stripcropping, crop rotations that include grasses and legumes, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the slope, this soil is poorly suited to septic tank absorption fields and dwellings. On sites for septic tank absorption fields, this limitation can be overcome by cutting and filling or by installing a trench absorption system on the contour. On sites for dwellings, it can be overcome by cutting and filling or by installing retaining walls Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of low strength, the slope, and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength and frost action can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 3R.

CeA—Caryville sandy loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, well drained soil is in plane areas on flood plains and stream terraces. It is subject to rare flooding. Individual areas are oblong and generally range from 3 to 50 acres in size.

Typically, the surface layer is dark reddish brown sandy loam about 16 inches thick. The next layer is dark reddish brown loamy sand about 4 inches thick. The substratum to a depth of about 60 inches is brown sand. In places the surface layer is loam. In some areas silty or loamy strata are in the substratum.

'ncluded with this soil in mapping are small areas of the somewhat excessively drained Burkhardt soils. These soils have more gravel in the lower part of the subsoil and in the substratum than the Caryville soil. They are in the slightly higher positions on the landscape. Also included are a few small areas of Caryville soils that have mottles in the upper part of the substratum and are moderately well drained. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper loamy part of this Caryville soil and moderately rapid or rapid in

the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy layers.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, soil blowing is a hazard. It can be controlled by conservation tillage and field windbreaks. Dikes and diversions help to prevent flooding. Returning crop residue to the soil or adding other organic material reduces the amount of water lost through evaporation, increases the rate of water infiltration, helps to maintain fertility, and reduces susceptibility to soil blowing.

A cover of pasture plants is effective in controlling soil blowing and erosion. Forage yields are generally low unless fertilizer is applied and the amount of moisture is adequate. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is IIIw. The woodland ordination symbol is 3A.

CkA—Chetek sandy loam, 0 to 2 percent slopes. This deep, nearly level, somewhat excessively drained soil is in plane areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsoil is about 12 inches thick. It is dark brown, friable sandy loam in the upper part and dark brown, very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In places the depth to sand and gravel is more than 20 inches. In some areas the slope is more than 2 percent.

Included with this soil in mapping are small areas of the excessively drained Menahga soils. These soils are sandy throughout. They are in the slightly higher positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the subsoil of the Chetek soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the substratum.

Most areas are used as cropland. Some are used as pasture or woodland. Some have been planted to pine. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, soil blowing is a hazard. It can be controlled by conservation tillage, field windbreaks, and winter cover crops. Returning crop residue to the soil or adding other organic material reduces the amount of water lost through evaporation, helps to maintain fertility, increases the rate of water infiltration, and reduces the susceptibility to soil blowing.

A cover of pasture plants is effective in controlling soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality is a management concern. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local roads and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs. The woodland ordination symbol is 6S.

CkB—Chetek sandy loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat excessively drained soil is in slightly convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is

brown sandy loam about 5 inches thick. The subsoil is about 7 inches thick. It is dark brown, friable sandy loam in the upper part and dark brown, very friable 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 the lower part of the subsoil is sandy loam. In some areas the depth to sand and gravel is more than 20 inches. In other areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of the excessively drained Menahga soils. These soils are sandy throughout. They are in the slightly higher positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the subsoil of the Chetek soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil and in the substratum.

Most areas are used as cropland. Some are used as pasture or woodland. Some have been planted to pine. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing. Most areas have slopes that are too short and too irregular to be stripcropped or cultivated on the contour. Conservation tillage, field windbreaks, and winter cover crops help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees Seedling mortality is a management concern. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local roads and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIe. The woodland ordination symbol is 6S.

CkC2—Chetek sandy loam, 6 to 12 percent slopes, eroded. This deep, sloping, somewhat excessively drained soil is on side slopes and knolls on outwash plains, stream terraces, and pitted moraines. Individual areas are irregular in shape and generally range from 5 to 25 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsoil is dark brown, friable sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is brown, stratified sand and gravel. In places it has a few cobbles. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are a few small areas of the excessively drained Mahtomedi soils. These soils are in positions on the landscape similar to those of the Chetek soil. They are loamy sand in the surface layer and in the upper part of the subsoil. Also included, on knolls and sharp slope breaks, are a few areas of soils that have a surface layer of gravelly loamy sand. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the subsoil of the Chetek soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the substratum.

Most areas are used as cropland or pasture. A few are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Most areas have slopes that are too short and too irregular to be stripcropped or cultivated on the contour. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality is a management concern. Seedling survival can be

improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 6S.

CkD2—Chetek-Mahtomedi complex, 12 to 25 percent slopes, eroded. These deep, moderately steep and steep soils are on side slopes on outwash plains and pitted moraines. The Chetek soil is somewhat excessively drained, and the Mahtomedi soil is excessively drained. Individual areas are irregular in shape and generally range from 10 to 80 acres in size. They are 45 to 55 percent Chetek soil and 25 to 35 percent Mahtomedi soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer of both soils. Typically, the remaining surface layer in the Chetek soil is dark brown sandy loam about 5 inches thick. The subsoil is about 10 inches thick. It is reddish brown, friable sandy loam in the upper part and dark brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown and yellowish brown, stratified sand and gravel.

Typically, the remaining surface layer in the Mahtomedi soil is dark brown loamy sand about 6 inches thick. The subsoil is reddish brown, very friable gravelly loamy sand about 15 inches thick. The substratum to a depth of about 60 inches is yellowish red sand and gravel. In places the slope is less than 12 or more than 25 percent.

Included with these soils in mapping are small areas of the well drained Rosholt soils. These included soils are in positions on the landscape similar to those of the Chetek and Mahtomedi soils. They have a loamy solum and are deeper to sand and gravel than the Chetek and Mahtomedi soils. They make up 10 to 25 percent of the unit.

Permeability is moderately rapid in the subsoil of the Chetek soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil and in the substratum.

Permeability is rapid in the Mahtomedi soil. The available water capacity is low. Natural fertility also is low. The organic matter content is very low or low in the surface layer. The rooting depth of most crops is limited by droughtiness in the sandy subsoil and in the substratum.

Most areas are used as pasture. A few are used as cropland or woodland. A few have been planted to pine. Because of severe or very severe hazards of erosion, drought, and soil blowing, these soils generally are not suited to cultivated crops. They are poorly suited to pasture. A cover of pasture plants is effective in controlling erosion and soil blowing, but forage yields generally are low because of the low available water capacity. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

These soils are suited to trees. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the slope and a poor filtering capacity, these soils are poorly suited to septic tank absorption fields. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in the included areas where the slope is less than 12 percent. The soils readily absorb the effluent from septic tanks. They do not adequately filter the effluent, however, because of the rapid or very rapid permeability. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, these soils are poorly suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the

dwelling so that one side of the basement fronts on the lower part of the slope. Also, the dwelling can be built in the included areas where the slope is less than 12 percent.

Because of the slope, these soils are poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is VIe. The woodland ordination symbol is 6R.

CkE—Chetek-Mahtomedi complex, 25 to 40 percent slopes. These deep, steep and very steep soils are on terrace escarpments. The Chetek soil is somewhat excessively drained, and the Mahtomedi soil is excessively drained. Individual areas are long and narrow and generally range from 10 to 200 acres in size. They are 40 to 50 percent Chetek soil and 30 to 40 percent Mahtomedi soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, the Chetek soil has a surface layer of very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 14 inches thick. It is dark brown. It is friable sandy loam in the upper part and very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is stratified sand and gravel.

Typically, the Mahtomedi soil has a surface layer of very dark grayish brown loamy sand about 4 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 15 inches thick. It is loose. It is dark brown coarse sand in the upper part and reddish brown coarse sand and gravel in the lower part. The substratum to a depth of about 60 inches is dark brown coarse sand and gravel. In places the slope is less than 25 percent.

Included with these soils in mapping are small areas of the excessively drained Menahga soils. These included soils are in positions on the landscape similar to those of the Chetek and Mahtomedi soils. They are sandy throughout. They make up 10 to 25 percent of the unit.

Permeability is moderately rapid in the subsoil of the Chetek soil and rapid or very rapid in the substratum. The available water capacity is low The organic matter content is moderately low or moderate in the surface layer.

Permeability is rapid in the Mahtomedi soil. The available water capacity is low. Natural fertility also is low. The organic matter content is very low or low in the surface layer.

These soils are not suited to cultivated crops or pasture because of very severe hazards of erosion, drought, and soil blowing.

Most areas are wooded. These soils are suited to trees. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

These soils generally are not suitable as sites for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the slope. Overcoming this limitation is difficult. A better suited site should be considered.

The land capability classification is VIIe. The woodland ordination symbol is 6R.

Cm—Comstock silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slightly concave foot slopes and along drainageways on glacial lake plains. Individual areas are irregular in shape and generally range from 10 to 120 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown, mottled silt loam about 4 inches thick. The subsoil is mostly brown, dark yellowish brown, and yellowish brown, mottled, firm silt loam about 36 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. In places the slope is more than 2 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Almena, poorly drained and very poorly drained Barronett, and moderately well drained Crystal Lake soils. Almena soils are in positions on the landscape similar to those of the Comstock soil. They are underlain by gravelly sandy loam till. Barronett soils are in the lower positions on the landscape. Crystal Lake soils are in the slightly higher positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Comstock soil and moderately slow in the substratum. The available water capacity is very high The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Land smoothing, surface drains, diversions, interceptor subsurface drains, and grassed waterways help to remove excess water. If tile drains are installed, silt and the finer sand enter the tile lines unless a suitable filter is used to cover the tile. Applying a system of conservation tillage and returning

crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of small-seeded crops. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing the foundation on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or base material.

The land capability classification is IIw. The woodland ordination symbol is 3W.

CuA—Crystal Lake silt loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in plane and slightly convex areas on glacial lake plains. Individual areas are irregular in shape and generally range from 20 to 120 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly grayish brown silt loam about 16 inches thick. The subsoil is dark brown, mottled, friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the slope is more than 3 percent.

Included with this soil in mapping are small areas of the well drained Campia and somewhat poorly drained Comstock soils. Campia soils are in the higher positions on the landscape. Comstock soils are in the lower positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Crystal Lake soil and moderately slow in the substratum. The available water capacity is very high. The organic matter content is moderate in the surface layer. This layer is friable but tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. A few are used as pasture or woodland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage, returning crop residue to the soil, and adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the shrink-swell potential, this soil is only moderately suited to dwellings without basements. This limitation can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel; by strengthening the basement walls; and by installing a subsurface drainage system at or below the basement elevation. The wetness is a limitation on sites for dwellings with basements. It can be overcome by

constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is I. The woodland ordination symbol is 3A.

ElB—Eleva sandy loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained and somewhat excessively drained soil is on slightly convex foot slopes and on the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is dark yellowish brown sandy loam about 5 inches thick. The subsoil is yellowish brown and dark brown, friable sandy loam about 23 inches thick. The substratum is pale brown sand about 3 inches thick. Poorly cemented sandstone is at a depth of about 39 inches. In places the slope is more than 6 percent.

Included with this soil in mapping are small areas of the well drained Billett and Elkmound soils. Billett soils are underlain by sand. They are in the slightly lower positions on the landscape. Elkmound soils are shallow over sandstone. They are in the higher positions on the landscape. Included soils make up 2 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Eleva soil and moderately rapid or rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by the droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland or pasture. A few are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, soil blowing is a hazard. Contour farming, contour stripcropping, grassed waterways, field windbreaks, and conservation tillage help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees. The trees grow so slowly and are so poorly shaped that they seldom attain more than minimum merchantability. The soil-related management problems are minor.

Because of the depth to bedrock and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the depth to bedrock. This limitation can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIs. The woodland ordination symbol is 2A.

ElC2—Eleva sandy loam, 6 to 12 percent slopes, eroded. This moderately deep, sloping, well drained and somewhat excessively drained soil is on side slopes in the uplands Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 27 inches thick. It is friable. It is dark yellowish brown loam in the upper part and yellowish brown sandy loam in the lower part. The substratum is yellowish brown sand about 4 inches thick. Poorly cemented sandstone is at a depth of about 40 inches. In places the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Elkmound and excessively drained Plainbo soils. Elkmound soils are shallow over sandstone. They are in the higher positions on the landscape. Plainbo soils formed in sandy deposits over sandstone. They are in the lower positions on the

landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Eleva soil and moderately rapid or rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland or pasture. A few are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, soil blowing is a hazard. Contour farming, contour stripcropping, and conservation tillage help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees. The trees grow so slowly and are so poorly shaped that they seldom attain more than minimum merchantability. The soil-related management problems are minor.

Because of the depth to bedrock and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwelling so that one side of the basement fronts on the lower part of the slope. Also, the dwelling can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 2A.

EID2—Eleva sandy loam, 12 to 20 percent slopes, eroded. This moderately deep, moderately steep, well drained and somewhat excessively drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer Typically, the remaining surface layer is dark brown sandy loam about 5 inches thick. The subsoil is about 19 inches thick. It is dark brown. It is friable sandy loam in the upper part and very friable loamy sand in the lower part. The substratum is yellowish brown sand about 14 inches thick. Poorly cemented sandstone is at a depth of about 38 inches. In places, the soil is severely eroded and the dark brown subsoil is exposed. In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the well drained Elkmound and excessively drained Plainbo soils. Elkmound soils are shallow over sandstone. They are in the higher positions on the landscape. Plainbo soils formed in sandy deposits over sandstone. They are in the lower positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Eleva soil and moderately rapid or rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy lower layers or by the underlying sandstone.

Most areas are used as cropland or pasture. A few are wooded. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a severe hazard. Also, soil blowing is a hazard. Contour farming, contour stripcropping, crop rotations that include grasses and legumes, and conservation tillage help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that

improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees. The trees grow so slowly and are so poorly shaped that they seldom attain more than minimum merchantability. The erosion hazard and the equipment limitation are management concerns. Planting trees on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock.

Because of the depth to bedrock, the slope, and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent The poor filtering capacity can result in the pollution of ground water. The depth to bedrock and the poor filtering capacity can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is poorly suited to dwellings This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 2R.

EmB—Elkmound loam, 2 to 6 percent slopes. This shallow, gently sloping, well drained soil is on foot slopes and the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 5 to 30 acres in size.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 11 inches thick. It is friable. It is dark brown fine sandy loam in the upper part and dark yellowish brown sandy loam in the lower part. Poorly cemented sandstone is at a depth of about 19 inches. In places the surface layer is sandy loam.

Included with this soil in mapping are small areas of the well drained and somewhat excessively drained Eleva soils. These soils are in positions on the landscape similar to those of the Elkmound soil. They are deeper to sandstone than the Elkmound soil. They make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the Elkmound soil. The available water capacity is low. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by the underlying sandstone.

Most areas are used as cropland. A few are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways, field windbreaks, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees. The trees grow slowly and are poorly shaped. Seedling mortality and windthrow are management concerns. Harvesting equipment can be used, but the soil is too shallow for machine planting. Selecting vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees.

Because of the shallow depth to bedrock, this soil generally is not suited to septic tank absorption fields, is only moderately suited to dwellings without basements, and is poorly suited to dwellings with basements. On sites for dwellings, this limitation can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the depth to bedrock and the potential for frost action, this soil is only moderately suited to local roads and streets The bedrock can be removed by blasting or by using suitable power equipment. The potential for frost action can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel.

