United States Department of Agriculture

Natural Resources Conservation Service and Forest Service

In cooperation with Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Michigan State University Extension, and Michigan Technological University

# Soil Survey of Alcona County, Michigan

# How to Use This Soil Survey

### General Soil Map

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

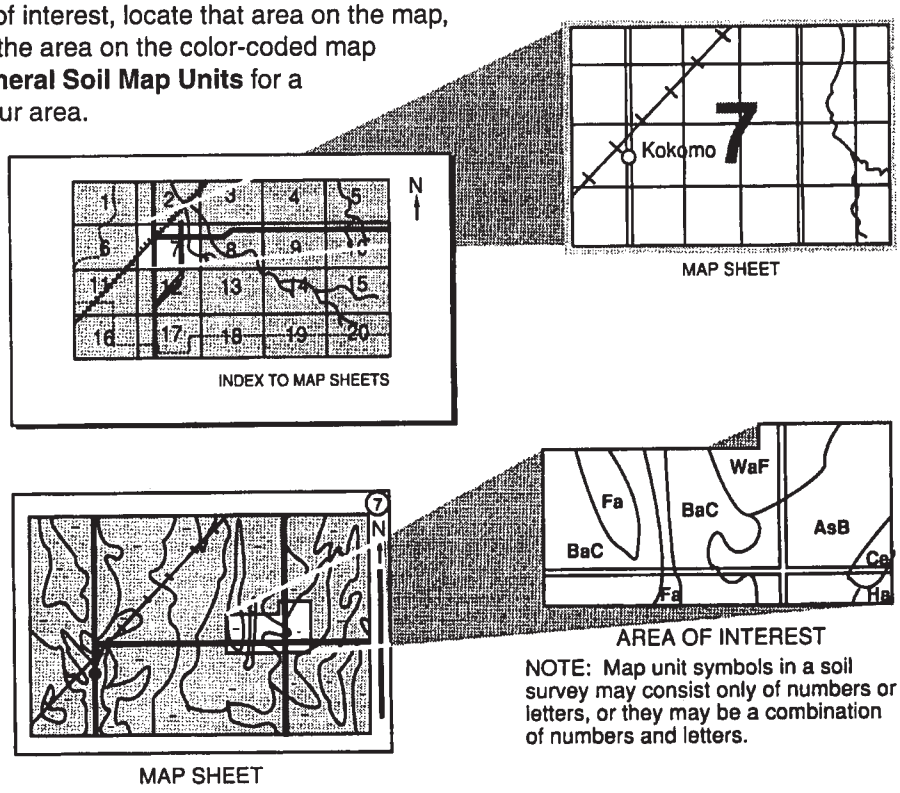
To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

### Detailed Soil Maps

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

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

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




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

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

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

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the Forest Service, Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Michigan State University Extension, and Michigan Technological University. Financial assistance was provided by the Alcona County Board of Commissioners. The survey is part of the technical assistance furnished to the Alcona County Soil and Water Conservation District.

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

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**Cover: Deer grazing in a wildlife planting in an area of Chinwhisker sand, 0 to 4 percent slopes.**

# Contents

Issued 1998

# Foreword

This soil survey contains information that can be used in land-planning programs in Alcona 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 too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

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

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State Conservationist
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# Soil Survey of
# Alcona County, Michigan

By Thomas E. Williams, Michigan Department of Agriculture

Fieldwork by Thomas E. Williams and Larry F. Perrault, Michigan Department of Agriculture; Dwight S. Jerome and Ramez Mahjoory, Natural Resources Conservation Service; and Jeffrey Bruggink, Richard Watson, and Peter Greaney, Forest Service

United States Department of Agriculture, Natural Resources Conservation Service and Forest Service,
in cooperation with
the Michigan Department of Agriculture, Michigan Agricultural Experiment Station, Michigan State University Extension, and Michigan Technological University

Alcona County is in the northeastern part of the Lower Peninsula of Michigan (fig. 1). It is adjacent to Lake Huron. The county is bordered on the north by Alpena County, on the west by Oscoda County, and on the south by Iosco County. The county has an area of 445,126 acres, or approximately 695 square miles. About 70 percent is forested, including 113,000 acres in the Huron National Forest. About 13 percent of the county is farmed, and about 17 percent is used for other purposes, including recreation, wetlands, and transportation. In 1990, the population of the county was 10,145 and that of Harrisville, the county seat, was 559. Timber production, farming, and tourism are the main enterprises in the county.

Alcona County has about 153 different soil types. The soils vary widely in texture, natural drainage, slope, and other characteristics. Well drained and moderately well drained soils make up about 68 percent of the county, somewhat poorly drained soils make up 20 percent, and poorly drained and very poorly drained soils make up 12 percent.

## General Nature of the County

This section provides general information about the county. It describes history and development, climate, physiography, and lakes and streams.

### History and Development

Alcona County was formed by the Michigan Legislature in 1840 (Gauthier, 1989). It was first known as the Negwegon District, named after the Chippewa Indian chief. In 1843, the name was changed to Alcona District. Alcona is a Chippewa word meaning "a fine plain." In 1846, the first settlement in the county, a commercial fishing port, was established at the village of Springport. The first crop, rye, was raised near Springport in 1857. Additional ports were established at Alcona, Black River, and Harrisville to accommodate the growing fishing fleets and to serve the lumber industry. The Sturgeon Point Lighthouse opened in 1870 as a navigation aid, and the Life Saving Station opened in 1876.

In 1856, a water-powered sawmill was sold to Benjamin Harris. The mill was located at Mill Pond and was developed into a grist mill and sawmill. The village at this mill, Harrisville, became the county seat when Alcona County was established in 1869. By 1875, the expansion of logging had opened the county westward to Curran. The largest sawmill was at Black River. This mill burned in 1898.

Today the commercial ports no longer serve lumber and fishing commerce. The last commercial


**Figure 1.—Location of Alcona County in Michigan.**

fishing operation in Black River closed in 1950. The highway and road system serves the transportation needs of the forest producer, farmer, and tourist.

## Climate

The climate in the county is highly varied because of topographic variations and the county's proximity to Lake Huron. These variations cause changes in the climate over distances of only a few miles. Since adequate records are not available in Alcona County, data from stations at East Tawas and Hale, in adjacent Iosco County, were used.

Table 1 gives data on temperature and precipitation for the survey area as recorded at East Tawas and Hale in the period 1951 through 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 22.4 degrees F at East Tawas and 20.1 degrees at Hale. The average daily minimum temperature is 13.5 degrees F at East Tawas and 10.5 degrees at Hale. The lowest temperature on record, which occurred at East Tawas on February 20, 1929, is -29 degrees. In summer, the average temperature is 65.8 degrees F at East Tawas and 65.5 degrees at Hale. The average daily maximum temperature is 77.7 degrees F at East Tawas and 78.2 degrees at Hale. The highest recorded temperature, which occurred at East Tawas on July 9, 1936, is 106 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 29.46 inches in East Tawas and 28.05 inches in Hale. Of this, about 60 percent usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15.02 inches. The heaviest one-day rainfall during the period of record is 3.72 inches at East Tawas on August 16, 1938, and 3.50 inches at Hale on September 21, 1947. Thunderstorms occur on about 32 days each year, and most occur in July.

The average seasonal snowfall is 49.5 inches at East Tawas and 50.8 inches at Hale. The greatest snow depth at any one time during the period of record was 37 inches. On the average, 93 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.

Based on data recorded at the National Weather Service Office at Alpena Airport, in adjacent Alpena County, the average relative humidity at 1:00 p.m. is about 61 percent. Humidity is higher at night, and the average at 7:00 a.m. is about 83 percent. The sun shines 64 percent of the time possible in summer and 37 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 9.2 miles per hour, in April.

## Physiography

Alcona County is in the northeast upland division of the state, which is covered by thick deposits of glacial drift. Major topographic divisions are level and undulating plains and rolling to hilly morainic areas (fig. 2). Five distinct kinds of surface features occur in Alcona County. These are moraines, till plains, glacial drainage terraces, lake plains, and deltas. All of these features formed as a result of the complex action of glaciers and postglacial lakes (Kelley and Farrand, 1988).

The morainic areas are characterized by rolling to steep, uneven, knoblike hills and pothole depressions. The largest morainic area extends from

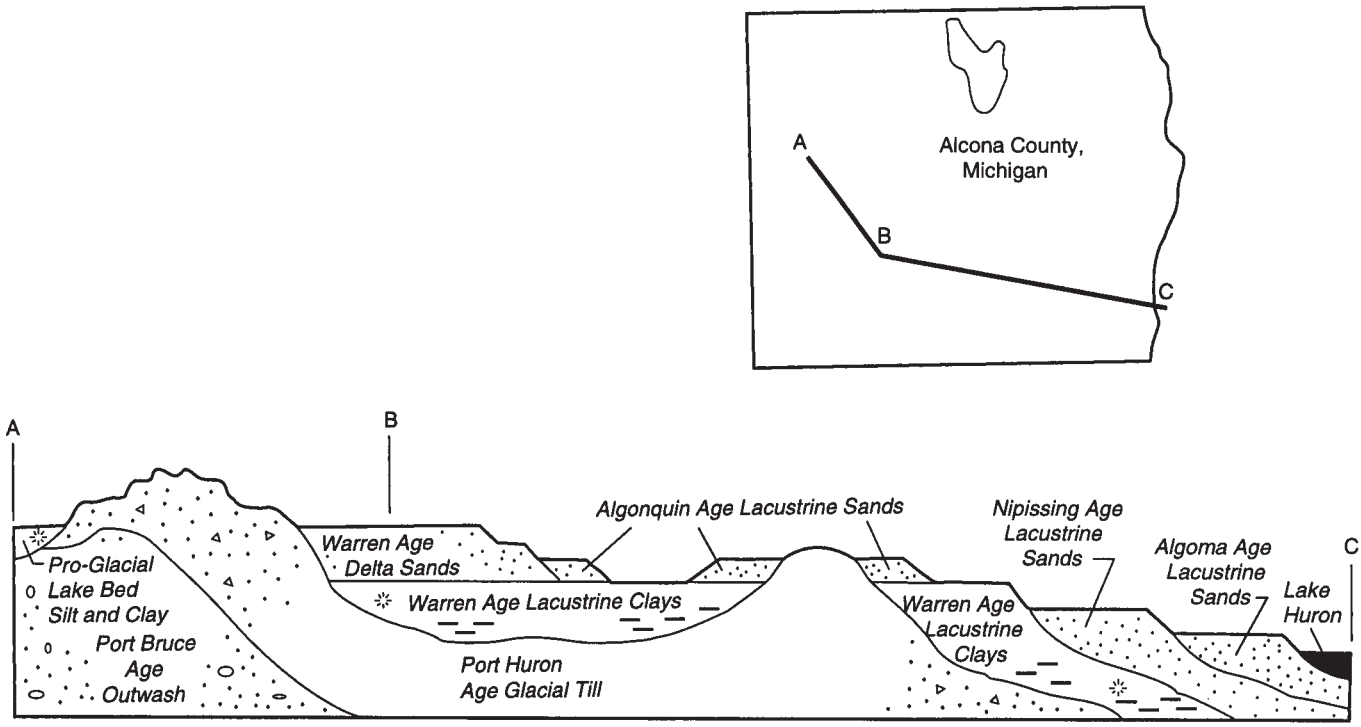


**Figure 2.—Diagrammatic cross-section showing glacial deposits of Alcona County. Modified after Burgis and Eschman, 1981.**

central Mitchell Township through the eastern part of Curtis Township.

The till plains, which occur in the form of drumlin fields, are characterized by elongated hills and ridges oriented from north to south. These till plains occur in Alcona, Hawes, and Haynes Townships.

Glacial drainage terraces are intermingled with the morainic areas and till plains. These terraces are characterized by elongated, nearly level to sloping areas that are pitted in places. The largest glacial drainage terrace is in the Au Sable River valley in the western part of Curtis Township.

The lake plains are associated with the former Great Lakes Warren, Algonquin, and Nipissing. They are characterized by nearly level to undulating areas separated by steep scarps, reflecting changes in lake elevation. The largest lake plain is in Mikado Township.

The deltas are characterized by broad, nearly level plains dissected at widely spaced intervals by deeply incised stream and river channels. The largest delta in the county formed at the outlet of the Au Sable River when it flowed into glacial Lake Warren.

The highest elevation in the county, 1,273 feet above mean sea level, is 3 miles southwest of Curran. The lowest elevation, 577 feet above mean sea level, is at the shoreline of Lake Huron, which forms the eastern boundary of Alcona County. Other significant elevations are the ancient shorelines of Great Lakes Warren, Algonquin, and Nipissing, which are about 850 feet, 680 feet, and 600 feet, respectively.

## Lakes and Streams

Alcona County has about 60 lakes and 3 major rivers. These water areas differ in size, shape, and shoreline characteristics. Bodies of water more than 40 acres in size make up about 10,500 acres in the survey area.

Among the larger lakes are Hubbard Lake, 8,821 acres; Alcona Dam Pond, 1,096 acres; Cedar Lake, 780 acres; and Jewell Lake, 185 acres.

Alcona County includes five watersheds. The Au Sable River flows south through the southwest corner of the county and drains the Au Sable River Watershed. The Pine River and its tributaries drain the Pine River Watershed in the south-central part of the county. The Pine River flows to the southeast and leaves the county in Mikado Township. The Black River drains the Black River Watershed in the northeastern part of the county and flows into Lake

Huron at the village of Black River. Wolf Creek drains the Wolf Creek Watershed in the northwestern part of the county. Hubbard Lake receives water from feeder streams in the Hubbard Lake Watershed in the north-central part of the county. Hubbard Lake drains to the Lower South Branch of the Thunder Bay River.

## How This Survey Was Made

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

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

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

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

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

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

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

### Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is

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

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called 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.

## Survey Procedures

The general procedures followed in making this survey are described in the National Soil Survey Handbook of the Natural Resources Conservation Service (USDA/NRCS). The Huron-Manistee National Forest Ecological Classification System (Driscoll and others, 1984) was used in conjunction with the handbook to prepare the soil survey on the Forest Service lands within the administrative boundary of the Huron National Forest. The map units on the Forest Service lands were designed differently from those in other parts of the survey area.

The ecological classification system is an integrated system that includes evaluation and classification of landscape areas. Ecological units are mapped on aerial photographs, and interpretations are made from inventory maps for use in managing forest land and resources. In this survey, map symbols 209B through 282 identify map units within the Huron National Forest.

### Procedures for Map Units 11B to 111B

The soil survey maps made for conservation planning prior to the start of the project were among the references used. Before the actual fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on 1:20,000 leaf-off aerial photographs. USGS topographic maps at a scale of 1:24,000 were used to help the soil scientists relate land and image features.

A reconnaissance was made by pickup truck before the soil scientists traversed the surface on foot. In areas where the soil pattern is very complex, traverses and random observations were spaced as closely as 200 yards. In areas where the soil pattern is relatively simple, traverses were about one-fourth mile apart.

As they traversed the surface, the soil scientists divided the landscape into segments. For example, a hillside was separated from a swale and a gently sloping ridgetop from a very steep side slope.

Observations of such items as landforms, blown-down trees, vegetation, and roadbanks were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations of the landscape and vegetation, and photo interpretation. The soil material was examined with the aid of a hand auger or a spade to a depth of about 7 feet. The pedons described as typical were observed and studied in pits that were dug with shovels, mattocks, and digging bars.

Notes were taken on the composition of map units during the first years of the project. These notes were supplemented with additional notes as mapping progressed and as the composition of individual map units was determined.

Samples for chemical and physical analyses were taken from representative sites of some soils in the survey area (USDA, 1991). The analyses were made by the Soil Research Laboratory, Michigan Technological University, Houghton, Michigan, and the National Soil Survey Laboratory, Lincoln,

Nebraska. The results of the studies can be obtained on request from the two laboratories or from the State office of the Natural Resources Conservation Service in East Lansing, Michigan.

After the completion of soil mapping on aerial photographs, map unit delineations were transferred by hand to another set of the same photographs. Cultural features were recorded from observations of the maps and the landscape.

**Procedures for Map Units 209B to 282**

Before ecological units were mapped, information on the climate, geology, soils, hydrology, and vegetation in the survey area was collected. Research techniques were used in mid and late successional stands to collect information on vegetative and soil components in areas of uplands. Samples were not collected on early successional aspen stands, young stands, plantations, or stands disturbed by recent harvest or fires. The results were used in developing ecological map units that are defined on the basis of both abiotic and biotic landscape characteristics. Abiotic landscape characteristics are generally stable over time, such as climate and landforms. Biotic characteristics are generally unstable over time, such as vegetation.

A premapping reconnaissance was conducted in the survey area before actual field inventory began. Important results of the reconnaissance activities include a listing of the expected ecological units that would be mapped in the area, the definition of features differentiating the units, and a set of specific sites in the Huron-Manistee National Forest where detailed data had been collected and analyzed in the laboratory for quality control.

Following reconnaissance, the mapping personnel traversed the landscape, evaluated the components of the current ecosystems, determined and observed ecological unit boundaries in the field, and delineated preliminary map units on aerial photographs. During field mapping, stereo images, photo-tones, and photo colors were used to delineate landscape features on the aerial photographs. Some important characteristics used by the field personnel to evaluate the context of an area included water table levels, soil texture and color, drainage systems, geologic indicators, and interpretation of vegetative species groups.

Mappers typically inventoried 300 to 500 acres per day. They performed detailed evaluations and completed note cards on 10 to 15 specific sites. These sites were strategically selected for the examination of landscape features and the collection of data on overstory, understory, ground flora, forest floor, soil, substratum, and ground water for documenting ecological units. Profiles of sandy soils were described to a depth of 15 feet. The presence of textural bands has been shown to have a significant influence on tree growth and species composition (Hannah and Zahner, 1970; Host and others, 1988). Thus, recording the presence, absence, or intensity of deep-lying textural bands was an important part of the sampling and inventory scheme. These data are a permanent part of the forest records available at the Huron-Manistee National Forest supervisor's office.

Following field inventory, the final boundaries of the ecological units were drawn on the aerial photographs. The completed photography was checked for line closure and for matching of delineations across photographs.

# General Soil Map Units

The general soil map in 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.

## Nearly Level and Gently Undulating Soils That Are Very Poorly Drained and Somewhat Poorly Drained

Most areas of these soils are used as woodland. Some are used for building site development. The soils are suited to trees and to habitat for wetland wildlife. They are poorly suited or unsuited to crops. The major management concerns affecting woodland are the equipment limitation and the windthrow hazard. If cultivated crops are grown, removing excess water, preventing ponding, and providing drainage outlets are management concerns. The soils are poorly suited or unsuited to building site development and to septic tank absorption fields.

### 1. Au Gres-Wakeley-Tawas Association

*Deep, nearly level and gently undulating, somewhat poorly drained and very poorly drained, sandy and mucky soils that formed in sandy material or in organic material underlain by sandy or sandy and clayey material; on lake terraces*

The Au Gres soils in this association are on long narrow ridges. The Wakeley and Tawas soils are in long narrow depressions. Slopes range from 0 to 4 percent.