The land capability classification is IIIe. The woodland ordination symbol is 2D

EmC2—Elkmound loam, 6 to 12 percent slopes, eroded. This shallow, sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown loam about 8 inches thick. The subsoil is yellowish brown, friable sandy loam about 9 inches thick. Partially weathered, platy sandstone is at a depth of about 17 inches. In places the surface layer is

sandy loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained and somewhat excessively drained Eleva and excessively drained Plainbo soils. Eleva soils are in positions on the landscape similar to those of the Elkmound soil. They are deeper to sandstone than the Elkmound soil. Plainbo soils formed in sandy deposits over sandstone. They are in the lower positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the Elkmound soil. The available water capacity is low. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by the underlying sandstone.

Most areas are used as cropland. A few are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees. The trees grow slowly and are poorly shaped. Seedling mortality and windthrow are management concerns. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees.

Because of the shallow depth to bedrock, this soil generally is not suited to septic tank absorption fields and is poorly suited to dwellings with basements. Because of the slope and the depth to bedrock, it is only moderately suited to dwellings without basements. On sites for dwellings, the slope can be overcome by cutting and filling or by installing retaining walls. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock can be overcome by excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with partially exposed basements.

Because of the depth to bedrock, the slope, and the potential for frost action, this soil is only moderately suited to local roads and streets. The bedrock can be removed by blasting or by using suitable power equipment. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IVe. The woodland ordination symbol is 2D.

EmD2—Elkmound loam, 12 to 20 percent slopes, eroded. This shallow, moderately steep, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 150 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown loam about 7 inches thick. The subsoil is about 12 inches thick. It is yellowish brown and dark yellowish brown, friable sandy loam in the upper part and yellowish brown, very friable loamy fine sand in the lower part. Partially weathered, platy sandstone is at a depth of about 19 inches. In places the surface layer is sandy loam In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the excessively drained Boone and well drained and somewhat excessively drained Eleva soils. Boone soils formed in sandy deposits over sandstone. They are in the lower positions on the landscape. Eleva soils are in positions similar to those of the Elkmound soil. They are deeper to sandstone than the Elkmound soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the Elkmound soil. The available water capacity is low. The organic matter content is moderately low in the surface layer. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil or by the underlying sandstone.

Most areas are used as pasture or woodland. This soil is generally not suited to cultivated crops because of a severe hazard of water erosion. A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is poorly suited to trees. The trees grow slowly and are poorly shaped. The erosion hazard, the equipment limitation, seedling mortality, and the windthrow hazard are management concerns. The use of

equipment is limited by shallow depth to bedrock and the slope. Hand planting, contour planting, and careful selection of sites for access roads help to offset trafficability problems and help to control erosion. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees.

Because of the shallow depth to bedrock and the slope, this soil generally is not suited to septic tank absorption fields. Because of the slope, it is poorly suited to dwellings. On sites for dwellings, the slope can be overcome by cutting and filling, by installing retaining walls, or by designing the dwelling so that one side of the basement fronts on the lower part of the slope. Also, the dwelling can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is VIe. The woodland ordination symbol is 2R.

EmE—Elkmound loam, 20 to 45 percent slopes. This shallow, steep and very steep, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is black loam about 2 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is about 10 inches thick. It is dark yellowish brown and friable. It is loam in the upper part and sandy loam in the lower part. Partially weathered, platy sandstone is at a depth of about 16 inches. In places the surface layer is sandy loam. In some areas the slope is less than 20 percent.

Included with this soil in mapping are small areas of the excessively drained Boone and well drained and somewhat excessively drained Eleva soils. Boone soils formed in sandy deposits over sandstone. They are in the lower positions on the landscape. Eleva soils are in positions similar to those of the Elkmound soil. They are deeper to sandstone than the Elkmound soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the Elkmound soil. The available water capacity is low. The organic matter content is moderately low in the surface layer. The rooting depth of most plants is limited by the underlying sandstone.

Most areas are wooded Because of a severe or very severe hazard of water erosion, this soil is not suited to cultivated crops. It is poorly suited to pasture because of the hazard of erosion and the difficulty in operating machinery on these steep and very steep slopes. In some of the less sloping areas, the pasture can be renovated and improved. The native vegetation generally is of poor quality for forage

This soil is poorly suited to trees. The trees grow slowly and are poorly shaped. The erosion hazard, the equipment limitation, seedling mortality, and windthrow are management concerns. The use of equipment is limited by the shallow depth to bedrock and the slope. Hand planting, contour planting, and careful selection of sites for access roads help to offset trafficability problems and help to control erosion. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the depth to bedrock and the slope. Overcoming these limitations is difficult. A better suited site should be considered.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

Eo—Elm Lake loamy sand, 0 to 2 percent slopes. This moderately deep or deep, nearly level, poorly drained soil is in drainageways and depressions on uplands. It is subject to ponding. Individual areas are elongated and generally range from 5 to 150 acres in size.

Typically, the surface layer is black loamy sand about 4 inches thick. The substratum is about 44 inches thick. It is grayish brown, light brownish gray, and pale brown loamy sand and sand in the upper part and gray and olive gray, mottled silty clay loam in the lower part. Poorly cemented sandstone interbedded with shale is at a depth of about 48 inches. In places the surface layer is mucky loamy sand or sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Merrillan and poorly drained and very poorly drained Newson soils. Merrillan soils have a loamy surface soil and subsoil. They are in the slightly higher positions on the landscape. Newson soils are sandy throughout. They are in positions on the landscape similar to those of the Elm Lake soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the sandy mantle of the Elm Lake soil and very slow in the underlying silty or loamy residuum. The available water capacity is low. The organic matter content is moderately low in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas of this soil are used as unimproved pasture or as woodland. Some are used as wetland wildlife habitat. Undrained areas generally are not suited to cultivated crops because of the wetness and the frost hazard. Drained areas are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The number of frost-free days per growing season is limited. Planting early maturing corn varieties or growing the corn for silage helps to overcome the frost hazard.

Unless drained, this soil is poorly suited to pasture. Establishing an improved pasture is difficult because of the wetness. Grazing is limited to the short periods when the soil is dry. The native vegetation generally is of poor quality for forage.

This soil is poorly suited to trees. The trees grow so slowly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the depth to bedrock and the ponding. Overcoming these limitations is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 3W.

FaB—Fallcreek sandy loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on slightly convex side slopes and knolls on ground moraines. Individual areas are irregularly shaped or elongated and generally range from 10 to 30 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mostly brown, mottled sandy loam about 12 inches thick. The subsoil is mostly reddish brown, mottled, firm loam about 20 inches thick. The substratum to a depth of about 60 inches is reddish brown loam. In places cobbles and stones cover as much as 20 percent of the surface.

Included with this soil in mapping are small areas of the moderately well drained Flambeau and poorly drained and very poorly drained Cable soils. Flambeau soils are in the slightly higher positions on the landscape. Cable soils have a silty surface layer and subsoil. They are in the lower positions on the landscape. Included soils make up 2 to 10 percent of the unit.

Permeability is moderately slow in the Fallcreek soil. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing. Terraces, contour farming, contour stripcropping, grassed waterways, and diversions help to remove excess water and help to control erosion and soil blowing. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

A cover of pasture plants is effective in controlling erosion and soil blowing. Alfalfa is generally short lived unless the soil is adequately drained. Overgrazing or grazing when the soil is wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains

around the foundations and providing gravity outlets or other dependable outlets.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 4W.

FbB—Flambeau loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on side slopes and knolls on ground moraines. Individual areas are irregular in shape and generally range from 5 to 75 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is about 9 inches of brown loam and brown, mottled sandy loam The subsoil is about 19 inches thick. It is reddish brown, mottled, and firm. It is loam in the upper part and sandy clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown loam. In some places the surface layer is sandy loam. In other places about 25 percent of the surface is covered with cobbles. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Fallcreek and Withee soils. Fallcreek soils have a sandy loam surface layer. They are in the lower positions on the landscape. Withee soils formed in silty deposits and in loam till. They are in the slightly lower positions on the landscape. Included soils make up 2 to 5 percent of the unit.

Permeability is moderate in the subsoil of the Flambeau soil and moderately slow in the substratum The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 3.5 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is only moderately suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse base material, such as sand or gravel, and by increasing the thickness of the pavement or the base or subbase material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIe The woodland ordination symbol is 4A.

FbC2—Flambeau loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on knolls and side slopes adjacent to drainageways on ground moraines. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is grayish brown loam about 8 inches thick. The subsurface layer is brown loam about 7 inches thick. The subsoil is reddish brown, mottled, firm loam about 17 inches thick. The substratum to a depth of about 60 inches is reddish brown loam. In a few places the surface layer is sandy loam In some areas about 20 percent of the surface is covered with cobbles. In other areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Arland soils. These soils are in positions on the landscape similar to those of the Flambeau soil. They are underlain by sandstone. They make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Flambeau soil and moderately slow in the substratum. The available water capacity is high. The organic matter

content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 3.5 feet.

Most areas are used as cropland. A few are used as pasture or woodland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, diversions, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. Wetness is a limitation on sites for dwellings with basements. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength, the slope, and the potential for frost action, this soil is only moderately suited to local roads and streets. Low strength and frost action can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or base material. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

Fm—Fordum loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in plane or slightly concave areas on flood plains. It is subject to ponding and is frequently flooded for long periods. Individual areas are long and narrow and generally range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, mottled loam about 9 inches thick. The upper 12 inches of the substratum is grayish brown, mottled sandy loam. The next 11 inches is brown, mottled loamy sand. The lower part to a depth of about 60 inches is pale brown sand. In places the surface layer is silt loam. In some areas layers of organic material are in the substratum.

Included with this soil in mapping are small areas of the very poorly drained Markey and poorly drained and very poorly drained Newson soils. Markey soils formed in organic material in depressions. Newson soils are in positions on the landscape similar to those of the Fordum soil. They are sandy throughout. Also included are areas of Rib mucky silt loam, ponded, 0 to 2 percent slopes. This soil is in positions on the landscape similar to those of the Fordum soil. It formed in silty deposits over stratified sand and gravel. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the loamy mantle of the Fordum soil and rapid or very rapid in the sandy substratum. The available water capacity is moderate. The organic matter content is high or very high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. Because of the wetness, a scarcity of suitable drainage outlets, and the flooding, this soil generally is not suited to cultivated crops. It is poorly suited to pasture unless it is drained and protected from flooding. Establishing or maintaining improved pasture is difficult because of the wetness. Grazing is limited to the short periods when the soil is dry. The native vegetation is generally of poor quality for forage.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical

removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is Vlw. The woodland ordination symbol is 2W.

FnB—Freeon silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on side slopes and knolls on ground moraines. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown, mottled silt loam about 11 inches thick. The subsoil is about 19 inches thick. It is mottled and firm. The upper part is dark brown silt loam, the next part is reddish brown loam, and the lower part is reddish brown sandy loam. The substratum to a depth of about 60 inches is reddish brown sandy loam. In some places the surface layer is loam or sandy loam. In other places cobbles are on the surface. In some areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Magnor and well drained Santiago soils. Magnor soils are in the slightly lower positions in the landscape. Santiago soils are in the slightly higher positions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the subsoil of the Freeon soil and moderately slow in the substratum. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2 to 3 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, diversions, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of the wetness and the potential for frost action, this soil is only moderately suited to local roads and streets. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is IIe. The woodland ordination symbol is 4A.

FnC2—Freeon silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on side slopes and knolls on ground moraines and end moraines. Individual areas are irregular in shape and generally range from 5 to 30 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is mostly brown, mottled silt loam about 11 inches thick. The subsoil is about 20 inches thick. It is mottled. The upper part is brown, friable silt loam; the next part is reddish brown, firm loam; and the lower part is reddish brown, firm sandy loam. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places the surface layer is loam or sandy loam. In some areas cobbles are on the surface.

Included with this soil in mapping are small areas of the well drained Amery and Santiago soils. Amery soils formed in loamy deposits. Both of the included soils are in the higher positions on the landscape. They make up 10 to 15 percent of the unit.

Permeability is moderately slow or moderate in the subsoil of the Freeon soil and moderately slow in the substratum. The available water capacity is high. The

organic matter content is moderately low or moderate in the surface layer. This layer is friable and can easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2 to 3 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, diversions, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness and the slope, this soil is only moderately suited to dwellings without basements. Because of the wetness, it is poorly suited to dwellings with basements. The wetness can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness. The slope can be overcome by cutting and filling or by installing retaining walls.

Because of the wetness, the slope, and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

FrA—Friendship loamy sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in plane areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is sand about 28 inches thick. It is dark brown and very friable in the upper part and is brown, mottled, and loose in the lower part. The substratum to a depth of about 60 inches is strong brown and light yellowish brown, mottled sand. In places the surface layer is sand, loamy fine sand, or fine sandy loam. In some areas loamy strata are in the subsoil and substratum.

Included with this soil in mapping are small areas of the somewhat poorly drained Meehan, excessively drained Menahga, and moderately well drained Moundville soils. Meehan soils are in the slightly lower positions on the landscape. Menahga soils are in positions similar to those of the Friendship soil or are in the slightly higher positions. Moundville soils are in positions similar to those of the Friendship soil. They have slightly more clay in the upper part of the subsoil than the Friendship soil. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Friendship soil. The available water capacity is low. Natural fertility also is low. The organic matter content is low or moderately low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy subsoil and substratum unless water is available from the seasonal high water table. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. Some have been planted to pine. A few support native trees. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If irrigated, however, it is suited to the commonly grown farm crops and to vegetables, such as snap beans, potatoes, sweet corn, and peas. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, the soil is subject to soil blowing. Winter cover crops, conservation tillage, wind stripcropping, and field windbreaks help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material reduces the amount of water lost through evaporation, increases the rate of water infiltration, helps to maintain fertility, and reduces the susceptibility to soil blowing.

A cover of pasture plants is effective in controlling soil blowing. Forage yields are generally low unless fertilizer is applied and the soil receives an adequate amount of moisture. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor

survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality is a management concern. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to local roads and streets and to dwellings without basements Because of the wetness, however, it is only moderately suited to dwellings with basements. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

The land capability classification is IVs. The woodland ordination symbol is 6S.

GaB—Gale silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes and ridgetops in the uplands. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 21 inches thick. It is friable. It is dark yellowish brown and dark brown silt loam in the upper part and dark yellowish brown loam in the lower part. The substratum is strong brown sand about 10 inches thick. Platy sandstone is at a depth of about 44 inches. In places the surface layer is loam. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the moderately well drained Hiles and well drained Northfield and Seaton soils. Hiles soils are underlain by sandstone and shale. They are in the lower positions on the landscape. Northfield and Seaton soils are in positions similar to those of the Gale soil. Northfield soils are shallow over sandstone. Seaton soils are underlain by silt loam or sand. Included soils make up 2 to 5 percent of the unit.

Permeability is moderate in the upper part of the Gale soil and rapid in the sandy residuum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the shrink-swell potential, this soil is only moderately suited to dwellings. This limitation can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel; by strengthening the basement walls; and by installing a subsurface drainage system at or below the basement elevation. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the

upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or the base or subbase material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 5A.