This association makes up about 14 percent of the county. It is about 35 percent Au Gres soils, 25 percent Wakeley soils, 15 percent Tawas soils, and 25 percent soils of minor extent.

Au Gres soils are gently undulating and are somewhat poorly drained. Typically, the surface layer is black sand about 3 inches thick. The subsurface layer is pinkish gray sand about 7 inches thick. The subsoil is sand about 23 inches thick. It is mottled. The upper part is dark brown, the next part is dark yellowish brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is pale brown, mottled sand. In some areas the substratum is reddish brown, mottled silty clay below a depth of 40 inches.

Wakeley soils are nearly level and are very poorly drained. Typically, the surface layer is black, mottled mucky sand about 6 inches thick. The sandy part of the substratum is about 23 inches thick. The upper part is gray sand; the next part is grayish brown, mottled sand; and the lower part is grayish brown, mottled, stratified sand and loamy sand. The clayey part of the substratum extends to a depth of about 60 inches. It is pinkish gray, mottled clay in the upper part and pinkish gray, mottled, stratified clay and silty clay in the lower part.

Tawas soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 5 inches thick. The next layer also is black muck. It is about 12 inches thick. The substratum to a depth of about 60 inches is brown and dark brown sand.

Of minor extent in this association are the moderately well drained Croswell soils, the somewhat poorly drained Allendale soils, and the very poorly drained Ausable soils. Croswell soils are on the higher and broader ridges. Allendale soils are underlain by silty clay. They are on low ridges. Ausable soils are on flood plains.

This association is used mainly as woodland or as wildlife habitat. Some areas of the Au Gres soils are used for building site development. If the soils are used as woodland, the major management concerns are equipment limitations, the windthrow hazard, and

plant competition. Seedling mortality is an additional concern on the Wakeley and Tawas soils. The soils in this association are poorly suited to use as cropland or as building sites. Ground-water pollution is a hazard.

### 2. Lupton-Tawas-Leafriver Association

*Nearly level, very poorly drained, mucky soils that formed in organic material or organic material and sandy material; on lake plains and outwash plains*

The soils in this association are in depressional areas. Slopes range from 0 to 2 percent.

This association makes up about 6 percent of the county. It is about 40 percent Lupton soils, 25 percent Tawas soils, 15 percent Leafriver soils, and 20 percent soils of minor extent.

Typically, the surface layer of the Lupton soils is black muck about 5 inches thick. The underlying layers to a depth of about 60 inches are dark reddish brown muck.

Typically, the surface layer of the Tawas soils is black muck about 5 inches thick. The next layer also is black muck. It is about 12 inches thick. The substratum to a depth of about 60 inches is brown and dark brown sand.

Typically, the surface layer of the Leafriver soils is black muck about 9 inches thick. The subsoil is brown, mottled sand about 12 inches thick. The substratum extends to a depth of about 60 inches. It is grayish brown, mottled sand in the upper part and dark grayish brown sand in the lower part.

The most common soils of minor extent in this association are the ponded Aquents and Histosols and the very poorly drained Dorval soils and Borosaprists.

This association is used as wildlife habitat or as woodland. The main management concerns are the windthrow hazard, equipment limitations, seedling mortality, and plant competition.

This association is generally unsuited to crops and pasture because of wetness and low strength. The soils are generally unsuited to building site development because of ponding and low strength.

## Nearly Level to Rolling Soils That Are Well Drained to Poorly Drained

Most areas of these soils are used as cropland or pasture. Some are used as woodland or for building site development. The soils are suited to crops and pasture. Management concerns are wetness, water erosion, and soil blowing. The soils are suited to woodland. Major management concerns affecting woodland are equipment limitations, seedling mortality, the windthrow hazard, and plant competition. Most areas of these soils are poorly suited to building site development and septic tank absorption fields. Seasonal wetness, the slope, restricted permeability, and a moderate or high shrink-swell potential are limitations.

### 3. Algonquin-Negwegon-Springport Association

*Nearly level and undulating, moderately well drained to poorly drained, loamy soils that formed in loamy and clayey sediments; on lake plains*

The soils in this association are on broad low-lying plains. Slopes range from 0 to 6 percent.

This association makes up about 10 percent of the county. It is about 32 percent Algonquin soils, 21 percent Negwegon soils, 13 percent Springport soils, and 34 percent soils of minor extent (fig. 3).

Algonquin soils are nearly level and undulating and are somewhat poorly drained. Typically, the surface layer is dark brown, mottled silt loam about 7 inches thick. The subsoil is mottled. It extends to a depth of more than 60 inches. The upper part is reddish brown and light reddish brown silty clay and silty clay loam about 22 inches thick. The lower part is light reddish brown silty clay loam.

Negwegon soils are undulating and are moderately well drained. Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsoil is about 38 inches thick. The upper part is reddish brown, mottled silty clay loam and brown silt loam. The lower part is reddish brown clay and silty clay. The substratum to a depth of about 60 inches is stratified brown silty clay loam and yellowish brown silt loam.

Springport soils are nearly level and are poorly drained. Typically, the surface layer is very dark gray clay loam about 8 inches thick. The subsoil is about 19 inches thick. It is mottled. The upper part is grayish brown clay. The lower part is reddish brown silty clay. The substratum to a depth of about 60 inches is reddish brown, mottled silty clay.

The most common soils of minor extent in this association are the moderately well drained Alcona and Hoist soils, the somewhat poorly drained Richter soils, and the poorly drained Tonkey soils. Alcona and Richter soils are in broad nearly level areas. Tonkey soils are in depressions and drainageways. Hoist soils are on knolls, ridges, and breaks to drainageways.

The soils in this association are used mainly as cropland or pasture. A few areas are used as woodland or as building sites.

The major soils are moderately well suited to crops and pasture. The major management concerns are overcoming the seasonal wetness and maintaining soil tilth. The hazard of erosion is an additional concern in areas of the Negwegon and Algonquin soils. If

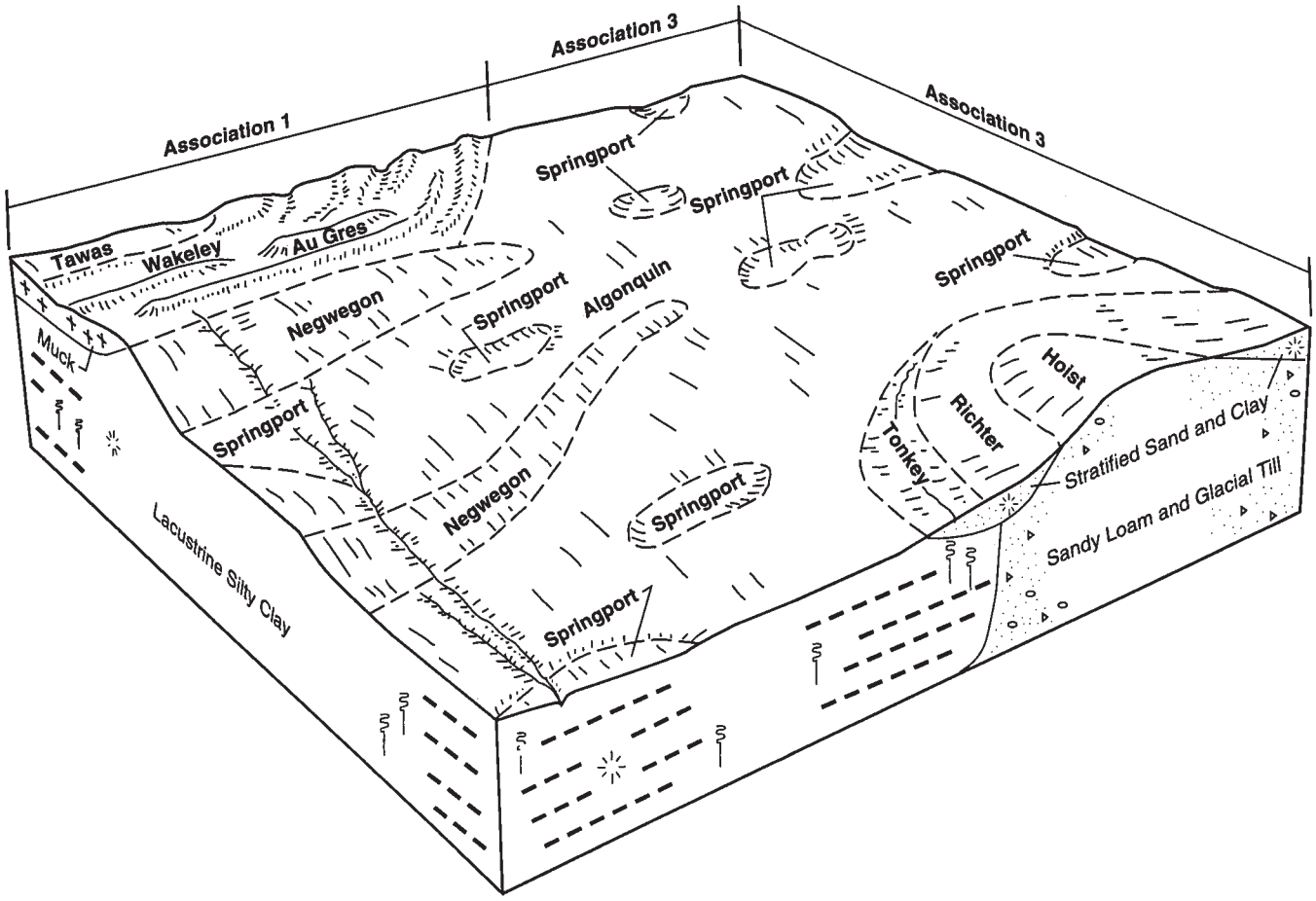


**Figure 3.—Typical pattern of soils and parent material in the Algonquin-Negwegon-Springport association (adjacent to the Au Gres-Wakeley-Tawas association).**

pastures are overgrazed, surface compaction is a management concern.

In areas used as woodland, the management concerns are equipment limitations, the windthrow hazard, seedling mortality, and plant competition.

The major soils are poorly suited or generally unsuited to building site development. The seasonal wetness, restricted permeability, and a high shrink-swell potential are limitations.

### 4. McGinn-Hoist-Klacking Association

*Nearly level to rolling, moderately well drained and well drained, sandy and loamy soils that formed in sandy and loamy material; on ground moraines*

The soils in this association are on knolls and ridges in the uplands. Slopes range from 0 to 18 percent.

This association makes up about 17 percent of the county. It is about 30 percent McGinn soils, 14 percent Hoist soils, 11 percent Klacking soils, and 45 percent soils of minor extent (fig. 4).

McGinn soils are well drained. Typically, the surface is covered with a layer of forest litter about 1 inch thick. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is light brownish gray loamy sand about 2 inches thick. The subsoil is about 31 inches thick. The upper part is strong brown and dark yellowish brown loamy sand. The next part is mixed grayish brown loamy sand and reddish brown sandy loam. The lower part is reddish brown sandy loam. The substratum to a depth of about 80 inches is light reddish brown sandy loam.

Hoist soils are moderately well drained and well drained. Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown sandy loam. Below this is mixed brown and reddish brown sandy loam. The next part is reddish brown loam. The lower part is light reddish

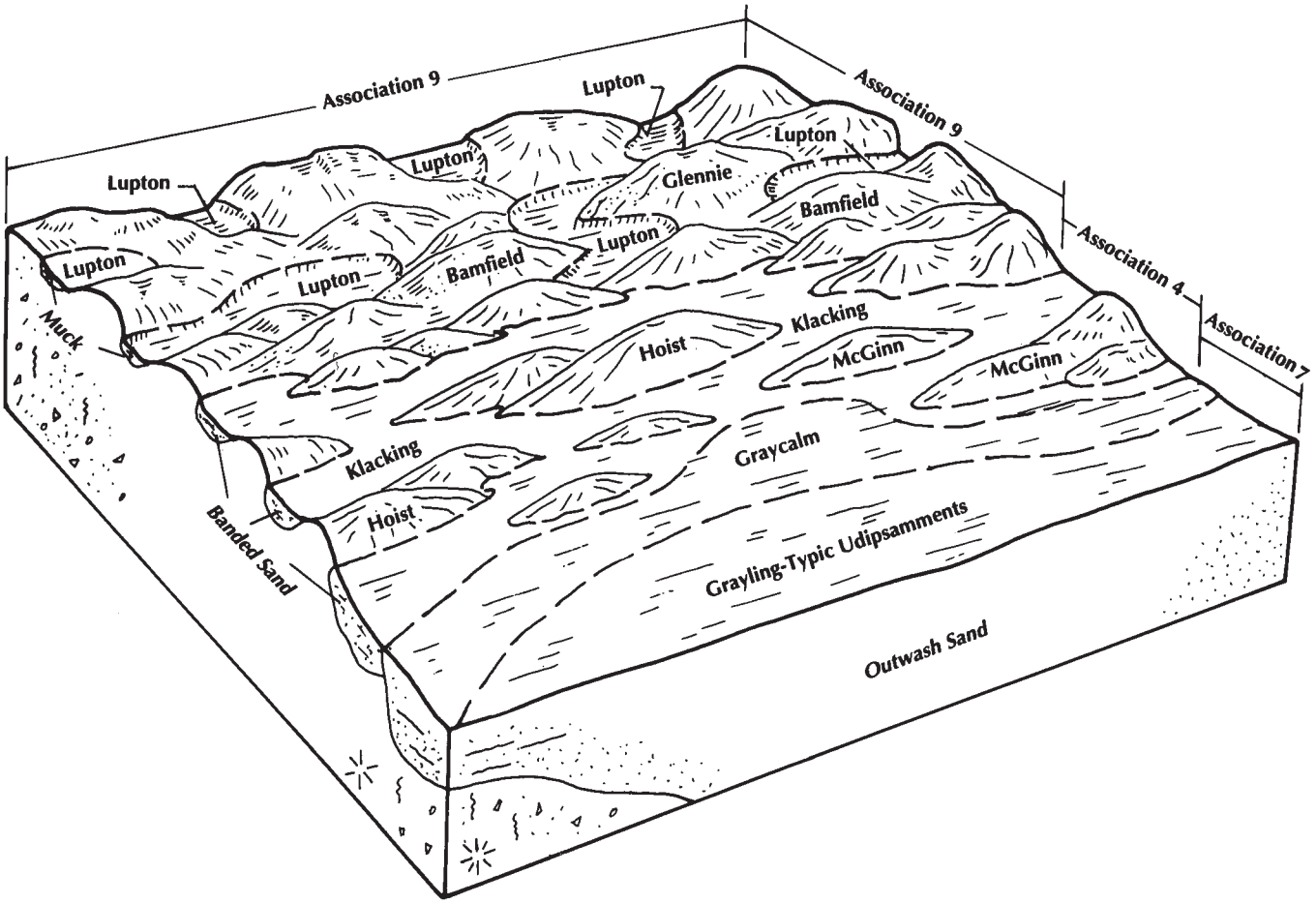


**Figure 4.—Typical pattern of soils and parent material in the McGinn-Hoist-Klacking, Grayling-Graycalm-Typic Udipsamments, and Glennie-Bamfield-Lupton associations.**

brown sandy loam that is mottled in places. The substratum to a depth of about 80 inches is light reddish brown sandy loam.

Klacking soils are well drained. Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark yellowish brown and yellowish brown loamy sand. Below this is light yellowish brown loamy sand that has bands of dark brown sandy loam. The next part is dark brown sandy loam and light yellowish brown loamy sand. The lower part is light yellowish brown loamy sand that has bands of dark brown sandy loam.

The most common soils of minor extent are the somewhat excessively drained East Lake soils, the excessively drained Entic Haplorthods, the well drained Alfic Haplorthods, the somewhat poorly drained Killmaster soils, and the poorly drained Ensley soils. East Lake soils, Entic Haplorthods, and Alfic Haplorthods are in the same landscape positions as the major soils. Killmaster soils are on nearly level tops of ridges and on the lower side slopes. Ensley soils are in depressions.

The soils in this association are used as cropland, pasture, woodland, or building sites.

The major soils are moderately well suited to crops and pasture. The major management concerns are water erosion and soil blowing. The slope is a management concern in the rolling areas.

If the major soils are used as woodland, equipment limitations and plant competition are management concerns in areas of the Hoist soils. Seedling mortality and seasonal droughtiness are management concerns in areas of the Klacking soils.

The McGinn and Klacking soils are suited to building site development in nearly level areas. Seasonal wetness and the slope are limitations in most other areas of this association.

### 5. Bamfield-Nester-Glossic Eutroboralfs Association

*Nearly level to gently rolling, moderately well drained and well drained, loamy soils that formed in loamy material; on ground moraines*

The soils in this association are on knolls and ridges in the uplands. Slopes range from 0 to 12 percent.

This association makes up about 6 percent of the county. It is about 32 percent Bamfield soils, 19 percent Nester soils, 18 percent Glossic Eutroboralfs, and 31 percent soils of minor extent.

Bamfield soils are moderately well drained and well drained. Typically, the surface is covered with a layer of forest litter about 1 inch thick. The surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is more than 60 inches thick. In sequence downward, it is yellowish brown fine sandy loam; pinkish gray fine sandy loam; mixed reddish brown clay loam and pinkish gray fine sandy loam; reddish brown clay loam that is mottled in places; and light reddish brown clay loam.

Nester soils are moderately well drained and well drained. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is mixed brown sandy loam and reddish brown, mottled clay loam. The next part is reddish brown, mottled clay loam. The lower part is reddish brown clay loam. The substratum to a depth of about 60 inches is light reddish brown clay loam.

Glossic Eutroboralfs are well drained. Typically, the surface layer is very dark gray sandy loam about 3 inches thick. The subsoil is about 40 inches thick. The upper part is brown and dark brown loamy sand. The next part is mixed reddish brown sandy clay loam and brown sandy loam. The lower part is reddish brown loamy sand. The substratum to a depth of about 80 inches is reddish brown loam.

Of minor extent in this association are the somewhat poorly drained Kawkawlin soils and the well drained Manistee soils and Arenic Eutroboralfs. Kawkawlin soils are in slightly depressional areas. Manistee soils and Arenic Eutroboralfs are in the same landscape positions as the major soils.

The soils in this association are used for crops and pasture (fig. 5), as woodland, or as building sites.

The major soils are moderately well suited to crops and pasture. The major management concern is controlling erosion.

If the major soils are used as woodland, equipment limitations and plant competition are management concerns.

These soils are only fairly well suited to building site development because of seasonal wetness, a moderate shrink-swell potential, and slow permeability.

### 6. Glennie-Sprinkler Association

*Nearly level to gently rolling, moderately well drained and somewhat poorly drained, loamy soils that formed in sandy and loamy material; on ground moraines*

The soils in this association are on broad plains in the uplands. Slopes range from 0 to 12 percent.

This association makes up about 2 percent of the county. It is about 75 percent Glennie soils, 15 percent Sprinkler soils, and 10 percent soils of minor extent.