GaC2—Gale silt loam, 6 to 12 percent slopes, eroded. This moderately deep, sloping, well drained soil is on side slopes and ridgetops in the uplands. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 24 inches thick. It is friable. It is dark brown and dark yellowish brown silt loam in the upper part and yellowish brown loamy fine sand in the lower part. Sandstone is at a depth of about 36 inches. In places the surface layer is loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Northfield and Seaton soils. Northfield soils are shallow over sandstone. They are in the slightly higher positions on the landscape. Seaton soils are in positions similar to those of the Gale soil. They are underlain by silt loam or sand. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Gale soil and rapid in the sandy residuum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy residuum or by the underlying sandstone.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the shrink-swell potential and the slope, this soil is only moderately suited to dwellings. The shrink-swell potential can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel, under and around the foundation. The slope can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site, or by constructing the dwellings with only partially exposed basements.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

GaD2—Gale silt loam, 12 to 20 percent slopes, eroded. This moderately deep, moderately steep, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 24 inches thick. It is friable. It is dark yellowish brown and dark brown silt loam in the upper part and dark yellowish brown, friable loam in the lower part. The substratum is strong brown sand about 4

inches thick. Sandstone bedrock is at a depth of about 34 inches. In places the surface layer is loam. In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the well drained Northfield and Seaton soils. Northfield soils are shallow over sandstone. They are in the slightly higher positions on the landscape. Seaton soils are in positions similar to those of the Gale soil. They are underlain by silt loam. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Gale soil and rapid in the sandy residuum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland or pasture. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled by contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition

This soil is suited to trees. The erosion hazard and the equipment limitation are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration

Because of the depth to bedrock, the slope, and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The depth to bedrock and the poor filtering capacity can be overcome by mounding the site with suitable filtering material. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is poorly suited to dwellings. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of the low strength, the slope, and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength and frost action can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 5R.

Gr—Greenwood peat, 0 to 1 percent slopes. This deep, nearly level, very poorly drained soil is in depressions on ground moraines and end moraines. It is subject to ponding. Individual areas are irregular in shape and generally range from 10 to 200 acres in size.

Typically, the organic material is at least 60 inches thick. The upper part is light gray sphagnum moss, the next part is dark brown and very dark grayish brown mucky peat, and the lower part is very dark brown muck.

Included with this soil in mapping are small areas of the very poorly drained Lupton soils. These soils are in positions on the landscape similar to those of the Greenwood soil. They typically are neutral in reaction. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the Greenwood soil. The available water capacity is very high. The organic matter content also is very high. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. Because of the wetness, a scarcity of suitable drainage outlets, the hazard of frost late in spring and early in fall, and an extremely acid reaction, this soil is generally not suited to cultivated crops or to pasture. If drained and cultivated, it is subject to burning and subsidence. It also is subject to soil blowing.

This soil is poorly suited to trees. The trees grow so poorly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be

controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is VIIw in undrained areas. The woodland ordination symbol is 3W.

Ha—Halder loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in slightly concave areas on stream terraces and outwash plains. Individual areas are elongated and generally range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is grayish brown, mottled loam about 4 inches thick. The subsoil is about 20 inches thick. It is mostly dark brown, mottled, friable loam in the upper part and dark brown, mottled, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown and brown, stratified sand and gravel. In places the surface layer is sandy loam or silt loam. In some areas the slope is more than 2 percent.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils are in the slightly higher positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Halder soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1.0 to 2.5 feet in undrained areas.

Most areas are used as cropland. A few are wooded. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration. Land smoothing, a surface drainage system, diversions, and interceptor subsurface drains help to remove excess water. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile.

This soil is suited to pasture. Alfalfa is generally short lived unless the soil is adequately drained. Overgrazing or grazing when the soil is wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 4W.

HeB—Hiles silt loam, 2 to 6 percent slopes. This moderately deep or deep, gently sloping, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 19 inches thick. The upper part is mostly yellowish brown, friable silt loam; the next part is olive, mottled, firm silty clay loam; and the lower part is light olive gray, mottled, friable loam. Weathered sandstone that has strata of shale is at a depth of about 30 inches. In places the surface layer is loam.

Included with this soil in mapping are small areas of the moderately well drained Hiles Variant, moderately well drained Humbird, and somewhat poorly drained Kert soils. Hiles Variant and Humbird soils are in positions on the landscape similar to those of the Hiles soil. Hiles Variant soils typically have a clayey subsoil. Humbird

soils are sandy loam in the surface layer and in the upper part of the subsoil. Kert soils are in the lower positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Hiles soil. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is very friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by extreme acidity in the lower part of the subsoil or by the underlying sandstone and shale. The depth to the seasonal high water table ranges from 2 to 4 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Alfalfa is generally short lived unless the soil is adequately drained. Overgrazing or grazing when the soil is wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the wetness, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 4A.

HfB—Hiles Variant loam, 2 to 8 percent slopes. This deep, gently sloping and sloping, moderately well drained soil is on side slopes and ridgetops in the uplands. Individual areas are irregular in shape and generally range from 5 to 15 acres in size

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsurface layer is mostly brown loam about 6 inches thick. The subsoil is dusky red, mottled, firm clay about 26 inches thick. The substratum is pale olive and pale yellow loam about 8 inches thick. Sandstone and shale are at a depth of about 48 inches. In places the surface layer is silt loam In some areas the slope is more than 8 percent.

Included with this soil in mapping are small areas of the moderately well drained Hiles and somewhat poorly drained Kert soils. These soils have a silty and loamy subsoil. Hiles soils are in the slightly higher positions on the landscape Kert soils are in the lower positions. Included soils make up 1 to 5 percent of the unit.

Permeability is very slow in the subsoil of the Hiles Variant soil and moderate in the substratum. The available water capacity is moderate The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by the extreme acidity and clayey nature of the subsoil and by the underlying sandstone and shale. The depth to the seasonal high water table ranges from 2.5 to 3.5 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, diversions, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality and the windthrow hazard are management concerns. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with

natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the slow permeability in the subsoil, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the shrink-swell potential, this soil is poorly suited to dwellings. This limitation can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel, under and around the foundation; by strengthening basement walls; and by installing a subsurface drainage system at or below the basement elevation.

Because of the shrink-swell potential and low strength, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or base material.

The land capability classification is IIe. The woodland ordination symbol is 4C.

HnB—Hixton loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on foot slopes and side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 18 inches thick. It is friable. It is dark brown and dark yellowish brown loam in the upper part and dark yellowish brown sandy loam in the lower part. The substratum is light yellowish brown sand about 12 inches thick. Poorly cemented sandstone is at a depth of about 38 inches.

Included with this soil in mapping are small areas of the well drained Northfield soils. These soils are in positions on the landscape similar to those of the Hixton soil. They are shallow over sandstone bedrock. Also included are a few small areas of soils that have a seasonal high water table at a depth of 3 to 5 feet. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Hixton soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the depth to bedrock. This limitation can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 4A.

HnC2—Hixton loam, 6 to 12 percent slopes, eroded. This moderately deep, sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 4 inches thick. The subsoil is about 13 inches thick. It is friable. It is dark yellowish brown loam in the

upper part and brown sandy loam in the lower part. The substratum is brown and strong brown loamy sand about 10 inches thick. Poorly cemented sandstone is at a depth of about 34 inches. In places the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained and somewhat excessively drained Eleva and well drained Northfield soils. Eleva soils have less clay in the subsoil than the Hixton soil. Northfield soils are shallow over sandstone. Both of the included soils are in positions on the landscape similar to those of the Hixton soil. They make up 10 to 15 percent of the unit.

Permeability is moderate in the subsoil of the Hixton soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum or by the underlying sandstone.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the rapid permeability in the substratum, this soil is poorly suited to septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

HuB—Humbird sandy loam, 2 to 6 percent slopes. This moderately deep, gently sloping, moderately well drained soil is on side slopes and the tops of low ridges in the uplands. Individual areas are irregular in shape and generally range from 5 to 45 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 28 inches thick. In sequence downward, it is dark brown, friable sandy loam; brown, mottled, very friable loamy sand; yellowish brown, mottled, friable loam, and light olive gray, mottled, firm silty clay loam. Weathered sandstone interbedded with shale is at a depth of about 36 inches. In places the surface layer is loamy sand. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Merrillan soils. These soils are in the lower positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the subsoil in the Humbird soil and slow in the lower part. The available water capacity is low. The organic matter content is moderately low in the surface layer This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by the extreme acidity and massive nature of the lower part of the subsoil or by the underlying sandstone and shale. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. Some are wooded. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing. Contour farming, contour stripcropping, conservation tillage, and grassed waterways help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of

water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, the wetness, and the slow permeability in the subsoil, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness and the depth to bedrock. The wetness can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. The depth to bedrock can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

HuC2—Humbird sandy loam, 6 to 12 percent slopes, eroded. This moderately deep, sloping, moderately well drained soil is on side slopes and the tops of low ridges in the uplands. Individual areas are irregular in shape and generally are 3 to 10 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsoil is about 24 inches thick. The upper part is dark brown, friable sandy loam; the next part is brown and dark brown, mottled, friable sandy loam; and the lower part is light brownish gray, firm silty clay. Weathered sandstone is at a depth of about 31 inches. In places the surface layer is loamy sand.

Included with this soil in mapping are small areas of the well drained Elkmound soils. These soils are shallow over sandstone. They are in the slightly higher positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the subsoil in the Humbird soil and slow in the lower part. The available water capacity is low. The organic matter content is moderately low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by the extreme acidity and massive nature of the lower part of the subsoil or by the underlying sandstone. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Contour farming, contour stripcropping, and conservation tillage help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, the wetness, and the slow permeability in the subsoil, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The wetness and

the depth to bedrock are limitations on sites for dwellings with basements. The wetness can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets. The depth to bedrock can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IVe. The woodland ordination symbol is 4A.

KeB—Kert silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is on foot slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 80 acres in size

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown and grayish brown, mottled silt loam about 14 inches thick. The subsoil is about 18 inches thick. It is mottled and friable. It is pale olive loam in the upper part and dark brown sandy loam in the lower part. The upper part of the substratum is olive yellow and pale yellow, stratified sand and silt. The lower part to a depth of about 60 inches is reddish yellow loam. In places the surface layer is loam.

Included with this soil in mapping are small areas of the moderately well drained Hiles, somewhat poorly drained Merrillan, and poorly drained Vesper soils. Hiles soils are in the slightly higher positions on the landscape. Merrillan soils are in positions similar to those of the Kert soil. They have less clay in the subsoil than the Kert soil and are underlain by interbedded sandstone and shale. Vesper soils are in drainageways. Also included are areas of soils that are underlain by sandstone at a depth of 40 to 60 inches. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the silty mantle of the Kert soil and slow in the subsoil and substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture or woodland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Land smoothing, surface drains, diversions, and interceptor subsurface drains help to remove excess water. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion (fig. 6). The surface layer is subject to crusting, which restricts the emergence of the plants. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the slow permeability, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

Figure 6.—A pastured area of Kert silt loam, 1 to 6 percent slopes.

The land capability classification is IIe. The woodland ordination symbol is 4W.

La—Lows loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is in plane or slightly concave areas in drainageways on stream terraces and valley fills. It is subject to ponding. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsurface layer is gray, mottled loam about 7 inches thick. The subsoil is about 23 inches thick. It is mottled and friable. The upper part is gray loam and silt loam, and the lower part is light brownish gray sandy loam. The substratum to a depth of about 60 inches is gray sand. In places the surface layer is sandy loam or silt loam. In some areas the substratum has loamy strata.

Included with this soil in mapping are small areas of the somewhat poorly drained Shiffer soils. These soils are in the slightly higher positions on the landscape. They make up 2 to 5 percent of the unit.

Permeability is moderate in the subsoil of the Lows soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate or high in the surface layer. This layer is friable but tends to crust or puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas are used as cropland. A few are used as pasture or woodland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Land smoothing, surface drains, interceptor subsurface drains, and grassed waterways help to remove excess water. If tile drains are installed, silt and the finer sand enter the tile lines unless a suitable filter is used to cover the tile Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Alfalfa is generally short lived unless the soil is adequately drained and protected from ponding. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is IIw in drained areas. The woodland ordination symbol is 2W.

LoB—Loyal silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on side slopes and knolls on ground moraines. Individual areas are irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown and pale brown silt loam about 8 inches thick. The subsoil is about 28 inches thick. It is mostly brown, mottled, friable silt loam in the upper part and reddish brown, mottled, firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled loam. In places cobbles are on the surface. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Withee soils. These soils are in the slightly lower positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Loyal soil. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by diversions, contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by mounding the site with suitable filtering material. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around the foundation and providing gravity outlets or other dependable outlets and by constructing the foundation on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. This limitation can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel.

The land capability classification is IIe. The woodland ordination symbol is 3A

LoC2—Loyal silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on side slopes on ground moraines. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown silt loam about 7 inches thick. The subsoil is about 29 inches thick. It is mostly dark brown and dark yellowish brown, mottled, friable silt loam in the upper part and reddish brown, mottled, firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown loam. In places cobbles are on the surface. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the moderately well drained Hiles soils. These soils are in positions on the landscape similar to those of the Loyal soil They formed in silty deposits and in material weathered from stratified sandstone and shale. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Loyal soil. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by diversions, grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields This limitation can be overcome by mounding the site with suitable filtering material. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The wetness is a limitation on sites for dwellings with basements. It can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

Lp—Lupton muck, 0 to 1 percent slopes. This deep, nearly level, very poorly drained soil is in depressions on ground moraines, outwash plains, and glacial lake plains. It is subject to ponding. Individual areas are irregular in shape and generally range from 10 to 160 acres in size.

Typically, the organic material is dark brown and very dark brown muck at least 60 inches thick. In places a thin layer of peat or sphagnum moss is at the surface.

Permeability is moderately rapid. The available water capacity is very high. The organic matter content also is very high. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. Because of the wetness, a scarcity of suitable drainage outlets, and the hazard of frost late in spring and early in fall, this soil is generally not suited to cultivated crops or to pasture. If drained and cultivated, it is subject to burning and subsidence. Also, it is subject to soil blowing.

This soil is poorly suited to trees. The trees grow so slowly poorly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 3W.

MbB—Magnor silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is on side slopes and in drainageways on ground moraines. Individual areas are irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly grayish brown, mottled silt loam about 6 inches thick. The subsoil is about 18 inches thick. It is mottled and friable. The upper part is mostly dark brown silt loam, the next part is dark brown sandy loam, and the lower part is reddish brown loam. The substratum to a depth of about 60 inches is reddish brown, mottled sandy loam. In places the surface layer is loam. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Almena and moderately well drained Freeon soils Almena soils are in positions on the landscape similar to those of the Magnor soil. They have a silty mantle that is thicker than that of the Magnor soil. Freeon soils are in the higher positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the silty mantle of the Magnor soil and moderately slow in the lower part of the subsoil and in the substratum. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 0.5 foot to 3.0 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture or woodland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by conservation tillage, winter cover crops, and grassed waterways (fig. 7). Land smoothing, surface drains, and diversions help to remove excess water. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and helps to control erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of the wetness and the potential for frost action, this soil is poorly suited to local roads and

Figure 7.—A grassed waterway and a protective cover of crop residue in an area of Magnor silt loam, 1 to 6 percent slopes.

streets. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is IIe. The woodland ordination symbol is 3W.

McB—Magnor silt loam, 1 to 6 percent slopes, stony. This deep, nearly level and gently sloping, somewhat poorly drained soil is on side slopes and in drainageways on ground moraines. Stones are on the surface. They commonly are 10 to 24 inches in diameter. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. It contains stones. The subsurface layer is grayish brown, mottled silt loam about 7 inches thick. The subsoil is about 21 inches thick. It is mottled and friable. The upper part is mostly brown silt loam, the next part is brown loam, and the lower part is reddish brown sandy loam. The substratum to a depth of about 60 inches also is reddish brown sandy loam. In places the surface layer is loam or sandy loam. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the poorly drained Auburndale and moderately well drained Freeon soils. Auburndale soils have a silty mantle that is thicker than that of the Magnor soil. They are in the lower positions on the landscape. Freeon soils are in the higher positions. Also included are a few small areas of Magnor soils that do not have stones on the surface. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the silty mantle of this Magnor soil and moderately slow in the lower part of the subsoil and in the substratum. The available water capacity is high. The organic matter content is moderate or high in the surface layer. This layer is friable, but tillage is restricted by the stones on and below the surface. The rooting depth of most plants is limited by a seasonal high water table, which is at a depth of 0.5 foot to 3.0 feet in undrained areas.

Most areas are used as unimproved pasture. A few are wooded. This soil generally is unsuitable for cultivated crops because of the surface stones, which interfere with tillage. If the stones are removed, however, the soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion and wetness are management concerns.

This soil is suited to pasture, but the surface stones hinder or prevent the use of the machinery that helps to establish and maintain an improved pasture. The native vegetation generally is of poor quality for forage

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. The use of planting and harvesting equipment is severely limited by the large number of stones on or below the surface and by the wetness. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the slow permeability, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of the wetness and the potential for frost action, this soil is poorly suited to local roads and streets. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is VIs. The woodland ordination symbol is 3X.

MdB—Mahtomedi loamy sand, 2 to 6 percent slopes. This deep, gently sloping, excessively drained soil is in slightly convex areas on outwash plains. Individual areas are irregular in shape and generally range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is about 16 inches thick It is reddish brown and very friable. It is loamy sand in the upper part and gravelly sand in the lower part. The substratum to a depth of about 60 inches is dark brown sand and gravel. In places the lower part of the subsoil is gravelly loamy sand. In some areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are a few small areas of the well drained Rosholt soils. These soils are in positions on the landscape similar to those of the Mahtomedi soil. They have more clay in the surface layer and subsoil than the Mahtomedi soil. They make up 2 to 10 percent of the unit.

Permeability is rapid in the Mahtomedi soil. The available water capacity is low. Natural fertility also is low. The organic matter content is very low or low in the surface layer This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness.

Most areas are used as cropland. Some have been planted to pine. A few support native trees. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If irrigated, however, it is suited to the commonly grown farm crops and to vegetables, such as snap beans, potatoes, sweet corn, and peas In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight hazard. Also, the soil is subject to soil blowing. Winter cover crops, conservation tillage, wind stripcropping, and field windbreaks help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Because of the loose sand, equipment with flotation tires or tracks can be operated more easily than other equipment. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation

interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local roads and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs. The woodland ordination symbol is 6S.

MdC—Mahtomedi loamy sand, 6 to 12 percent slopes. This deep, sloping, excessively drained soil is on convex side slopes and ridges on outwash plains. Individual areas are irregular in shape and generally range from 5 to 25 acres in size.

Typically, the surface layer is black loamy sand about 2 inches thick. The subsoil is about 22 inches thick. It is dark brown. It is very friable loamy sand in the upper part and loose sand in the lower part. The substratum to a depth of about 60 inches is brown sand and gravel. In some areas on knolls and side slopes, the surface layer is gravelly sand. In places the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are a few small areas of the well drained Rosholt soils. These soils are in positions on the landscape similar to those of the Mahtomedi soil. They have more clay in the surface layer and subsoil than the Mahtomedi soil They make up 5 to 15 percent of the unit.

Permeability is rapid in the Mahtomedi soil. The available water capacity is low. Natural fertility also is low. The organic matter content is very low or low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness.

Most areas are wooded. Some have been planted to pine. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Winter cover crops, conservation tillage, and field windbreaks help to control erosion and soil blowing. Most areas have slopes that are too short and irregular to be stripcropped or cultivated on the contour. Returning crop residue to the soil or adding other organic material reduces the hazards of erosion and soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Because of the loose sand, equipment with flotation tires or tracks can be operated more easily than other equipment. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVs. The woodland ordination symbol is 6S.

Me—Markey muck, 0 to 1 percent slopes. This deep, nearly level, very poorly drained soil is in depressions on outwash plains and ground moraines. It is subject to ponding. Individual areas are elongated and generally range from 20 to 120 acres in size.

Typically, the upper 36 inches is dark brown and black muck. The substratum to a depth of about 60 inches is gray sand. In some areas the organic material has strata of peat or mucky peat. In other areas it is less than 16 inches thick.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Fordum and Newson soils and the very poorly drained Lupton soils. Fordum and Newson soils are in the slightly higher areas. Fordum soils are stratified and typically are loamy in the upper part. Newson soils formed in sandy deposits. Lupton soils are in positions on the landscape

similar to those of the Markey soil. They formed in extremely acid organic material. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the organic part of the Markey soil and rapid in the substratum. The available water capacity is very high. The organic matter content also is very high The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. A few have been drained and are used as cropland. Because of the wetness, a scarcity of suitable drainage outlets, and the hazard of frost late in spring and early in fall, this soil is generally not suited to cultivated crops or to pasture. If drained and cultivated, it is subject to burning and subsidence. It also is subject to soil blowing.

This soil is poorly suited to trees. The trees grow so poorly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 4W.

Mh—Meehan loamy sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in shallow depressions on outwash plains. Individual areas are elongated and generally range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is very friable and loose sand about 22 inches thick The upper part is brown, and the lower part is pale brown and light brownish gray and is mottled. The substratum to a depth of about 60 inches is light brownish gray sand. In places it has strata of loamy sand less than 1 inch thick.

Included with this soil in mapping are small areas of the moderately well drained Friendship and poorly drained and very poorly drained Newson soils. Friendship soils are in the slightly higher positions on the landscape. Newson soils are in the lower positions. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Meehan soil. The available water capacity is low. Natural fertility also is low. The organic matter content is low to moderate in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture. If drained, the soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Excess water can be removed by diversions, grassed waterways, surface drains, and drainage tile. If the water table is excessively lowered, however, crop yields in most years are limited by the low available water capacity. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile. In areas that are drained and cultivated, soil blowing is a hazard. It can be controlled by wind stripcropping, field windbreaks, and conservation tillage. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing. Forage yields are generally low unless fertilizer is applied and an adequate amount of moisture is supplied either through a controlled drainage system or through irrigation. Alfalfa is short lived unless the soil is drained. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns Because of the wetness, hand planting or machine planting on prepared ridges is generally needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome

the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the wetness and the potential for frost action, this soil is only moderately suited to local roads and streets. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is IVw. The woodland ordination symbol is 5W.

MkB—Menahga loamy sand, 0 to 6 percent slopes. This deep, nearly level and gently sloping, excessively drained soil is in plane and slightly convex areas on outwash plains. Individual areas are irregular in shape and generally range from 10 to 80 acres in size

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is dark yellowish brown, strong brown, and yellowish brown, very friable and loose sand about 32 inches thick. The substratum to a depth of about 60 inches is brownish yellow sand. In places the surface layer is loamy fine sand or sand. In some areas the substratum is gravelly sand or has loamy or silty strata.

Included with this soil in mapping are small areas of the moderately well drained Friendship and excessively drained Plainbo soils. Friendship soils are in the slightly lower positions on the landscape. Plainbo soils are in the slightly higher positions. They are underlain by sandstone. Included soils make up 2 to 10 percent of the unit.

Permeability is rapid in the Menahga soil The available water capacity is low. Natural fertility also is low. The organic matter content is low or moderately low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness.

Most areas are used as cropland. Some have been planted to pine. A few support native trees. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If irrigated, however, it is suited to the commonly grown farm crops and to vegetables, such as snap beans, potatoes, sweet corn, and peas. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight hazard. Also, the soil is subject to soil blowing. Winter cover crops, conservation tillage, wind stripcropping, and field windbreaks help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Because of the loose sand, equipment with flotation tires or tracks can be operated more easily than other equipment. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local road and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs. The woodland ordination symbol is 6S.

MkC—Menahga loamy sand, 6 to 12 percent slopes. This deep, sloping, excessively drained soil is on side slopes on outwash plains. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 6 inches thick. The subsoil is brown and dark yellowish brown, very friable sand about 34 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand. In places it is sand and gravel or has loamy or silty strata. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the excessively drained Plainbo soils. These soils are underlain by sandstone. They are in the slightly higher positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is rapid in the Menagha soil. The available water capacity is low. Natural fertility also is low. The organic matter content is low or moderately low in the surface layer. This layer is very friable and can be

easily tilled throughout a wide range of moisture content The rooting depth of most crops is limited by droughtiness.

Most areas are wooded Some have been planted to pine. A few are used as cropland. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Winter cover crops, wind stripcropping, conservation tillage, and field windbreaks help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing and water erosion. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns Because of the loose sand, equipment with flotation tires or tracks can be operated more easily than other equipment. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVs. The woodland ordination symbol is 6S.

MIA—Meridian loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in plane areas on stream terraces and valley fills. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 28 inches thick. It is friable. It is brown loam in the upper part and dark yellowish brown sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand.

Included with this soil in mapping are small areas of the well drained Billett and moderately well drained Meridian soils. Billett soils are in positions on the landscape similar to those of this Meridian soil. They have less clay in the surface layer and subsoil than the Meridian soil. The wetter Meridian soils are in the slightly lower positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of this Meridian soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

This soil is only moderately suited to local roads and streets because of the potential for frost action. Replacing the upper part of the soil with coarse textured

base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIs. The woodland ordination symbol is 4A.

MIB—Meridian loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in slightly convex areas on stream terraces and valley fills. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is dark brown and brown, friable loam about 26 inches thick. The substratum to a depth of about 60 inches is yellowish brown sand. In places the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of the well drained Billett and moderately well drained Meridian soils. Billett soils are in positions on the landscape similar to those of this Meridian soil. They have less clay in the surface layer and subsoil than the Meridian soil. The wetter Meridian soils are in the slightly lower positions on the landscape Included soils make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of this Meridian soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

This soil is only moderately suited to local roads and streets because of the potential for frost action. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action

The land capability classification is IIe. The woodland ordination symbol is 4A

MmA—Meridian loam, moderately well drained, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in plane areas on stream terraces and valley fills. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick The subsurface layer is brown loam about 5 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown, mottled, and friable. It is loam in the upper part and sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand.

Included with this soil in mapping are small areas of the well drained Meridian and somewhat poorly drained Shiffer soils. The better drained Meridian soils are in the slightly higher positions on the landscape. Shiffer soils are in the slightly lower positions. Included soils make up 2 to 8 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of this Meridian soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy substratum. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy

competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIs. The woodland ordination symbol is 4A.

MrB—Merrillan sandy loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping, somewhat poorly drained soil is on foot slopes and side slopes in the uplands. Individual areas are irregular in shape and generally range from 3 to 120 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is brown, mottled sandy loam about 4 inches thick. The subsoil is about 17 inches thick. It is mottled. The upper part is dark brown and grayish brown, friable sandy loam; the next part is grayish brown, friable loam; and the lower part is gray, firm clay loam. The substratum is greenish gray and reddish brown silty clay about 20 inches thick. Poorly cemented sandstone interbedded with shale is at a depth of about 48 inches. In places the surface layer is loam or loamy sand.

Included with this soil in mapping are small areas of the poorly drained Elm Lake and moderately well drained Humbird soils. Elm Lake soils have a sandy mantle. They are in the lower positions on the landscape. Humbird soils are in the slightly higher positions. Included soils make up 1 to 10 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Merrillan soil and slow in the lower part and in the substratum. The available water capacity is moderate. The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are wooded. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, soil blowing is a hazard. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration. Land smoothing, a surface drainage system, diversions, and interceptor subsurface drains help to remove excess water.

A cover of pasture plants is effective in controlling water erosion and soil blowing. Alfalfa is generally short lived unless the soil is adequately drained. Overgrazing or grazing when the soil is wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seeding mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, the wetness, and the slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface drainage system and replacing the upper part of the soil

with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4W.

Mu—Minocqua loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in drainageways on outwash plains. It is subject to ponding. Individual areas are round or elongated and generally range from 3 to 30 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsoil is about 29 inches thick. It is grayish brown, mottled, very friable sandy loam in the upper part and gray, friable loam in the lower part. The substratum to a depth of about 60 inches is dark brown sand and gravel. In places the surface layer is mucky loam or mucky sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Halder, Oesterle, and Warman Variant soils. These soils are in the higher positions on the landscape. Halder soils have more clay in the upper part of the subsoil than the Minocqua soil. Warman Variant soils are sandy in the lower part of the subsoil. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Minocqua soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is high or very high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas

Most areas are used as unimproved pasture or support wetland vegetation. Because of the ponding and a scarcity of suitable drainage outlets, this soil is generally not suited to cultivated crops. If drained and protected from ponding, it is suited to the commonly grown farm crops. It is poorly suited to pasture unless it is drained. Establishing or maintaining an improved pasture is difficult because of the wetness. Grazing is limited to short periods when the soil is dry. The native vegetation is generally of poor quality for forage.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 7W.

MvA—Moundville loamy sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is on stream terraces and outwash plains. Individual areas are irregular in shape and generally range from 5 to 160 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 25 inches thick. The upper part is brown, very friable loamy sand; the next part is strong brown, mottled, very friable loamy sand; and the lower part is dark yellowish brown, mottled, loose sand. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled loamy sand and sand.

Included with this soil in mapping are small areas of the well drained Billett, excessively drained Menahga, and moderately well drained Scott Lake soils. Billett and Scott Lake soils are in positions on the landscape similar to those of the Moundville soil. Billett soils have more clay in the surface layer and in the upper part of the subsoil than the Moundville soil. Scott Lake soils have more clay in the surface layer and subsoil than the Moundville soil and have a substratum of sand and gravel. Menhaga soils have a subsoil and substratum of sand. They are in the slightly higher positions on the landscape Included soils make up 2 to 10 percent of the unit.

Permeability is rapid in the Moundville soil. The available water capacity is low. Natural fertility also is low. The organic matter content is low or moderately low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness. The depth to the seasonal high water table ranges from 2.0 to 3.5 feet.

Most areas are used as cropland. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If irrigated, however, it is suited to the commonly grown farm crops and to vegetables, such as snap beans, potatoes, sweet corn, and peas. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, the soil is subject to soil blowing. Winter cover crops, conservation tillage, wind stripcropping, and field windbreaks help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases

the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality is a management concern. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is only moderately suited to dwellings without basements and is poorly suited to dwellings with basements. This limitation can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the wetness, this soil is only moderately suited to local roads and streets. This limitation can be overcome by installing a subsurface drainage system.

The land capability classification is IVs. The woodland ordination symbol is 6S.

Na—Newson loamy sand, 0 to 2 percent slopes. This deep, nearly level, poorly drained and very poorly drained soil is in drainageways on outwash plains and low stream terraces. It is subject to ponding and rare flooding. Individual areas are irregularly shaped or elongated and generally range from 5 to 50 acres in size.