Glennie soils are nearly level to gently rolling and are moderately well drained. Typically, the surface is covered with a layer of forest litter about 2 inches thick. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is grayish brown loamy sand about 4 inches thick. The subsoil extends to a depth of more than 80 inches. In sequence downward, it is dark brown sandy loam and strong brown loamy sand; mixed brown loamy sand and reddish brown loam; mottled, mixed reddish brown sandy clay loam and brown sandy loam; mottled, dark reddish brown clay; and reddish brown sandy clay loam.

Sprinkler soils are nearly level and are somewhat poorly drained. Typically, the surface layer is very dark gray sandy loam about 5 inches thick. The subsurface layer is brown, mottled sandy loam about 8 inches thick. The subsoil is about 31 inches thick. It is mottled. The upper part is mixed brown sandy loam and brown loam. The next part is dark brown loam. The lower part is brown loam. The substratum to a depth of about 60 inches is brown, mottled loam.

Of minor extent in this association are the well drained Klacking soils and the very poorly drained Lupton soils. Klacking soils are in the same landscape positions as the Glennie soils. Lupton soils are in depressions.

The soils in this association are used as woodland. Some areas are used as pasture, cropland, or building sites.

The major soils are well suited to trees. Equipment limitations and plant competition are limitations.

The major soils are moderately well suited to crops and pasture. The major management concerns are water erosion and soil blowing on the Glennie soils and wetness on the Sprinkler soils.

The seasonal high water table, restricted permeability, and a moderate shrink-swell potential

**Figure 5.—Grass-legume hay in an area of Nester soils. Bamfield soils are in the background.**

are limitations if these soils are used as building sites.

## Nearly Level to Hilly Soils That Are Excessively Drained to Well Drained

Most areas of these soils are used as woodland. Some areas are used as building sites. Equipment limitations and seedling mortality are management concerns. The soils are suited to building site development, but a poor filtering capacity can result in the contamination of local ground water.

### 7. Grayling-Graycalm-Typic Udipsamments Association

*Nearly level and undulating, excessively drained and somewhat excessively drained, sandy soils that formed in sandy material; on deltas, outwash plains, and stream terraces*

The soils in this association are on broad plains in the uplands. They are deeply dissected at widely spaced intervals by currently active drainageways. Slopes range from 0 to 6 percent.

This association makes up about 14 percent of the county. It is about 47 percent Grayling soils, 18 percent Graycalm soils, 18 percent Typic Udipsamments, and 17 percent soils of minor extent (fig. 4).

Grayling soils are excessively drained. Typically, the surface layer is black sand about 2 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown sand. The lower part is yellowish brown sand. The substratum to a depth of about 80 inches is light yellowish brown sand.

Graycalm soils are somewhat excessively drained. Typically, the surface layer is black sand about 1 inch thick. The subsoil extends to a depth of more than 80 inches. The upper part is strong brown sand and loamy sand. The lower part is light yellowish brown sand that has bands of brown loamy sand.

Typic Udipsamments are excessively drained. Typically, the surface is covered with a layer of forest litter about 1 inch thick. The surface layer is very dark gray sand about 2 inches thick. The subsurface layer is light brownish gray sand about 2 inches thick. The subsoil is sand about 36 inches thick. The upper part is yellowish brown, and the lower part is brownish yellow. The substratum to a depth of about 80 inches is light yellowish brown sand.

The most common soils of minor extent are the somewhat excessively drained Mancelona soils; the moderately well drained Croswell and Chinwhisker soils; and strongly sloping to very steep soils on breaks to drainageways and on breaks to the lower or higher terraces. Mancelona soils are in the same landscape positions as the major soils. Croswell and Chinwhisker soils are in the slightly lower areas.

The major soils in this association are used mainly as woodland. Some areas are used as building sites.

The major soils are well suited to woodland. Equipment limitations and seedling mortality are management concerns.

Because of droughtiness and soil blowing, these soils are poorly suited to crops and pasture.

The major soils are well suited to use as building sites. The caving of cutbanks and a poor filtering capacity are concerns.

### 8. Klacking-Graycalm-Grayling Association

*Gently rolling to hilly, excessively drained to well drained, sandy soils that formed in sandy material or sandy material underlain by loamy material; on moraines and outwash plains*

The soils in this association are on ridges and knolls in the uplands. Slopes range from 6 to 25 percent.

This association makes up about 7 percent of the county. It is about 34 percent Klacking soils, 33 percent Graycalm soils, 10 percent Grayling soils, and 23 percent soils of minor extent.

Klacking soils are well drained. Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil extends to a depth of more than 60 inches. In sequence downward, it is dark yellowish brown and yellowish brown loamy sand; light yellowish brown loamy sand that has bands of dark brown sandy loam; dark brown sandy loam and light yellowish brown loamy sand; and light yellowish brown loamy sand that has bands of dark brown sandy loam.

Graycalm soils are somewhat excessively drained. Typically, the surface layer is black sand about 1 inch thick. The subsoil extends to a depth of more than 80 inches. The upper part is strong brown sand and loamy sand. The lower part is light yellowish brown sand that has bands of brown loamy sand.

Grayling soils are excessively drained. Typically, the surface layer is black sand about 2 inches thick. The subsoil is sand about 27 inches thick. The upper part is dark yellowish brown, and the lower part is light yellowish brown. The substratum to a depth of about 80 inches is light yellowish brown sand.

The most common soils of minor extent are the somewhat excessively drained Mancelona soils, the excessively drained Typic Udipsamments, and the well drained Alfic Haplorthods. These soils are in landscape positions similar to those of the major soils.

The soils in this association are used mainly as woodland. Some areas are used as building sites.

The major soils are well suited to woodland. Equipment limitations and seedling mortality are management concerns.

Because of droughtiness, the slope, and soil blowing, these soils are poorly suited to crops and pasture.

The major soils are poorly suited to use as building sites. The slope is the main limitation. The caving of cutbanks and a poor filtering capacity are also concerns.

## Nearly Level to Very Steep Soils That Are Very Poorly Drained, Moderately Well Drained, Well Drained, and Excessively Drained

Most areas of these soils are used as woodland. The soils are suited to trees. Because of the slope, equipment limitations and water erosion are the major management concerns. The soils are generally unsuited to cropland and to building site development because of the slope or wetness.

### 9. Glennie-Bamfield-Lupton Association

*Nearly level to very steep, very poorly drained and well drained, mucky and loamy soils that formed in sandy and loamy material and organic material; on disintegration moraines and ground moraines*

The Glennie and Bamfield soils in this association are on ridges and knolls in the uplands. The Lupton soils are in closed depressions in the uplands. Slopes range from 0 to 45 percent.

This association makes up about 6 percent of the county. It is about 31 percent Glennie soils, 23 percent Bamfield soils, 21 percent Lupton soils, and 25 percent soils of minor extent (fig. 4).

Glennie soils are steep and are well drained. Typically, the surface is covered with a layer of forest litter about 2 inches thick. The surface layer is black loamy sand about 1 inch thick. The subsurface layer is grayish brown loamy sand about 4 inches thick. The subsoil extends to a depth of more than 80 inches. In sequence downward, it is dark brown sandy loam and strong brown loamy sand; mixed brown loamy sand and reddish brown loam; mixed reddish brown sandy clay loam and brown sandy loam; dark reddish brown clay; and reddish brown sandy clay loam.

Bamfield soils are rolling to very steep and are well drained. Typically, the surface is covered with a layer of forest litter about 1 inch thick. The surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsoil extends to a depth of more than 60 inches. In sequence downward, it is yellowish brown fine sandy loam; pinkish gray fine sandy loam; mixed reddish brown clay loam and pinkish gray fine sandy loam; reddish brown clay loam; and light reddish brown clay loam.

Lupton soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 5 inches thick. The underlying layers to a depth of about 60 inches are dark reddish brown muck.

The most common soils of minor extent are the well drained Alfic Haplorthods, Arenic Eutroboralfs, and Glossic Eutroboralfs. These soils are in landscape positions similar to those of the Glennie and Bamfield soils.

The soils in this association are used mainly as woodland. A few areas are used as building sites.

The Glennie and Bamfield soils are well suited to trees. The major concerns are the slope, plant competition, the windthrow hazard, the hazard of erosion, and equipment limitations. The Lupton soils are poorly suited to trees because of ponding.

The soils in this association are generally not suited to cropland. The slope is a limitation on the Glennie and Bamfield soils, and ponding is a concern on the Lupton soils.

The Glennie and Bamfield soils are poorly suited to building site development because of a moderate shrink-swell potential, the slope, and restricted permeability. The Lupton soils are generally unsuited to building site development because of ponding and low strength.

### 10. Alfic Haplorthods-Entic Haplorthods Association

*Nearly level to steep, excessively drained and well drained, sandy soils that formed in sandy material and sandy over loamy material; on moraines*

The soils in this association are on ridges and knolls in the uplands. Slopes range from 0 to 25 percent.

This association makes up about 3 percent of the county. It is about 85 percent Alfic Haplorthods, 12 percent Entic Haplorthods, and 3 percent soils of minor extent.

Alfic Haplorthods are well drained. Typically, the surface is covered with a layer of forest litter about 2 inches thick. The surface layer is very dark grayish brown loamy sand about 2 inches thick. The subsurface layer is grayish brown sand about 3 inches thick. The subsoil is about 35 inches thick. The upper part is dark brown, strong brown, and yellowish brown sand, and the lower part is dark brown sandy loam. The substratum to a depth of about 180 inches is reddish yellow and brownish yellow sand.

Entic Haplorthods are excessively drained. Typically, the surface is covered with a layer of forest litter about 1 inch thick. The surface layer is black sand about 2 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is about 23 inches thick. It is dark brown, strong brown, and brownish yellow sand. The substratum to a depth of about 180 inches is very pale brown and light yellowish brown sand.

The most common soils of minor extent are the well drained Glossic Eutroboralfs. These soils are in landscape positions similar to those of the major soils.

The soils in this association are used as woodland.

The major soils are well suited to trees. The major management concerns are the slope, equipment limitations, the erosion hazard, and seedling mortality.

The major soils range from well suited to building site development to unsuited to this use.

### 11. Klacking-McGinn Association

*Moderately sloping to very steep, well drained, sandy soils that formed in sandy and loamy material; on dissected moraines*

The soils in this association are on ridges in the uplands. Slopes range from 8 to 50 percent.

This association makes up about 12 percent of the county. It is about 38 percent Klacking soils, 27 percent McGinn soils, and 35 percent soils of minor extent (fig. 6).

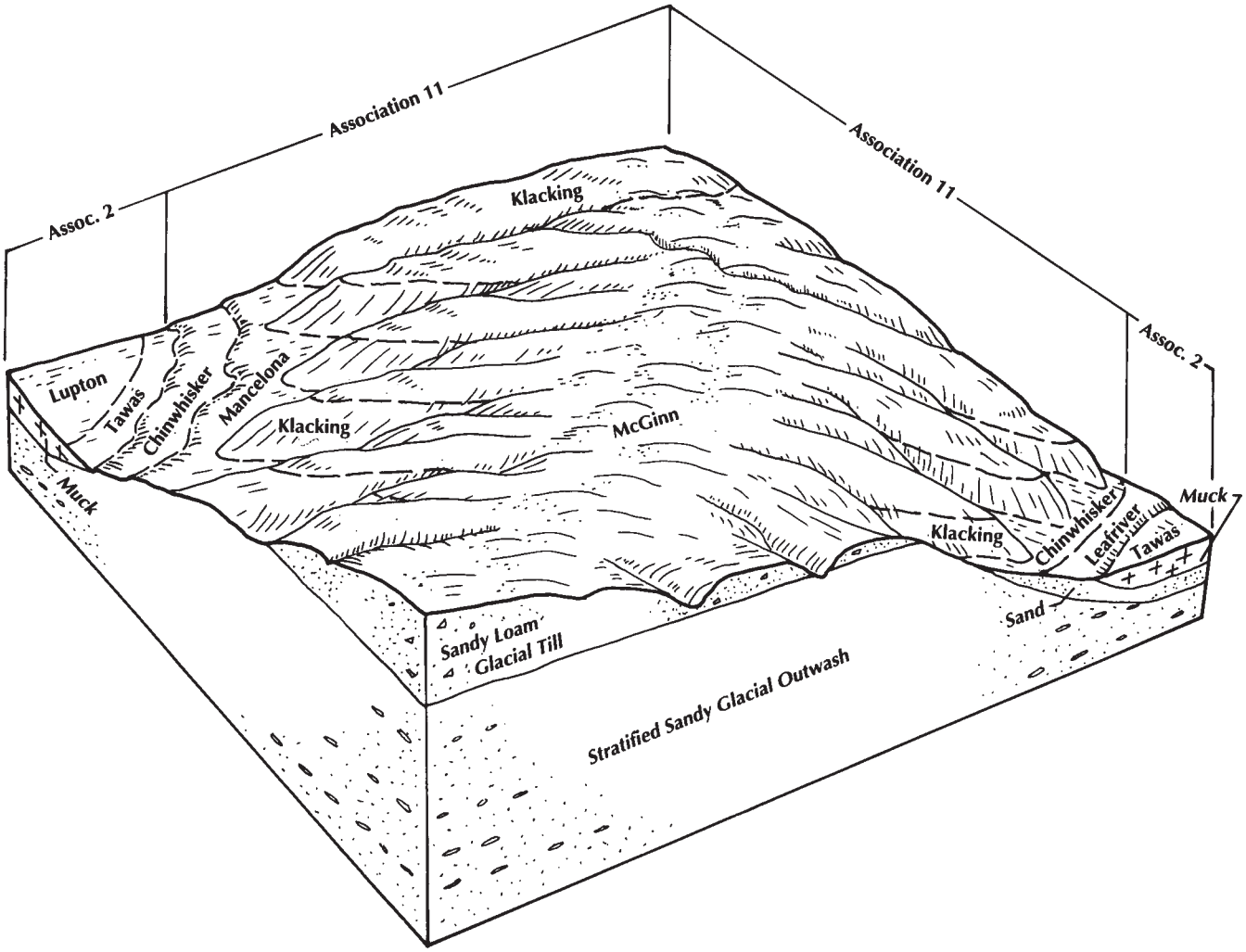


**Figure 6.—Typical pattern of soils and parent material in the Klacking-McGinn association (adjacent to the Lupton-Tawas-Leafriver association).**

Klacking soils are moderately sloping to very steep. Typically, the surface layer is black loamy sand about 2 inches thick. The subsurface layer is brown loamy sand about 1 inch thick. The subsoil extends to a depth of more than 60 inches. In sequence downward, it is dark yellowish brown and yellowish brown loamy sand; light yellowish brown loamy sand that has bands of dark brown sandy loam; dark brown sandy loam and light yellowish brown loamy sand; and light yellowish brown loamy sand that has bands of dark brown sandy loam.

McGinn soils are moderately sloping to steep. Typically, the surface is covered with a layer of forest litter about 1 inch thick. The surface layer is black loamy sand about 1 inch thick. The subsoil is about 31 inches thick. The upper part is strong brown and dark yellowish brown loamy sand. The next part is mixed grayish brown loamy sand and reddish brown sandy loam. The lower part is reddish brown sandy loam. The substratum to a depth of about 80 inches is light reddish brown sandy loam.

The most common soils of minor extent are the moderately well drained Chinwhisker soils, the well drained Hoist soils, and the somewhat excessively drained Alfic Haplorthods, Entic Haplorthods, and Mancelona soils. These soils are on nearly level to gently rolling terraces. Also of minor extent are nearly level to undulating areas of McGinn soils, which are commonly on ridgetops and hilltops.

The soils in this association are used as woodland.

The major soils are well suited to trees. The major management concerns are equipment limitations, the hazard of erosion, and seedling mortality.

The soils in this association are generally not suited

to cropland because of the slope, the hazard of erosion, and droughtiness.

The major soils are generally unsuited to building site development because of the slope. Suitable building sites are in areas of the less sloping minor soils.

### 12. Zimmerman-Alcona Association

*Gently rolling to very steep, moderately well drained to excessively drained, sandy soils that formed in stratified sandy and loamy material; on moraines*

The soils in this association are on ridges in the uplands. Slopes range from 6 to 50 percent.

This association makes up about 3 percent of the county. It is about 57 percent Zimmerman soils, 31 percent Alcona soils, and 12 percent soils of minor extent.

Zimmerman soils are gently rolling to steep and are excessively drained. Typically, the surface layer is black loamy fine sand about 2 inches thick. The subsurface layer is grayish brown loamy fine sand about 2 inches thick. The subsoil extends to a depth of more than 80 inches. The upper part is strong brown loamy fine sand. The next part is yellowish brown loamy fine sand. The lower part is yellowish brown fine sand that has bands of strong brown loamy fine sand.

Alcona soils are strongly sloping to very steep and are moderately well drained and well drained. Typically, the surface layer is black loamy very fine sand about 1 inch thick. The subsurface layer is grayish brown loamy very fine sand about 2 inches thick. The subsoil is about 38 inches thick. In sequence downward, it is dark brown and yellowish brown loamy very fine sand; brown loamy very fine sand; brown loam and light yellowish brown very fine sandy loam that are mottled in places; and dark brown loam that is mottled in places. The substratum to a depth of about 60 inches is light yellowish brown loamy very fine sand that is mottled in places.

The most common soils of minor extent are the well drained Alfic Haplorthods and the excessively drained Typic Udipsamments. These soils are in nearly level to steep areas.

The soils in this association are used as woodland.

The major soils are well suited to trees. The major management concerns are equipment limitations, the hazard of erosion, and seedling mortality.

The soils in this association are generally not suited to cropland because of the slope, the hazard of erosion, and droughtiness.

The major soils are generally unsuited to building site development because of the slope.

## Broad Land Use Considerations

The soils in Alcona County vary widely in their suitability for major land uses. The general soil map is helpful in identifying broad areas that can be developed for agriculture, forestry, wildlife habitat, industry, urban development, and other uses. It should not be used, however, in the selection of sites for specific structures or specific crops.

### Cropland

About 13 percent of the county is farmland. Corn, small grain, and grass-legume hay are the major crops (fig. 7). The cropland is concentrated in associations 3, 4, 5, and 6. The major soils in these associations are generally suited to crops. The major soils in associations 3 and 5 are prime farmland. Maintaining soil tilth and controlling erosion and wetness are the main management concerns. The soils in associations 4 and 6 are areas of important farmland in Alcona County. Controlling water erosion, soil blowing, and wetness is the main management concern.

Crops are generally not grown in associations 1, 2, 7, 8, 9, 10, 11, and 12. The soils in associations 1 and 2 are difficult to drain because suitable outlets are not available. The soils in associations 7 and 8 are droughty. The soils in associations 9, 10, 11, and 12 are severely limited because of the slope.

### Pasture

Associations 3, 4, 5, and 6 are generally suited to pasture. Wetness and surface compaction are management concerns in associations 3 and 5. The soils in associations 1 and 2 are too wet for use as pasture. Ground-water pollution from manure is a hazard. The soils in associations 7 and 8 are generally too droughty for the maintenance of forage plants. The soils in associations 9, 10, 11, and 12 are severely limited because of the slope.