Typically, the surface layer is black loamy sand about 9 inches thick. The subsurface layer is very dark gray sand about 5 inches thick. The subsoil is loose sand about 30 inches thick. It is grayish brown in the upper part and pale brown and mottled in the lower part. The substratum to a depth of about 60 inches is light brownish gray and pale brown sand. In places the surface layer is sand, mucky loamy sand, or muck.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Fordum, very poorly drained Markey, and somewhat poorly drained Meehan soils. Fordum soils have a loamy mantle. They are on flood plains. Markey soils formed in organic material in depressions. Meehan soils are in the slightly higher positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Newson soil. The available water capacity is low. Natural fertility also is low. The organic matter content is high or very high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas of this soil are wooded or support wetland vegetation. Some are used as pasture. Undrained areas are generally not suited to cultivated crops because of the wetness. Drained areas are suited to the commonly grown farm crops and to certain vegetables. Unless the soil is irrigated, crop yields usually are limited by the low available water capacity. The number of frost-free days per growing season is limited. Planting early maturing crop varieties or growing corn for silage helps overcome the frost hazard. If drained and cultivated, the soil is subject to soil blowing.

This soil is poorly suited to pasture unless it is drained. Establishing an improved pasture is difficult because of the wetness Grazing is limited to the short periods when the soil is dry. The native vegetation is generally of poor quality for forage.

This soil is poorly suited to trees. The trees grow so poorly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 6W.

NtB—Northfield silt loam, 2 to 6 percent slopes. This shallow, gently sloping, well drained soil is on the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is dark yellowish brown, friable silt loam in the upper part and yellowish brown, very friable loamy sand in the lower part. Platy sandstone is at a depth of about 19 inches.

Included with this soil in mapping are small areas of the well drained Gale soils. These soils are in positions on the landscape similar to those of the Northfield soil. They are moderately deep over sandstone. They make up 2 to 8 percent of the unit.

Permeability is moderate in the Northfield soil. The available water capacity is low The organic matter content is moderately low in the surface layer. This layer is friable and can be easily tilled, but it tends to crust or puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil or by the underlying sandstone.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality and the windthrow hazard are management concerns. Carefully planting vigorous nursery stock improves the survival rate of trees planted during dry periods. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the shallow depth to bedrock, this soil generally is not suited to septic tank absorption fields, is only moderately suited to dwellings without basements, and is poorly suited to dwellings with basements. On sites for dwellings, this limitation can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the depth to bedrock, this soil is only moderately suited to local roads and streets. The bedrock can be removed by blasting or by suitable power equipment.

The land capability classification is IIIe. The woodland ordination symbol is 3D.

NtC2—Northfield silt loam, 6 to 12 percent slopes, eroded. This shallow, sloping, well drained soil is on side slopes and the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 10 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown, friable silt loam about 2 inches thick The subsoil is dark brown, friable silt loam about 8 inches thick. Platy sandstone is at a depth of about 18 inches. In places sandstone channers are on the surface. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained and somewhat excessively drained Eleva and well drained Gale soils. These soils are in positions on the landscape similar to those of the Northfield soil. They are moderately deep over sandstone. They make up 2 to 10 percent of the unit.

Permeability is moderate in the Northfield soil. The available water capacity is low. The organic matter content is moderately low in the surface layer. This layer is friable, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by the underlying sandstone.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an

increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality and the windthrow hazard are management concerns. Carefully planting vigorous nursery stock improves the survival rate of trees planted during dry periods. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the shallow depth to bedrock, this soil generally is not suited to septic tank absorption fields, is only moderately suited to dwellings without basements, and is poorly suited to dwellings with basements. The slope also is a limitation on sites for dwellings. It can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the depth to bedrock and the slope, this soil is only moderately suited to local roads and streets. The bedrock can be removed by blasting or by suitable power equipment. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 3D.

NtD2—Northfield silt loam, 12 to 20 percent slopes, eroded. This shallow, moderately steep, well drained soil is on side slopes in the uplands. Individual areas are elongated and generally range from 5 to 75 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 8 inches thick. The subsoil is about 7 inches thick. It is dark brown, friable silt loam in the upper part and yellowish brown, very friable loamy sand in the lower part. Platy sandstone is at a depth of about 15 inches In places the content of sandstone channers in the surface layer is as much as 5 percent. In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the somewhat excessively drained and well drained Eleva soils. These soils are in positions on the landscape similar to those of the Northfield soil. They are moderately deep over sandstone. They make up 5 to 10 percent of the unit.

Permeability is moderate in the Northfield soil. The available water capacity is low. The organic matter content is moderately low in the surface layer. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil or by the underlying sandstone.

Most areas are used as pasture. A few are wooded. Because of a very severe hazard of water erosion, this soil is not suited to cultivated crops. A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard, the equipment limitation, seedling mortality and the windthrow hazard are management concerns. Erosion can be controlled by planting the trees on on the contour and by carefully locating skid roads during harvest. Carefully planting vigorous nursery stock reduces the seedling mortality rate. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the shallow depth to bedrock and the slope, this soil generally is not suited to septic tank absorption fields. It is poorly suited to dwellings because of the slope. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwellings can be designed so that one side of the basement fronts on the lower part of the slope. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is VIe. The woodland ordination symbol is 3R.

Oe—Oesterle sandy loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is

in drainageways on stream terraces and outwash plains. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown sandy loam about 7 inches thick. The subsurface layer is mostly dark grayish brown sandy loam about 10 inches thick. The subsoil is about 17 inches thick. It is mottled. It is dark brown, friable sandy loam in the upper part and dark yellowish brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand and gravel. In places it is sand.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils are in the slightly higher positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Oesterle soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are wooded. A few are used as cropland or pasture. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Excess water can be removed by diversions, grassed waterways, surface drains, and interceptor subsurface drains. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile. If the soil is drained and cultivated, soil blowing is a hazard. It can be controlled by wind stripcropping, field windbreaks, and conservation tillage. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing. Alfalfa is short lived unless the soil is drained. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 3W.

Or—Orion silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in plane and slightly convex areas on flood plains. It is frequently flooded for brief periods. Individual areas are elongated and generally range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The upper substratum is brown and dark grayish brown, mottled silt loam about 25 inches thick. The next 11 inches is a buried surface layer of black, mottled silt loam. The lower substratum to a depth of about 60 inches is dark gray and grayish brown, mottled silt loam. In places the surface layer is sandy loam or loam.

Included with this soil in mapping are small areas of the moderately well drained Arenzville soils. These soils are in the slightly higher positions on the flood plains. Also included are small areas of poorly drained soils in depressions. Included soils make up 2 to 10 percent of the unit.

Permeability is moderate in the Orion soil. The available water capacity is high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as pasture. A few are used as cropland If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Dikes and diversions help to prevent flooding. Land smoothing, diversions, and interceptor subsurface drains help to remove excess water. Restrictive soil layers may limit the movement of water into tile drains If drainage tile is installed, silt and fine sand enter the tile lines unless a suitable filter is used to cover the tile. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Alfalfa is generally short lived because of the seasonal high water table, the flooding, and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species Proper stocking rates, measures that improve fertility, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation is a management concern Because of the wetness, hand planting or machine planting on prepared ridges is needed if natural regeneration is unreliable. Planting vigorous nursery stock reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the wetness. Overcoming these limitations is difficult. A better suited site should be considered.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

OsC2—Otterholt silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes on ground moraines. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly grayish brown silt loam about 8 inches thick. The subsoil is friable silt loam about 20 inches thick. It is mostly dark yellowish brown in the upper part and is yellowish brown in the lower part. The upper 7 inches of the substratum is yellowish brown silt loam. The lower part to a depth of about 60 inches is reddish brown sandy loam. In places cobbles are on the surface In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the moderately well drained Spencer soils. These soils are in the slightly lower positions on the landscape They make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Otterholt soil and moderately slow in the lower part of the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, grassed waterways and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by constructing a mound of suitable filtering material and possibly by increasing the size of the absorption field.

Because of the shrink-swell potential and the slope, this soil is only moderately suited to dwellings. The shrink-swell potential can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel; by strengthening the basement walls; and by installing a subsurface drainage system at or below the basement elevation. The slope can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also,

the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

Pc—Pits, gravel. This map unit consists of open excavations from which sand and gravel and, in a few places, glacial till have been removed to a depth of at least several feet. Individual areas are irregular in shape and generally range from 3 to 30 acres in size.

Typically, the material on the bottom and sides of these pits is stratified sand and gravel. It is droughty. Other soil properties vary.

Included in this unit in mapping are piles of soil material that was removed from the pit area before the excavation was made and, within the pit area, piles of material that was discarded because it did not contain enough gravel. Also included are areas of stones and boulders that are too large to be crushed. Included areas make up less than 5 percent of the unit.

Many pits are still mined. Some have been abandoned and are covered with brush and weeds. Other abandoned pits contain water

The main management concern is reclamation of the pits after excavation. In most of the pits, land shaping and additions of suitable topsoil are needed before a plant cover can be established. The suitability of these pits for septic tank absorption fields, dwellings, and local roads and streets should be determined by onsite investigation.

This unit is not assigned a land capability classification or a woodland ordination symbol.

PdB—Plainbo loamy sand, 2 to 6 percent slopes. This moderately deep, gently sloping, excessively drained soil is in slightly convex areas on outwash plains, stream terraces, and foot slopes in the uplands. Individual areas are irregular in shape and generally range from 3 to 30 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 8 inches thick. The subsoil is yellowish brown and dark yellowish brown, very friable sand about 15 inches thick. The substratum is yellow sand about 15 inches thick. Poorly cemented sandstone is at a depth of about 38 inches. In places the surface layer is sand.

Included with this soil in mapping are small areas of the excessively drained Menahga soils. These soils are in positions on the landscape similar to those of the Plainbo soil. They are sandy throughout. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainbo soil. The available water capacity is very low. Natural fertility is low. The organic matter content is very low or low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness or by the underlying sandstone.

Most areas are used as cropland. A few have been planted to pine. This soil is poorly suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the very low available water capacity. If cultivated crops are grown, water erosion is a slight hazard. Also, the soil is subject to soil blowing. Winter cover crops, conservation tillage, wind stripcropping, and field windbreaks help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material reduces the hazards of erosion and soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing and erosion. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate. Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Because of the loose sand, equipment with flotation tires or tracks can be operated more easily than other equipment. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the rapid permeability, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

This soil is suited to local roads and streets and to dwellings without basements. It is only moderately suited to dwellings with basements because of the depth to bedrock. This limitation can be overcome by ripping and excavating the bedrock with suitable power equipment;

by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

The land capability classification is IVs. The woodland ordination symbol is 5S.

PdC—Plainbo loamy sand, 6 to 12 percent slopes. This moderately deep, sloping, excessively drained soil is on foot slopes and side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 21 inches thick. It is brown, very friable loamy sand in the upper part and brown and yellowish brown, loose sand in the lower part. Poorly cemented sandstone is at a depth of about 30 inches. In places the surface layer is sand. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Elkmound and excessively drained Menahga soils. Elkmound soils formed in loamy deposits that are shallow over sandstone. They are in the higher positions on the landscape. Menahga soils are sandy throughout. They are in the lower positions on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainbo soil. The available water capacity is very low Natural fertility is low. The organic matter content is very low or low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness or by the underlying sandstone.

Most areas are used as pasture or woodland. This soil is not suited to cultivated crops because of the hazards of drought, water erosion, and soil blowing. A cover of pasture plants is effective in controlling soil blowing and erosion. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate Planting early in spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition

This soil is suited to trees. The equipment limitation and seedling mortality are management concerns. Because of the loose sand, equipment with flotation tires or tracks can be operated more easily than other equipment. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock and the rapid permeability, this soil is poorly suited to septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The absorption field functions adequately if the site is mounded with suitable filtering material.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent. The depth to bedrock is a limitation on sites for dwellings with basements. It can be overcome by ripping and excavating the bedrock with suitable power equipment; by adding fill material, which raises the site; or by constructing the dwellings with only partially exposed basements.

Because of the slope, this soil is only moderately suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is VIs. The woodland ordination symbol is 5S.

PdD—Plainbo loamy sand, 12 to 20 percent slopes. This moderately deep, moderately steep, excessively drained soil is on side slopes in the uplands. Individual areas are irregularly shaped or elongated and generally range from 5 to 160 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 6 inches thick. The subsoil is yellowish brown, very friable and loose sand about 14 inches thick. The substratum is brownish yellow channery sand about 8 inches thick. Poorly cemented sandstone is at a depth of about 28 inches. In places the surface layer is sand.

Included with this soil in mapping are small areas of the well drained Elkmound soils. These soils formed in loamy deposits that are shallow over sandstone. They are in the higher positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainbo soil. The available water capacity is very low. Natural fertility is low. The organic matter content is very low or low in the surface layer. The rooting depth of most crops is limited by droughtiness or by the underlying sandstone.

Most areas are used as pasture or woodland. Some have been planted to pine. Because of the hazards of drought, erosion, and soil blowing, this soil is not suited to cultivated crops. It is poorly suited to pasture. Forage yields are generally low because of the very low available water capacity. A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of

the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition

This soil is suited to trees. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the depth to bedrock, the slope, and the rapid permeability, this soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Mounding the site with suitable filtering material helps to overcome the poor filtering capacity and the depth to bedrock. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is poorly suited to dwellings. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of the slope, this soil is poorly suited to local roads and streets. This limitation can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is VIIs. The woodland ordination symbol is 5R.

Pv—Plover silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in shallow depressions and drainageways on glacial lake plains. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown, mottled silt loam about 12 inches thick. The subsoil is about 18 inches thick. It is mostly reddish brown, is mottled, and is friable. The upper part is very fine sandy loam, the next part is silt loam, and the lower part is very fine sandy loam. The substratum to a depth of about 60 inches is dark brown, stratified fine sand, very fine sand, and silt. In places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of the moderately well drained Alban and poorly drained Rib soils. Alban soils have a surface layer of fine sandy loam. They are in the slightly higher positions on the landscape. Rib soils are underlain by stratified sand and gravel. They are in the lower positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Plover soil. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Excess water can be removed by diversions, land smoothing, grassed waterways, surface drains, and interceptor subsurface drains. If tile drains are installed, silt and the finer sand enters the tile lines unless a suitable filter covers the tile. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material reduce the amount of water lost through evaporation, increase the rate of water infiltration, and help to maintain fertility.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of small-seeded crops. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome this limitation. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material

above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 3W.

Px—Poskin silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in shallow depressions and drainageways on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 10 to 80 acres in size.

Typically, the surface layer is dark brown silt loam about 10 inches thick The subsurface layer is about 9 inches of mostly brown silt and silt loam. It is mottled in the lower part. The subsoil is about 19 inches thick. It is mottled and friable. It is mostly dark yellowish brown silt loam in the upper part and dark brown sandy loam in the lower part The substratum to a depth of about 60 inches is dark brown sand and gravel.

Included with this soil in mapping are small areas of the moderately well drained Brill and poorly drained Rib soils Brill soils are in the slightly higher positions on the landscape. Rib soils are in the lower positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Poskin soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Excess water can be removed by diversions, grassed waterways, surface drains, and interceptor subsurface drains. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material reduce the amount of water lost through evaporation, increase the rate of water infiltration, and help to maintain fertility.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of small-seeded crops. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel, and by increasing the thickness of the pavement or base material. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material help to prevent the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 3W

Rb—Rib silt loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is in drainageways on outwash plains and stream terraces. It is subject to ponding and is occasionally flooded for brief periods. Individual areas are oblong and generally range from 5 to 50 acres in size.

Typically, the surface layer is black silt loam about 8 inches thick. The subsoil is about 25 inches thick. It is gray, mottled, and friable. It is silt loam in the upper part and loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In places it has loamy strata.