### Woodland

About 70 percent of Alcona County is forested. Most of the areas in associations 1, 2, 4, 7, 8, 9, 10, 11, and 12 are used for trees. Common trees in associations 1 and 2 are northern whitecedar on the very poorly drained soils and paper birch, red maple, and black ash on the somewhat poorly drained soils. Trees on the well drained and moderately well drained soils in associations 3 and 5 are sugar maple, American beech, white ash, and American basswood. Associations 4, 9, and 10 support sugar maple on the loamy soils and northern red oak on the sandy soils.

**Figure 7.—Hay in an area of Negwegon and Algonquin soils. Maintaining soil tilth, controlling erosion, and overcoming the seasonal wetness are concerns in areas of these soils.**

Paper birch and northern red oak are important trees on the major soils in association 6. The dominant trees in associations 7 and 8 are jack pine, black oak, and red pine. The major trees in associations 11 and 12 are northern red oak, red pine, and eastern white pine. Quaking aspen and bigtooth aspen grow on most of the soils in the county.

### Wildlife Habitat

The soils in associations 1 and 2 are suited to wetland wildlife habitat. The soils in associations 3, 6, and 9 are suited to wetland wildlife habitat and woodland wildlife habitat. The major soils in associations 4, 8, 10, 11, and 12 are suited to woodland wildlife habitat. The soils in association 7 are poorly suited to wildlife habitat because of droughty conditions and because surface water is not available. The soils in association 7 support habitat for the Kirtland's warbler and other endangered species.

### Building Site Development

The soils in associations 1 and 2 are poorly suited to unsuited to building site development because of wetness, ponding, or low strength. The somewhat poorly drained and moderately well drained soils in association 1 are extensively used as building sites in areas bordering lakes. Ground-water pollution from septic tank effluent is a hazard in these areas. The soils in associations 3, 5, and 6 are poorly suited to building site development because of wetness and a moderate or high shrink-swell potential. Restricted permeability and wetness are limitations affecting septic tank absorption fields. The soils in associations 4, 7, and 8 have few limitations affecting building site development. The pollution of ground water is a hazard in associations 7 and 8. The soils in associations 9, 10, 11, and 12 are generally unsuited to building site development because of the slope.

# Detailed Soil Map Units

The map units on the detailed soil maps in 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 is given under the heading "Use and Management of the Soils."

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Graycalm sand, 18 to 35 percent slopes, is a phase of the Graycalm series.

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

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Algonquin-Springport complex, 0 to 6 percent slopes, is an example.

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

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

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

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

## 11B—Eastport sand, 0 to 6 percent slopes

### *Setting*

*Landform:* Beach ridges
*Shape of areas:* Elongated
*Size of areas:* 50 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black sand

*Subsurface layer:*
1 to 8 inches—grayish brown sand

*Subsoil:*
8 to 14 inches—strong brown sand
14 to 23 inches—yellowish brown sand
23 to 29 inches—very pale brown sand

*Substratum:*
29 to 80 inches—very pale brown sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Very low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils in depressions
• The moderately well drained Croswell soils in shallow depressions

*Similar inclusions:*
• Sandy soils that are somewhat excessively drained

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

#### Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

#### Buildings

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity of this soil can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 5S
*Michigan soil management group:* 5.3a

## 12B—Tawas-Au Gres complex, 0 to 4 percent slopes

### *Setting*

*Landform:* Swale-ridge complex on a lake terrace; Tawas—in swales with slopes of 0 to 2 percent; Au Gres—on low ridges with slopes of 0 to 4 percent
*Shape of areas:* Elongated
*Size of areas:* 500 to 1,000 acres

### *Typical Profile*

#### Tawas

*Surface layer:*
0 to 5 inches—black muck

*Subsoil:*
5 to 17 inches—black muck

*Substratum:*
17 to 60 inches—brown and dark brown sand

#### Au Gres

*Surface layer:*
0 to 3 inches—black sand

*Subsurface layer:*
3 to 10 inches—pinkish gray sand

*Subsoil:*
10 to 14 inches—dark brown, mottled sand
14 to 27 inches—dark yellowish brown, mottled sand
27 to 33 inches—yellowish brown, mottled sand

*Substratum:*
33 to 60 inches—pale brown, mottled sand

### *Soil Properties and Qualities*

*Permeability:* Tawas—moderately slow to moderately rapid in the mucky part, rapid in the sandy part; Au Gres—rapid
*Available water capacity:* Tawas—high; Au Gres—low
*Drainage class:* Tawas—very poorly drained; Au Gres—somewhat poorly drained
*Seasonal high water table:* Tawas—1.0 foot above to 1.0 foot below the surface from October through May; Au Gres—at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Tawas—ponded; Au Gres—very slow
*Flooding:* None
*Organic matter content:* Tawas—high; Au Gres—moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Tawas—moderate; Au Gres—severe
*Shrink-swell potential:* Low

### *Composition*

Tawas soil and similar soils: 60 to 70 percent
Au Gres soil and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 15 percent

### *Inclusions*

*Contrasting inclusions:*
• The very poorly drained Lupton soils, which have organic material more than 51 inches thick; in deep depressions between ridges

*Similar inclusions:*
• Soils that have organic layers less than 15 inches thick
• Sandy soils that have a calcareous substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

#### Woodland

*Major management concerns:* Tawas—equipment limitation, windthrow hazard, plant competition, seedling mortality; Au Gres—equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Trees that can withstand seasonal wetness should be selected for planting in areas of the Au Gres soil.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted in areas of the Tawas soil.

#### Buildings

*Major management concerns:* Au Gres—seasonal wetness, cutbanks cave; Tawas—ponding (fig. 8)
*Management considerations:*
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Because of ponding, the Tawas soil is generally unsuited to building site development.

#### Septic tank absorption fields

*Major management concerns:* Au Gres—poor filtering capacity, seasonal wetness; Tawas—ponding
*Management considerations:*
• Because of ponding, the Tawas soil is generally unsuited to septic tank absorption fields.
• The poor filtering capacity of the Au Gres soil can result in the pollution of ground water.
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* VIw
*Woodland ordination symbol:* Tawas—5W; Au Gres—6W
*Michigan soil management group:* Tawas—M/4c; Au Gres—5b

## 16B—Graycalm sand, 0 to 6 percent slopes

### *Setting*

*Landform:* Outwash plains and stream terraces

**Figure 8.—Areas of Tawas-Au Gres complex, 0 to 4 percent slopes, are near Lake Huron and are seemingly attractive building sites, but ponding in the lower areas is a common problem.**

*Shape of areas:* Irregular
*Size of areas:* 50 to 1,000 acres

### Typical Profile

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand
46 to 80 inches—light yellowish brown sand that has bands of brown loamy sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
- The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Graycalm soil

*Similar inclusions:*
- Sandy soils that do not have bands of loamy sand in the substratum

### Use and Management

**Land use:** Dominant use—woodland; other uses—building sites, pasture

**Pasture**

*Major management concerns:* Droughtiness, soil blowing

*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* IVs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a

## 16C—Graycalm sand, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on outwash plains
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand

*Substratum:*
46 to 80 inches—light yellowish brown sand that has bands of brown loamy sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Graycalm soil
• The moderately well drained Glennie soils, which have a loamy and clayey subsoil; in landscape positions similar to those of the Graycalm soil

*Similar inclusions:*
• Sandy soils that do not have bands in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—building sites, pasture

**Pasture**

*Major management concerns:* Droughtiness, soil blowing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing,

maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Slope, poor filtering capacity
*Management considerations:*
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a

## 16D—Graycalm sand, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges and knolls on outwash plains and stream terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand

*Substratum:*
46 to 80 inches—light yellowish brown sand that has bands of brown loamy sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Glennie soils, which have a loamy and clayey subsoil; on the summits of knolls
• The well drained McGinn soils, which have a loamy subsoil; in landscape positions similar to those of the Graycalm soil
• The somewhat excessively drained Mancelona soils, which have a substratum of very gravelly sand; in landscape positions similar to those of the Graycalm soil

*Similar inclusions:*
• Sandy soils that do not have bands of loamy sand in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality

*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Slope, poor filtering capacity
*Management considerations:*
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a

## 16E—Graycalm sand, 18 to 35 percent slopes

### *Setting*

*Landform:* Escarpments on stream terraces
*Shape of areas:* Elongated
*Size of areas:* 5 to 30 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand

*Substratum:*
46 to 80 inches—light yellowish brown sand that has bands of brown loamy sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

Graycalm soil and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Graycalm soil

*Similar inclusions:*
• Sandy soils that do not have bands of loamy sand in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour

or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Seeding skid roads, logging roads, and landings after the trees are logged helps to control erosion. Some areas may require mulch.
• Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
• Planting when the soil is moist can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIs
*Woodland ordination symbol:* 6R
*Michigan soil management group:* 5a

## 17B—Croswell sand, 0 to 6 percent slopes

### *Setting*

*Landform:* Stream terraces and lake terraces
*Shape of areas:* Elongated and irregular
*Size of areas:* 20 to 300 acres

### *Typical Profile*

*Organic mat:*
0 to 1 inch—black, well decomposed forest leaf litter

*Surface layer:*
1 to 4 inches—dark grayish brown sand

*Subsoil:*
4 to 10 inches—dark brown sand
10 to 20 inches—strong brown sand
20 to 29 inches—brownish yellow, mottled sand

*Substratum:*
29 to 80 inches—yellowish brown and light yellowish brown, mottled sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Moderately well drained
*Depth to the water table:* 2 to 4 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres and Battlefield soils on the lower slopes and in depressions
• The very poorly drained Leafriver soils in depressions

*Similar inclusions:*
• Soils that have a surface layer of loamy sand

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Available water capacity, low organic matter content, soil blowing, seasonal droughtiness, nutrient loss
*Management considerations:*
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture and reduces the hazard of soil blowing.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.
• Nutrients in manure and fertilizer applications should not exceed the nutrient requirements of the plants.