Included with this soil in mapping are small areas of the somewhat poorly drained Halder and Poskin soils. Halder soils formed in loamy deposits. Both of the included soils are in the slightly higher positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Rib soil and very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate to very high in the surface layer. This layer is friable, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas are used as cropland. A few are used as pasture or woodland. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Dikes and diversions help to prevent flooding. Excess water can be removed by grassed waterways, land smoothing, surface drains, and interceptor subsurface drains. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material reduce the amount of water lost through evaporation, increase the rate of water infiltration, and help to maintain fertility.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of small-seeded crops. Alfalfa is subject to the winterkill caused by frost heave. It is short lived unless the soil is adequately drained and protected from ponding and flooding. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges is generally needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is IIw in drained areas. The woodland ordination symbol is 2W.

Rc—Rib mucky silt loam, ponded, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is in depressions and drainageways on outwash plains and stream terraces. It is subject to ponding and is occasionally flooded. The flooding and ponding last for long periods. Individual areas are irregularly shaped or elongated and generally range from 5 to 30 acres in size.

Typically, the surface layer is black mucky silt loam about 15 inches thick. The subsoil is friable silt loam about 25 inches thick. The upper part is gray and dark gray and is mottled, and the lower part is greenish gray. The substratum to a depth of about 60 inches is dark gray, stratified sand and gravel. In places the surface layer is not mucky. In some areas the silty deposits are more than 40 inches thick.

Included with this soil in mapping are small areas of the very poorly drained Markey soils and small areas of the Rib soils that are not ponded for long periods. Markey soils formed in organic material in depressions on the lower parts of the landscape. The included Rib soils have a surface layer of silt loam. They are in the slightly higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the subsoil of this Rib soil and very rapid in the substratum. The available water capacity is moderate. The organic matter content is high or very high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. A few are used as pasture. Because of the wetness, a scarcity of suitable drainage outlets, the flooding, and the hazard of frost late in spring and early in fall, this soil is generally not suited to cultivated crops. It is poorly suited to pasture. Establishing or maintaining an improved pasture is difficult because of the wetness. Grazing is limited to the short periods when the soil is dry. The native vegetation is generally of poor quality for forage.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges is generally needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation

and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and the ponding. Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 2W.

RfA—Richford loamy sand, 0 to 3 percent slopes. This deep, nearly level and gently sloping, well drained and somewhat excessively drained soil is in slightly convex areas on stream terraces and outwash plains. Individual areas are irregular in shape and generally range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsurface layer is dark brown and yellowish brown loamy sand about 14 inches thick. The subsoil also is about 14 inches thick. It is dark brown. It is friable sandy loam in the upper part and very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown coarse sand and gravel. In places cobbles are on the surface.

Included with this soil in mapping are small areas of the excessively drained Menahga and well drained Rosholt soils. Menahga soils are sandy throughout, and Rosholt soils have a loamy surface layer and subsoil. Both of these soils are in positions on the landscape similar to those of the Richford soil. They make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the subsoil in the Richford soil and rapid in the lower part and in the substratum. The available water capacity is low. Natural fertility also is low. The organic matter content is very low or low in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If irrigated, it is suited to vegetables, such as snap beans, potatoes, sweet corn, and peas. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, soil blowing is a hazard. It can be controlled by field windbreaks, wind stripcropping, winter cover crops, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of soil blowing.

A cover of pasture plants is effective in controlling soil blowing. Forage yields are generally low unless fertilizer is applied and the supply of moisture is adequate Planting early in the spring, before the soil has a chance to dry out, helps to overcome the droughtiness. Planting later in the year is likely to result in a poor survival rate. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Measures that improve fertility, proper stocking rates, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. Seedling mortality is the main management concern. Seedling survival can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local roads and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs. The woodland ordination symbol is 4S.

RoA—Rosholt sandy loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in plane areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is mostly brown and yellowish brown sandy loam about 17 inches thick. The subsoil is about 14 inches thick. It is dark brown and friable. It is loam in the upper part and sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In places the surface layer is loam. In some areas cobbles are on the surface.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils are in the lower positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Rosholt soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the substratum.

Most areas are used as cropland This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, soil blowing is a hazard. It can be controlled by conservation tillage, winter cover crops, and field windbreaks. Returning crop residue to the soil or adding other organic material helps to

maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of soil blowing.

A cover of pasture plants is effective in controlling soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIs. The woodland ordination symbol is 3A.

RoB—Rosholt sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in slightly convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsoil is about 24 inches thick. It is mostly dark brown. It is friable sandy loam in the upper part and very friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, stratified sand and gravel. In places the surface layer is loam. In some areas cobbles are on the surface. In other areas the slope is less than 2 or more than 6 percent.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils are in the lower positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Rosholt soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing. Conservation tillage, grassed waterways, and field windbreaks help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3A.

RoC2—Rosholt sandy loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes and knolls on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown sandy loam about 4 inches thick. The subsoil is about 26 inches thick. It is dark brown. It is friable sandy loam in the upper part and very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown, stratified sand and gravel. In places the surface layer is loam. In some areas cobbles are on the surface. In other areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils

are in the lower positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Rosholt soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is very friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil and in the sand and gravel substratum.

Most areas are used as cropland. A few are used as pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a moderate hazard. Also, the soil is subject to soil blowing. Conservation tillage, field windbreaks, contour farming, contour stripcropping, and grassed waterways help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

RpA—Rosholt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in plane areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is mostly brown loam about 7 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown, friable loam; the next part is dark brown, friable sandy loam; and the lower part is brown, very friable loamy sand. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In places the surface layer is sandy loam. In some areas the content of gravel and cobbles in the surface layer is as much as 5 percent.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils are in the slightly lower positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Rosholt soil and rapid or very rapid in the substratum. The available water capacity is moderate The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil and in the sand and gravel substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the

rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIs. The woodland ordination symbol is 3A.

RpB—Rosholt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in slightly convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is dark brown loam about 9 inches thick. The subsoil is about 25 inches thick The upper part is mostly dark brown, friable loam; the next part is dark brown, friable sandy loam; and the lower part is reddish brown, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is yellowish red, stratified sand and gravel. In places the surface layer is sandy loam. In some areas the content of gravel and cobbles in the surface layer is as much as 5 percent.

Included with this soil in mapping are small areas of the moderately well drained Scott Lake soils. These soils are in the slightly lower positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Rosholt soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the sandy part of the subsoil and in the sand and gravel substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3A.

RpC2—Rosholt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is mostly brown loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable loam; the next part is reddish brown, friable sandy loam; and the lower part is yellowish red, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is yellowish red, stratified sand and gravel. In some places the surface layer and subsoil are sandy loam. In other places the depth to sand and gravel is 16 to 24 inches. In some areas cobbles are on the surface. In other areas the slope is less than 6 or more than 12 percent.

Permeability is moderate or moderately rapid in the subsoil of the Rosholt soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by the droughtiness in the sandy part of the subsoil and in the sand and gravel substratum.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding

other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. 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, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

SaB—Santiago silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in slightly convex areas on ground moraines. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is dark brown silt loam about 10 inches thick. The subsurface layer is mostly brown silt loam about 5 inches thick. The subsoil is about 15 inches thick. It is friable. The upper part is mostly dark brown silt loam, the next part is reddish brown loam, and the lower part is yellowish red sandy loam. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places cobbles are on the surface. In some areas sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of the moderately well drained Freeon soils. These soils are in depressions on the lower parts of the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate in the Santiago soil. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings. It is only moderately suited to septic tank absorption fields because of the moderate permeability. Mounding the site with suitable filtering material helps to overcome this limitation. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIe. The woodland ordination symbol is 4A.

SaC2—Santiago silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes and knolls on ground moraines. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 7 inches thick. The subsurface layer is mostly brown silt loam about 6 inches

thick. The subsoil is about 17 inches thick. It is friable. The upper part is mostly dark yellowish brown and dark brown silt loam, the next part is dark brown loam, and the lower part is reddish brown sandy loam. The substratum to a depth of about 60 inches is dark reddish brown sandy loam. In places cobbles are on the surface. In some areas sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of the moderately well drained Freeon soils. These soils are in the lower positions on the landscape. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Santiago soil. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the moderate permeability and the slope, this soil is only moderately suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome the moderate permeability. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas. The slope can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of the slope and the potential for frost action, this soil is only moderately suited to local roads and streets. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

SaD2—Santiago silt loam, 12 to 20 percent slopes, eroded. This deep, moderately steep, well drained soil is on side slopes on ground moraines. Individual areas are irregular in shape and generally range from 5 to 30 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 27 inches thick. It is friable. It is mostly yellowish brown silt loam in the upper part and dark reddish brown and reddish brown loam in the lower part. The substratum to a depth of about 60 inches is reddish brown sandy loam. In places cobbles are on the surface. In some areas the slope is less than 12 or more than 20 percent.

Included with this soil in mapping are small areas of the well drained Arland soils. These soils are in positions on the landscape similar to those of the Santiago soil. They are underlain by sandstone. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Santiago soil. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland or pasture. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. It can be controlled by contour farming, contour stripcropping, crop rotations that include grasses and legumes, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard and the equipment limitation are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the slope, this soil is poorly suited to septic tank absorption fields, dwellings, and local roads and streets. This limitation can be overcome by cutting and filling. It also can be overcome by installing a trench absorption system on the contour, by designing dwellings so that one side of the basement fronts on the lower part of the slope, by installing retaining walls, and by building roads in the less sloping areas

The land capability classification is IVe. The woodland ordination symbol is 4R.

SbA—Sattre loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, well drained soil is in plane areas on stream terraces and outwash plains. Individual areas are irregular in shape and generally range from 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is about 23 inches thick. It is dark brown and friable. It is loam in the upper part and gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is strong brown sand and gravel. In places the surface layer and the upper part of the subsoil are sandy loam. In some areas a few cobbles are on the surface.

Permeability is moderate or moderately rapid in the subsoil of the Sattre soil and very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to dwellings and to local roads and streets. It readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the very rapid permeability. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIs. The woodland ordination symbol is 4A.

ScB—Scott Lake sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 8 inches thick. The subsoil is mostly dark brown, mottled, friable sandy loam about 20 inches thick. The substratum to a depth of about 60 inches is yellowish brown, stratified sand and gravel. In some places the surface layer is loam. In other places the lower part of the substratum is stratified very fine sandy loam and silt. In some areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Halder, moderately well drained Moundville, and well drained Rosholt soils. Halder soils are loam in the surface layer and in the upper part of the subsoil. They are in the lower positions on the landscape. Moundville soils are in positions similar to those of the Scott Lake soil. They formed in sandy deposits. Rosholt soils are in the slightly higher areas. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Scott Lake soil and rapid or very rapid in the substratum. The available water capacity is low. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by droughtiness in the substratum. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In most years crop yields are limited by the low available water capacity. If cultivated crops are grown, water erosion is a slight or moderate hazard. Also, the soil is subject to soil blowing.

Conservation tillage, grassed waterways, and field windbreaks help to control erosion and soil blowing. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazards of erosion and soil blowing.

A cover of pasture plants is effective in controlling erosion and soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. This limitation can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel.

The land capability classification is IIe. The woodland ordination symbol is 4A.

SdA—Scott Lake loam, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in slightly convex areas on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 28 inches thick. It is friable. The upper part is mostly dark brown loam; the next part is dark yellowish brown, mottled loam; and the lower part is dark brown, mottled sandy loam. The substratum to a depth of about 60 inches is dark brown and dark yellowish brown, stratified sand and gravel. In places the surface layer is sandy loam. In some areas cobbles are on the surface.

Included with this soil in mapping are small areas of the somewhat poorly drained Halder and well drained Rosholt soils. Halder soils are loam in the surface layer and in the upper part of the subsoil. They are in the slightly lower positions on the landscape. Rosholt soils are in the slightly higher positions. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate or moderately rapid in the subsoil of the Scott Lake soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the substratum. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid or very rapid permeability in the substratum. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is only moderately suited to local roads and streets. This limitation can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel.

The land capability classification is IIs. The woodland ordination symbol is 4A.

SeB—Seaton silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on the tops of ridges in the uplands. Individual areas are irregular in shape and generally range from 5 to 150 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable silt loam about 33 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam. In places the slope is more than 6 percent.

Included with this soil in mapping are small areas of the well drained Gale and moderately well drained Seaton soils. Gale soils are underlain by sandstone. They are in the higher positions on the landscape. The wetter Seaton soils are in the lower positions. Included soils make up 2 to 10 percent of the unit.

Permeability is moderate in this Seaton soil. The available water capacity is very high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by terraces, grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to septic tank absorption fields and dwellings. It is poorly suited to local roads and streets because of low strength and the potential for frost action. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIe. The woodland ordination symbol is 5A.

SeC2—Seaton silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 200 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is yellowish brown and dark yellowish brown, friable silt loam about 32 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam. In places the lower part of the substratum is sandy loam. In some areas the slope is less than 6 or more than 12 percent.

Included with this soil in mapping are small areas of the well drained Gale soils. These soils are underlain by sandstone. They are in the higher positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is moderate in the Seaton soil. The available water capacity is very high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by terraces, contour farming, contour stripcropping, grassed waterways, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which

interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the slope, this soil is only moderately suited to septic tank absorption fields. This limitation can be overcome by cutting and filling or by installing a trench absorption system on the contour. Also, the absorption field can be installed in the included areas where the slope is less than 6 percent.

Because of the slope, this soil is only moderately suited to dwellings. This limitation can be overcome by cutting and filling, by installing retaining walls, or by designing the dwellings so that one side of the basement fronts on the lower part of the slope. Also, the dwellings can be constructed in the included areas where the slope is less than 6 percent.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIIe. The woodland ordination symbol is 5A.

SeD2—Seaton silt loam, 12 to 25 percent slopes, eroded. This deep, moderately steep and steep, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and generally range from 5 to 70 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is dark brown silt loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable silt loam about 28 inches thick. The substratum to a depth of about 60 inches is yellowish brown silt loam. In places the lower part of the substratum is sandy loam. In some areas the slope is less than 12 or more than 25 percent.

Included with this soil in mapping are small areas of the well drained Gale soils. These soils are underlain by sandstone. They are in the higher positions on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderate in the Seaton soil. The available water capacity is very high. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland or pasture. This soil is suited to corn and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a severe hazard. It can be controlled by contour farming, contour stripcropping, crop rotations that include grasses and legumes, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The erosion hazard, the equipment limitation, and seedling mortality are management concerns. Planting on the contour and carefully locating skid roads during harvest minimize erosion. Seedling survival on the steeper slopes facing south or west can be improved by careful planting of vigorous nursery stock. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the slope, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by cutting and filling or by installing a trench absorption system on the contour.

Because of the slope, this soil is poorly suited to dwellings. This limitation can be overcome by cutting and filling or by installing retaining walls. Also, the dwelling can be designed so that one side of the basement fronts on the lower part of the slope.

Because of low strength, the slope, and the potential for frost action, this soil is poorly suited to local roads and streets. Low strength and frost action can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material. The slope can be overcome by shaping the roadway through cutting and filling. Also, the road can be built in the less sloping areas.

The land capability classification is IVe. The woodland ordination symbol is 5R.

SfA—Seaton silt loam, moderately well drained, 0 to 3 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is in plane areas on uplands. Individual areas are irregular in shape and generally range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is

friable silt loam about 28 inches thick. It is dark yellowish brown in the upper part and yellowish brown and mottled in the lower part The substratum to a depth of about 60 inches is brown, mottled silt loam. In places the surface layer is thicker and darker.

Included with this soil in mapping are small areas of the somewhat poorly drained Comstock soils and the well drained Seaton soils that have a sandy substratum. Comstock soils are in the slightly lower positions on the landscape. The better drained Seaton soils are in positions similar to those of this Seaton soil. They are sandy in the lower part of the substratum. Included soils make up 2 to 5 percent of the unit.

Permeability is moderate in this Seaton soil. The available water capacity is very high. The organic matter content is moderate in the surface layer This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by mounding the site with suitable filtering material. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness This limitation can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is I. The woodland ordination symbol is 5A

SgA—Seaton silt loam, sandy substratum, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in plane areas on valley fills. Individual areas are irregular in shape and generally range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown silt loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable silt loam about 22 inches thick. The upper 10 inches of the substratum is yellowish brown silt loam. The lower part to a depth of about 60 inches is yellowish brown sand. In places the surface layer is thicker and darker.

Included with this soil in mapping are small areas of the moderately well drained Seaton soils. These soils are in positions on the landscape similar to those of this Seaton soil. They have a substratum of silt loam. They make up 2 to 5 percent of the unit.

Permeability is moderate in the upper part of this Seaton soil and rapid in the sandy part of the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to septic tank absorption fields and dwellings. It is poorly suited to local roads and streets because of low strength and the potential for frost action. These limitations can be overcome by replacing

the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is I. The woodland ordination symbol is 5A.

SgB—Seaton silt loam, sandy substratum, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on foot slopes on valley fills. Individual areas are irregular in shape and generally range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown silt loam about 3 inches thick. The subsoil is dark yellowish brown, friable silt loam about 28 inches thick. The upper 18 inches of the substratum is yellowish brown silt loam. The lower part to a depth of about 60 inches is light yellowish brown sand. In places the surface layer is thicker and darker.

Included with this soil in mapping are small areas of the moderately well drained Seaton soils. These soils have a substratum of silt loam. They are in the slightly lower positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is moderate in the upper part of this Seaton soil and rapid in the sandy part of the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by terraces, contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil is suited to septic tank absorption fields and dwellings. It is poorly suited to local roads and streets because of low strength and the potential for frost action. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material

The land capability classification is IIe. The woodland ordination symbol is 5A.

Sm—Seelyeville muck, 0 to 1 percent slopes. This deep, nearly level, very poorly drained soil is in depressions on outwash plains and ground moraines. It is subject to ponding and rare flooding. Individual areas are irregular in shape and generally range from 10 to 150 acres in size.

Typically, the organic material is dark brown, black, and very dark gray muck at least 60 inches thick. In places the surface layer is peat. In some areas strata of mucky peat or peat are below the surface layer.

Included with this soil in mapping are some small areas of the very poorly drained Lupton soils. These soils are in positions on the landscape similar to those of the Seelyeville soil. They formed in extremely acid organic material. They make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Seelyeville soil. The available water capacity is very high. The organic matter content also is very high. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas support wetland vegetation. Because of the wetness, a scarcity of suitable drainage outlets, and the hazard of frost late in spring or early in fall, this soil is generally not suited to cultivated crops or pasture. If drained and cultivated, it is subject to burning and subsidence. Also, it is subject to soil blowing.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the flooding and ponding.

Overcoming these hazards is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 8W.

So—Shiffer loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in shallow depressions and drainageways on stream terraces and valley fills. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 22 inches thick. It is brown and mottled. It is friable loam in the upper part and very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled sand. In places the surface layer is sandy loam.

Included with this soil in mapping are small areas of the poorly drained Lows and moderately well drained Meridian soils. Lows soils are in the lower positions on the landscape. Meridian soils are in the slightly higher positions Included soils make up 2 to 8 percent of the unit.

Permeability is moderate in the upper part of the subsoil in the Shiffer soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Excess water can be removed by diversions, grassed waterways, surface drains, and interceptor subsurface drains. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. Alfalfa is short lived unless the soil is adequately drained. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the potential for frost action, this soil is poorly suited to local roads and streets. Replacing the upper part of the soil with coarse textured base material, such as sand or gravel, helps to prevent the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 2A.

SrB—Spencer silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on side slopes and knolls on ground moraines and the lower terminal moraines. Individual areas are irregular in shape and generally range from 4 to 125 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is mostly brown silt loam about 6 inches thick. The subsoil is mottled, friable silt loam about 22 inches thick. It is mostly dark yellowish brown in the upper part and dark brown in the lower part. The upper 5 inches of the substratum is dark yellowish brown, mottled silt loam. The lower part to a depth of about 60 inches is yellowish red sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Almena soils. These soils are in the lower positions on the landscape. They make up 2 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Spencer soil and moderately slow in the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 6.0 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth,

increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the shrink-swell potential, this soil is only moderately suited to dwellings. This limitation can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel; by strengthening the basement walls; and by installing a subsurface drainage system at or below the basement elevation. The wetness is a limitation on sites for dwellings with basements. It can be overcome by installing tile drains around the foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIe. The woodland ordination symbol is 3A.

SrC2—Spencer silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, moderately well drained soil is on side slopes on ground moraines and terminal moraines. Individual areas are irregular in shape and generally range from 5 to 50 acres in size.

In most cultivated areas on the crest of hills and the upper side slopes, erosion has removed most of the original surface layer. Typically, the remaining surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly brown silt loam about 4 inches thick. The subsoil is mottled, friable silt loam about 23 inches thick. It is mostly dark brown in the upper part and is dark yellowish brown in the lower part. The upper 7 inches of the substratum is dark brown, mottled silt loam. The lower part to a depth of about 60 inches is reddish brown sandy loam. In places cobbles are on the surface.

Included with this soil in mapping are small areas of the well drained Otterholt and Santiago soils. Otterholt soils are in the slightly higher positions on the landscape. Santiago soils have a silty mantle that is thinner than that of the Spencer soil. They are in the higher positions on the landscape. Included soils make up 2 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Spencer soil and moderately slow in the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 2.5 to 6 0 feet.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a moderate hazard. It can be controlled by grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by suitable herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability in the substratum, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the slope and the shrink-swell potential, this soil is only moderately suited to dwellings. The slope

can be overcome by cutting and filling or by installing retaining walls. Also, the dwellings can be designed so that one side of the basement fronts on the lower part of the slope. The shrink-swell potential can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel; by strengthening the basement walls; and by installing a subsurface drainage system at or below the basement elevation. The wetness is a limitation on sites for dwellings with basements. It can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

SsA—Spencer silt loam, gravelly substratum, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on foot slopes on terminal moraines. Individual areas are irregular in shape and generally range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsurface layer is mostly brown silt loam about 4 inches thick. The subsoil is yellowish brown, friable silt loam about 30 inches thick. The upper 6 inches of the substratum is brown, mottled silt loam. The lower part to a depth of about 60 inches is yellowish brown sand and gravel. In places the silty mantle is more than 50 inches thick.

Included with this soil in mapping are small areas of the well drained Antigo and moderately well drained Crystal Lake soils. Antigo soils have a silty mantle that is thinner than that of the Spencer soil. They are in the slightly higher positions on the landscape. Crystal Lake soils are silt loam throughout. They are in the lower positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Spencer soil and rapid or very rapid in the gravelly part of the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Applying a system of conservation tillage and returning crop residue to the soil or adding other organic material help to maintain fertility and good tilth and increase the rate of water infiltration.

This soil is suited to pasture. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by mounding the site with suitable filtering material Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is I. The woodland ordination symbol is 3A.

SsB—Spencer silt loam, gravelly substratum, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on foot slopes and knolls on terminal moraines. Individual areas are irregular in shape and generally range from 10 to 160 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is pale brown silt loam about 4 inches thick. The subsoil is friable silt loam about 34 inches thick It is mostly dark yellowish brown in the upper part and yellowish brown in the lower part. The upper 4 inches of the substratum is yellowish brown, mottled silt loam. The lower part to a depth of about 60 inches is yellowish brown sand and gravel. In places the silty mantle is more than 60 inches thick.

Included with this soil in mapping are small areas of the well drained Antigo and moderately well drained

Spencer soils. Antigo soils have a silty mantle that is thinner than that of the Spencer soil. They are in the slightly higher positions on the landscape. Spencer soils formed in silty deposits over sandy loam. They are in the higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Spencer soil and rapid or very rapid in the gravelly part of the substratum. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The depth to the seasonal high water table ranges from 3 to 6 feet.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard It can be controlled by terraces, grassed waterways, contour farming, contour stripcropping, and conservation tillage. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, pasture rotation, measures that improve fertility, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness, this soil is poorly suited to septic tank absorption fields. This limitation can be overcome by mounding the site with suitable filtering material. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

This soil is suited to dwellings without basements, but it is only moderately suited to dwellings with basements because of the wetness. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIe. The woodland ordination symbol is 3A.

TeB—Tell silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is in slightly convex areas on stream terraces and outwash plains. Individual areas are irregular in shape and generally range from 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 24 inches thick. It is dark yellowish brown, friable silt loam in the upper part and yellowish brown, friable sandy loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand.

Included with this soil in mapping are small areas of the moderately well drained Meridian soils. These soils are loam in the surface layer and in the upper part of the subsoil They are in the slightly lower positions on the landscape. They make up 6 to 10 percent of the unit.

Permeability is moderate in the subsoil of the Tell soil and rapid in the substratum. The available water capacity is moderate. The organic matter content is moderately low or moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by droughtiness in the sandy substratum.

Most areas are used as cropland. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a slight or moderate hazard. It can be controlled by contour farming, contour stripcropping, conservation tillage, and grassed waterways. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion.

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. The only soil-related management problem is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by suitable herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water.

This soil is suited to dwellings with basements. It is only moderately suited to dwellings without basements, however, because of the shrink-swell potential. This limitation can be overcome by excavating the soil and replacing it with coarse textured material, such as sand or gravel.

Because of low strength and the potential for frost action, this soil is poorly suited to local roads and streets. These limitations can be overcome by replacing the upper part of the soil with coarse textured base material, such as sand or gravel. Low strength also can be overcome by increasing the thickness of the pavement or the base material.

The land capability classification is IIe. The woodland ordination symbol is 4A.

Ud—Udifluvents, loamy, nearly level. These deep, moderately well drained and somewhat poorly drained soils are in areas on flood plains that commonly are dissected by streams and stream channels. The soils are frequently flooded. Individual areas are long and narrow and generally range from 5 to 40 acres in size

The soil texture and colors and the thickness of the individual soil layers vary greatly. Typically, the texture is loamy sand, sandy loam, or loam. In places the soils have strata of sand or silt loam.

Included with these soils in mapping are small areas of the poorly drained and very poorly drained Fordum soils. These included soils are in positions on the flood plains similar to those of the Udifluvents. They make up 2 to 15 percent of the unit.

Permeability is moderate to rapid in the Udifluvents. The available water capacity is low. The organic matter content is low in the surface layer.

Most areas are wooded. Some are used as pasture. A few are used as cropland. Because of the frequent flooding and the low available water capacity, these soils are generally not suited to cultivated crops They are poorly suited to pasture. Establishing or maintaining an improved pasture is difficult because of the flooding. Grazing is limited to periods when the soils are dry. The native vegetation generally is of poor quality for forage.

Because the soil properties vary, managing these soils as woodland is difficult. Competing vegetation interferes with natural regeneration and with the establishment of planted trees. This vegetation can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

These soils generally are not suitable as sites for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the frequent flooding. Overcoming this hazard is difficult. A better suited site should be selected.

The land capability classification is VIs. No woodland ordination symbol is assigned.

Ve—Vesper silt loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is in drainageways on uplands. It is subject to ponding. Individual areas are elongated and generally range from 10 to 60 acres in size.

Typically, the surface layer is very dark gray silt loam about 7 inches thick The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 26 inches thick. It is mottled It is dark grayish brown, friable loam in the upper part and olive gray, firm clay loam in the lower part. The substratum to a depth of about 60 inches is grayish brown, stratified sand and loam. In places the surface layer is loam. In some areas a few stones are on the surface. In other areas the slope is more than 2 percent.

Included with this soil in mapping are small areas of the poorly drained Elm Lake and somewhat poorly drained Kert soils. Elm Lake soils are in positions on the landscape similar to those of the Vesper soil. They are underlain by sandstone interbedded with shale. Kert soils are in the slightly higher positions on the landscape. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the subsoil of the Vesper soil and slow in the substratum. The available water capacity is moderate The organic matter content is high in the surface layer. The rooting depth of most plants is limited by a seasonal high water table, which is near or above the surface in undrained areas.

Most areas of this soil are used as unimproved pasture. Undrained areas are generally not suited to cultivated crops because of the wetness and the frost hazard. Drained areas are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The number of frost-free days per growing season is limited. Planting early maturing crop varieties or growing corn for silage helps to overcome the frost hazard.

This soil is poorly suited to trees. The trees grow so slowly and are so poorly shaped that they are barely merchantable at best. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Selection of vigorous nursery stock for planting reduces the seedling mortality rate. Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can

destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil generally is not suitable as a site for septic tank absorption fields, dwellings, or local roads and streets, mainly because of the ponding. Overcoming this hazard is difficult. A better suited site should be considered.

The land capability classification is VIw in undrained areas. The woodland ordination symbol is 1W.

Wb—Warman Variant sandy loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in shallow depressions and drainageways on outwash plains and stream terraces. Individual areas are irregular in shape and generally range from 5 to 75 acres in size.

Typically, the surface layer is very dark brown sandy loam about 12 inches thick. The subsoil is about 12 inches thick. It is mottled and friable. It is dark reddish brown and brown sandy loam in the upper part and dark brown loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown and dark yellowish brown sand and gravel. In places the surface layer is loam.

Included with this soil in mapping are small areas of the poorly drained and very poorly drained Minocqua soils in depressions. These soils have a loamy mantle that is thicker than that of the Warman Variant soil. They make up 2 to 10 percent of the unit.

Permeability is moderately rapid in the subsoil of the Warman Variant soil and rapid in the substratum. The available water capacity is low. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled throughout a wide range of moisture content. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 1 to 3 feet in undrained areas.

Most areas are used as cropland. A few are used as pasture. If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Excess water can be removed by diversions, grassed waterways, surface drains, and interceptor subsurface drains. If the water table is excessively lowered, however, crop yields in most years are limited by the low available water capacity. If tile drains are installed, the finer sand enters the tile lines unless a suitable filter covers the tile. In areas that are drained and cultivated, soil blowing is a hazard. It can be controlled by wind stripcropping, field windbreaks, and conservation tillage. Returning crop residue to the soil or adding other organic material reduces the hazard of soil blowing and the amount of water lost through evaporation, increases the rate of water infiltration, and helps to maintain fertility.

A cover of pasture plants is effective in controlling soil blowing. Overgrazing can cause surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and pasture rotation help to keep the pasture in good condition.

This soil is poorly suited to trees. The equipment limitation is the main management concern. The trees grow so slowly and are so poorly formed that they are barely merchantable. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable. Harvesting is frequently limited to periods when the ground is frozen. Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

This soil readily absorbs the effluent in septic tank absorption fields. It does not adequately filter the effluent, however, because of the rapid permeability. The poor filtering capacity can result in the pollution of ground water. The wetness also is a limitation. Mounding the site with suitable filtering material helps to overcome the wetness and the poor filtering capacity. Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by installing tile drains around foundations and providing gravity outlets or other dependable outlets and by constructing the foundations on coarse textured fill material above the level of wetness.

Because of the wetness and the potential for frost action, this soil is only moderately suited to local roads and streets. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

WeB—Withee silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is in concave areas on ground moraines. Individual areas are irregular in shape and generally range from 10 to 250 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is mostly pale brown, mottled silt loam about 10 inches thick. The subsoil is about 24 inches thick. It is mottled. It is mostly brown, friable silt loam in the upper part and reddish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown loam. In places the surface layer is loam or sandy loam. In some areas cobbles are on the surface.

Included with this soil in mapping are small areas of the moderately well drained Loyal and poorly drained and very poorly drained Cable soils. Loyal soils are in the

slightly higher positions on the landscape. Cable soils are in depressions and drainageways. Included soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Withee soil. The available water capacity is high. The organic matter content is moderate in the surface layer. This layer is friable and can be easily tilled, but it tends to crust and puddle after hard rains or if it is tilled when too wet. The rooting depth of most crops is limited by a seasonal high water table, which is at a depth of 0.5 foot to 2.0 feet in undrained areas

Most areas are used as cropland. A few are wooded If drained, this soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If the soil is cultivated, erosion is a slight or moderate hazard It can be controlled by conservation tillage and grassed waterways Land smoothing, surface drains, and diversions help to remove excess water. Returning crop residue to the soil or adding other organic material helps to maintain fertility and good tilth, increases the rate of water infiltration, and reduces the hazard of erosion

A cover of pasture plants is effective in controlling erosion. The surface layer is subject to crusting, which restricts the emergence of the plants. Alfalfa is generally short lived because of the seasonal high water table and the winterkill caused by frost heave. Red clover is generally grown. Overgrazing or grazing when the soil is too wet causes surface compaction, depletion of the plant cover, and an increase in the extent of undesirable plant species. Proper stocking rates, measures that improve fertility, and restricted use during wet periods help to keep the pasture in good condition

This soil is suited to trees. The equipment limitation and the windthrow hazard are management concerns. Because of the wetness, hand planting or machine planting on prepared ridges generally is needed if natural regeneration is unreliable Selection of vigorous nursery stock for planting reduces the seedling mortality rate Harvesting is frequently limited to periods when the ground is frozen. Harvesting by clearcut or area-selection methods helps to prevent windthrow of the remaining trees Competing vegetation interferes with natural regeneration following harvest. It can be controlled by herbicides or by mechanical removal. Skidding also can destroy competing vegetation and can expose enough mineral soil to allow for rapid natural regeneration.

Because of the wetness and the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Mounding the site with suitable filtering material helps to overcome these limitations Also, the effluent can be pumped to an absorption field on a better suited soil in some nearby areas.

Because of the wetness, this soil is poorly suited to dwellings. This limitation can be overcome by constructing foundations on coarse textured fill material above the level of wetness and by installing tile drains around the foundations and providing gravity outlets or other dependable outlets.

Because of the wetness and the potential for frost action, this soil is poorly suited to local roads and streets. Installing a subsurface drainage system and replacing the upper part of the soil with coarse textured base material, such as sand or gravel, help to prevent the damage caused by wetness and frost action.

The land capability classification is IIe. The woodland ordination symbol is 4W.

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 275,000 acres in Chippewa County, or more than 40 percent of the land area, is prime farmland. This land is in scattered areas throughout the county, mainly in associations 1, 3, 5, 6, and 7, which are described under the heading "General Soil Map Units." Approximately 175,000 acres of this land is used for crops The crops grown on this land, mainly corn and alfalfa, account for an estimated two-thirds of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial

and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

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 and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have 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 for crops and pasture; as woodland; 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 potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

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

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the 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.

In 1982, about 422,000 acres of Chippewa County was farmland. About 264,000 acres was used as cropland, 23,800 acres as pasture, and 102,450 acres as woodland. The rest was used for other farm purposes (*15*).

The potential for increased food production in Chippewa County is good. If proper conservation practices are applied, much of the pasture or woodland could be used for food crops. Food production also could be increased considerably by extending the latest crop production technology to all of the cropland in the county. This soil survey can greatly facilitate the application of such technology.

The paragraphs that follow describe main concerns in managing the soils in the county for crops and pasture. These concerns are water erosion, soil blowing, wetness, fertility, and tilth.

Water erosion is the major problem on about 60 percent of the cropland and pasture in the county. It is a hazard on all soils having a slope of 2 percent or more.

Loss of the surface layer through erosion is damaging in at least two ways. First, productivity is reduced as the surface layer is lost and part of the subsurface layer or subsoil is incorporated into the plow layer. The surface layer contains more organic matter than other parts of the soil. Incorporation of material from the subsurface layer or subsoil can result in poor tilth and crusting, which, in turn, can result in poor seed germination or seedling emergence. Second, erosion can result in sedimentation of streams. Control of erosion minimizes this pollution and improves water quality for municipal use, for recreation, and for fish and wildlife.

Erosion-control measures provide a protective ground cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that does not reduce the productive capacity of the soils. On livestock farms, where pasture and hay are needed, including grasses and legumes in the cropping sequence not only provides nitrogen and improves tilth but also reduces the risk of erosion.

Chisel plowing and other conservation tillage systems that leave crop residue on the surface increase the rate of water infiltration and reduce the hazard of erosion. These systems can be applied on most of the soils in the county.

Terraces and diversions reduce the length of slopes and the risks of erosion and runoff. They are most practical on deep, well drained or moderately well drained, gently sloping or sloping soils. Otterholt and Seaton are examples of soils that are suitable for terracing. Some soils are less well suited to terraces and diversions because they have irregular slopes, are moderately steep, or have sandstone within a depth of 40 inches.

Contour farming and contour stripcropping also help to control erosion in the county (fig. 8). They are best suited to soils that have uniform slopes. Arland, Eleva, Hixton, and Seaton soils are examples.

Soil blowing is a hazard on sandy and loamy soils, such as Billett, Mahtomedi, and Menahga soils, and on the organic Markey soils. It can damage the soils and young plants growing on them in just a few hours if winds are strong and the soils are dry and are not protected by vegetation or surface mulch. Maintaining a cover of plants or surface mulch, wind stripcropping, and establishing field windbreaks minimize soil blowing.

Information about the design of measures that control erosion and soil blowing on each soil in the county is provided in the Technical Guide, which is available in the local office of the Soil Conservation Service.

Wetness is the major management concern on about 20 percent of the acreage used for crops or pasture in

Figure 8.—Contour stripcropping, grassed waterways, and diversions on the moderately steep Seaton and Gale soils.

the county. Some soils are naturally so wet that they generally cannot be used for the crops commonly grown in the county unless they are drained. These are the very poorly drained and poorly drained soils, such as Barronett, Markey, and Rib. Unless drained, Comstock, Magnor, Withee, and other somewhat poorly drained soils are so wet that crops are damaged during most years.

The design of both surface and subsurface drainage systems varies, depending on soil properties and site conditions. A combination of surface and subsurface drains is needed in most areas of the poorly drained and very poorly drained soils used for intensive row cropping. Diversions are needed in some areas to remove runoff from the adjacent fields. In soils that are underlain by stratified silt and very fine sand or fine sand, special covering is needed over the drainage tile. This covering helps to keep substratum material from filling and clogging the tile.

If organic soils are used as cropland, special management measures are necessary. These soils oxidize and subside when water is removed from their pores and the pores are filled with air. Drainage systems that control the depth and period of drainage are needed. Keeping the water table at the level required for crop growth during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of these soils.

Further information about the design of drainage systems is provided in the Technical Guide, which is available in the local office of the Soil Conservation Service.

Soil fertility varies in the soils of Chippewa County, depending on the cropping history. Most of the soils are naturally acid. Applications of lime are needed to raise the pH of these soils to the level required by the crop to be grown. Available phosphorus and potassium levels are naturally low or medium in most of the soils. On all soils additions of lime or fertilizer should be based on the results of soil tests, the needs of the crop, and 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 is an important factor affecting the germination of seeds, the emergence of seedlings, and the infiltration of water into the soils. Soils with good tilth are granular and porous.

Tilling or grazing during wet periods can result in poor tilth, especially on soils that have a surface layer of silt loam. If the soil is bare, a surface crust can form during periods of heavy rainfall. This crust reduces the rate of water infiltration and increases the runoff rate and the hazard of erosion. Maintaining tilth is especially difficult on eroded soils because they have a lower content of organic matter than uneroded soils. Returning crop residue to the soil and regularly adding manure improve tilth and minimize crusting.

Field crops suited to most of the soils and the climate of the county include corn, which is the most commonly grown row crop, and oats, the most common close-grown crop. A limited acreage is used for barley or wheat.

The most commonly grown *hay and pasture* species are mixtures of alfalfa and bromegrass and of red clover and timothy. Bluegrass is the most common native pasture species.

Specialty crops grown commercially in the county are sweet corn, peas, snap beans, kidney beans, sunflowers, ginseng, potatoes, strawberries, raspberries, and apples. Most of the well drained soils are suited to these crops. Soils in low areas where frost is frequent and air drainage is poor generally are poorly suited to early vegetables, small fruits, and orchards. The latest 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 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification 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 (*7*). Available yield data from nearby counties and results of field trials and demonstrations are also considered.

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

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

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the 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. 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 rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*13*). 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.

Woodland Management and Productivity

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

Before settlement, the entire land area of Chippewa County was forested, except for limited areas of marsh (*5*). The trees have been removed from about two-thirds of the original forest. About 213,900 acres currently is forested. Of this acreage, 211,400 acres is commercial forest. The stands are dominated by the oak-hickory and aspen-birch forest types, each of which covers about 70,000 acres. The other forest types and their acreages are maple-beech-birch, 29,200 acres; conifers, 17,600 acres; and elm-ash-cottonwood, 16,300 acres. About 8,400 acres is nonstocked (*18*).

About 68 percent of the forested acreage occurs as privately owned farm woodlots, 15 percent as county and municipal forests, and 13 percent as privately owned nonfarm woodlots. The rest of the woodland is owned by corporations.

The woodland is protected by a well organized fire-control system. The main management concern probably is the need for removal of defective trees and of the less valuable species. Many of the pine plantations on sandy soils are now old enough to require pruning and thinning (fig. 9). Improved forest management is needed most on the privately owned land.

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

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

Figure 9.—Red pine plantation in an area of Menahga soils. Stands of pine are thinned for pulpwood and fenceposts. When mature, the remaining trees are used for saw logs.

a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F

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

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, 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, 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. Additional information about woodland management and productivity can be obtained from the Wisconsin Department of Natural Resources, the Soil Conservation Service, or the Cooperative Extension Service.

Windbreaks and Environmental Plantings

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

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

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

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

Recreation

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 bedrock or a hardpan should be considered.

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

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

Wildlife Habitat

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

Because of the diverse soils and land uses, Chippewa County has an abundant and varied population of wildlife. The paragraphs that follow specify the kinds of wildlife and wildlife habitat in areas of the associations described under the heading "General Soil Map Units."

The Menahga-Friendship association is a mixture of cropland, nonpastured grassland, woodland, and wetlands. The woodland supports primarily jack pine, red pine, and northern pin oak. The association has many streams and some large wetlands adjacent to the streams. The most common wildlife are red fox, whitetail deer, cottontail rabbit, raccoon, skunk, hawks, and owls. The chief wetland species are mallard, blue-winged teal, beaver, muskrat, mink, and otter.

Much of the Amery-Santiago association is wooded. Some areas, primarily those south of State Highway 64, are farmed. Large acreages of county forests are in this association. The woodland supports northern hardwoods, white birch, and aspen. Many lakes and wooded wetlands increase the diversity of the wildlife habitat. The typical wildlife species include whitetail deer, black bear, ruffed grouse, porcupine, coyote, red fox, snowshoe hare, bobcat, raccoon, squirrels, mink, otter, and beaver. Waterfowl also frequent this association, primarily during their migrations. The farmed areas are inhabited by such species as cottontail rabbit, woodchuck, badger, and skunk.

The Spencer-Magnor-Almena association provides habitat for many wildlife species because it has a good diversity of vegetation, including northern hardwoods and aspen. The association has many acres of county forests. Some large wetlands support shrubs, such as alder and willow, which provide cover for many wildlife species. Also, open wetlands attract waterfowl and muskrats. Areas near Boyd generally are cropped but have wooded corridors and scattered wetlands. The wildlife species are the same as those that inhabit the Amery-Santiago association.

The Elkmound-Plainbo-Eleva, Seaton-Gale, and Kert-Elm Lake-Vesper associations are used mainly for dairy

farms. There are a few wetlands and scattered woodlots, some of which are very large. The woodlots support oak and aspen. They provide some good habitat for deer and ruffed grouse. The most common wildlife species are red fox, cottontail rabbit, raccoon, and skunk.

The Billett-Rosholt-Oesterle association is used mainly for dairy farms and cash crops. Some areas are irrigated. The acreage of woodland is smaller than that in the Elkmound-Plainbo-Eleva and Seaton-Gale associations. Some areas have very little plant cover. The chief wildlife species are red fox, cottontail rabbit, raccoon, and skunk. The wildlife population is lower than that in other farmed areas.

The Flambeau-Fallcreek-Withee association generally is wooded. The soils in this association are highly productive sites for northern hardwoods. Some areas are farmed. Streams and wooded wetlands provide good habitat for furbearers. Other wildlife include squirrels, whitetail deer, ruffed grouse, and many other woodland species.

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 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 curly dock, goldenrod, smartweed, and ragweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are dogwood, highbush cranberry, and crabapple.

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

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 depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds (fig. 10).

Figure 10.—A wildlife pond in an area of Cable soils.

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, bobolink, meadowlark, field sparrow, cottontail rabbit, and red fox.

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

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

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. 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, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the 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 the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 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. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site

features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts 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, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

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

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

Excessive seepage 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 and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts 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 bedrock or 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. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal 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 fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts, 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, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts, and 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. 11) "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.

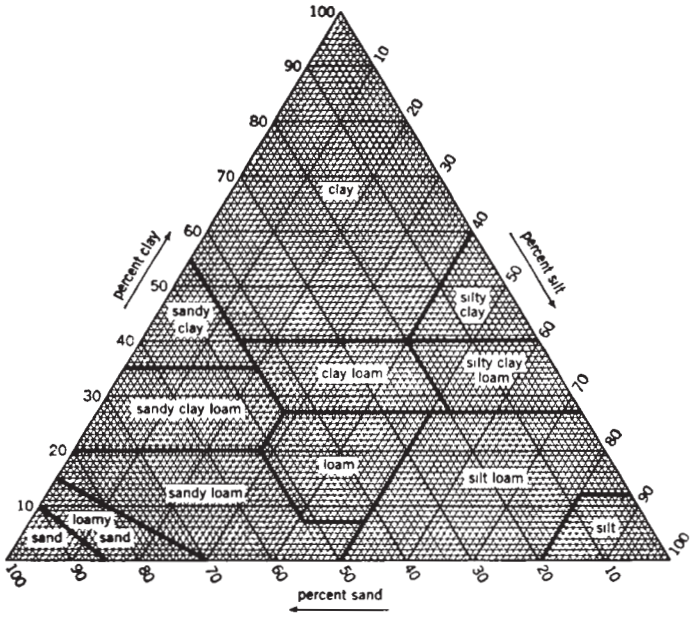

Figure 11.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence 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 total subsidence, which usually is a result of 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 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)