• Conservation tillage and additions of organic material increase the organic matter content and the available water capacity.

**Pasture**

*Major management concerns:* Droughtiness, soil blowing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality, windthrow hazard, plant competition
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

**Buildings**

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity, seasonal wetness
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* IVs
*Woodland ordination symbol:* 5S
*Michigan soil management group:* 5a

## 18A—Au Gres sand, 0 to 3 percent slopes

### *Setting*

*Landform:* Stream terraces and lake terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 3 inches—black sand

*Subsurface layer:*
3 to 10 inches—pinkish gray sand

*Subsoil:*
10 to 14 inches—dark brown, mottled sand
14 to 27 inches—dark yellowish brown, mottled sand
27 to 33 inches—yellowish brown, mottled sand

*Substratum:*
33 to 60 inches—pale brown, mottled sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The excessively drained Grayling soils on low knolls and ridges
• The very poorly drained Leafriver soils in depressions

*Similar inclusions:*
• Sandy soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

#### Cropland

*Major management concerns:* Available water capacity, seasonal wetness, soil blowing, nutrient loss
*Management considerations:*
• A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture and reduces the hazard of soil blowing.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.
• Subsurface drains can reduce the wetness if a suitable outlet is available.

#### Pasture

*Major management concerns:* Droughtiness, soil blowing, seasonal wetness
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

#### Woodland

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

#### Buildings

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity, seasonal wetness
*Management considerations:*
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* IVw
*Woodland ordination symbol:* 6W
*Michigan soil management group:* 5b

## 19—Leafriver muck

### *Setting*

*Landform:* Depressions on lake plains and outwash plains
*Slope:* 0 to 1 percent
*Shape of areas:* Elongated and irregular

*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—black muck

*Subsoil:*
9 to 21 inches—brown, mottled sand

*Substratum:*
21 to 27 inches—grayish brown, mottled sand
27 to 60 inches—dark grayish brown sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Moderate
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Leafriver and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils

*Similar inclusions:*
- Soils that have a thicker organic surface layer
- Sandy soils that are poorly drained

### *Use and Management*

**Land use:** Dominant use—woodland; other use—abandoned cropland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Landing sites generally can be used only during the driest time of the year.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
- After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
- Special harvest methods may be needed to control undesirable plants.
- Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Building sites**

*Major management concerns:* Ponding
*Management considerations:*
- Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
- Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* 5c

## 26B—Croswell sand, loamy substratum, 0 to 6 percent slopes

### *Setting*

*Landform:* Lake terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—dark brown sand

*Subsurface layer:*
1 to 6 inches—pinkish gray sand

*Subsoil:*
6 to 20 inches—dark brown sand
20 to 35 inches—strong brown sand

*Substratum:*
35 to 50 inches—yellowish brown, mottled sand

50 to 55 inches—stratified, mottled pale brown sand and strong brown sandy loam
55 to 60 inches—brown, mottled silty clay loam

### Soil Properties and Qualities

*Permeability:* Rapid in the sandy part; moderately slow in the loamy substratum
*Available water capacity:* Low
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2 to 4 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The very poorly drained Wakeley soils in depressions

*Similar inclusions:*
• Soils that have more clay in the substratum
• Soils that have a surface layer of loamy sand

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

#### Cropland

*Major management concerns:* Available water capacity, low organic matter content, soil blowing, seasonal droughtiness, nutrient loss
*Management considerations:*
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.
• Nutrients in manure and fertilizer applications should not exceed the nutrient requirements of the plants.
• Conservation tillage and additions of organic material increase the organic matter content and the available water capacity.

#### Pasture

*Major management concerns:* Droughtiness, soil blowing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

#### Woodland

*Major management concerns:* Equipment limitation, seedling mortality, plant competition
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Adequate site preparation controls initial plant competition, and spraying controls subsequent competition.

#### Buildings

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity, moderately slow permeability, seasonal wetness
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Mounding or adding suitable fill material helps to raise the absorption field above the water table and increases the thickness of the filtering material.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter

of the system, and low, uniform application rates help to prevent the pollution of ground water.

### Interpretive Groups

*Land capability classification:* IVs
*Woodland ordination symbol:* 7S
*Michigan soil management group:* 5a

## 27A—Au Gres sand, clayey substratum, 0 to 3 percent slopes

### Setting

*Landform:* Lake terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### Typical Profile

*Organic mat:*
0 to 1 inch—black, partially decomposed forest leaf litter

*Surface layer:*
1 to 15 inches—dark gray and light gray sand

*Subsoil:*
15 to 23 inches—very dusky red and strong brown, mottled sand
23 to 32 inches—pale brown, mottled sand and loamy sand
32 to 44 inches—strong brown and grayish brown, mottled loamy sand

*Substratum:*
44 to 58 inches—pinkish gray sand
58 to 80 inches—reddish brown, mottled silty clay

### Soil Properties and Qualities

*Permeability:* Rapid in the sandy part; very slow in the silty clay part
*Available water capacity:* Low
*Drainage class:* Somewhat poorly drained
*Seasonal high water table:* Perched at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low in the upper part; high in the silty clay part of the substratum

### Composition

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

### Inclusions

*Contrasting inclusions:*
- The very poorly drained Wakeley soils in depressions

*Similar inclusions:*
- Soils that are moderately well drained
- Soils that have less clay in the substratum

### Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, building sites

#### Pasture

*Major management concerns:* Droughtiness, soil blowing, seasonal wetness
*Management considerations:*
- Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
- Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

#### Woodland

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
- Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

#### Buildings

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
- Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
- Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

#### Septic tank absorption fields

*Major management concerns:* Poor filter, very slow permeability, seasonal wetness

*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Increasing the size of the absorption area helps to compensate for the restricted permeability.
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* IVw
*Woodland ordination symbol:* 7W
*Michigan soil management group:* 5b

## 28B—East Lake sand, 0 to 6 percent slopes

### *Setting*

*Landform:* Outwash plains and lake terraces
*Shape of areas:* Irregular
*Size of areas:* 10 to 300 acres

### *Typical Profile*

*Surface layer:*
0 to 4 inches—black sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 12 inches—dark brown loamy sand
12 to 20 inches—strong brown loamy sand
20 to 30 inches—strong brown sand

*Substratum:*
30 to 60 inches—brown, stratified sand and very gravelly loamy coarse sand

### *Soil Properties and Qualities*

*Permeability:* Rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Very low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Battlefield soils in depressions
• The very poorly drained Wheatley soils in depressions and drainageways

*Similar inclusions:*
• Soils that have a loamy layer in the subsoil
• Soils that have a surface layer of loamy sand

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—pasture, building sites

#### Pasture

*Major management concerns:* Droughtiness, soil blowing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

#### Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

#### Buildings

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter

of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* IVs
*Woodland ordination symbol:* 2S
*Michigan soil management group:* 5a

## 28C—East Lake sand, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on outwash plains and lake terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 4 inches—black sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 12 inches—dark brown loamy sand
12 to 20 inches—strong brown loamy sand
20 to 30 inches—strong brown sand

*Substratum:*
30 to 60 inches—brown, stratified sand and very gravelly loamy coarse sand

### *Soil Properties and Qualities*

*Permeability:* Rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Very low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
- The somewhat poorly drained Battlefield soils in depressions
- The very poorly drained Wheatley soils in depressions and drainageways

*Similar inclusions:*
- Soils that have a loamy layer in the subsoil
- Soils that have a surface layer of loamy sand

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—pasture, building sites

#### Pasture

*Major management concerns:* Droughtiness, soil blowing
*Management considerations:*
- Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

#### Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

#### Buildings

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
- Some land grading may be needed.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity, slope
*Management considerations:*
- The poor filtering capacity can result in the pollution of ground water.
- Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.
- Land shaping and installing the distribution lines

across the slope help to ensure that the absorption field functions properly.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 2S
*Michigan soil management group:* 5a

## 28E—East Lake sand, 12 to 35 percent slopes

### Setting

*Landform:* Ridges and escarpments on outwash plains
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Surface layer:*
0 to 4 inches—black sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 12 inches—dark brown loamy sand
12 to 20 inches—strong brown loamy sand
20 to 30 inches—strong brown sand

*Substratum:*
30 to 60 inches—brown, stratified sand and very gravelly loamy coarse sand

### Soil Properties and Qualities

*Permeability:* Rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Very low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The somewhat excessively drained Graycalm soils, which do not have a very gravelly substratum; in landscape positions similar to those of the East Lake soil

*Similar inclusions:*
• Soils that have a loamy layer in the subsoil

### Use and Management

**Land use:** Dominant use—woodland

#### Woodland

*Major management concerns:* Erosion hazard, equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand and the slope can hinder the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• The hazard of erosion can be reduced by seeding logging roads, landings, and areas that have been cut and filled and by installing water bars and culverts.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

#### Buildings

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is poorly suited to building sites unless extensive land shaping is applied.

#### Septic tank absorption fields

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* 2R
*Michigan soil management group:* 5a

## 29A—Battlefield sand, 0 to 3 percent slopes

### Setting

*Landform:* Lake terraces and outwash plains

*Shape of areas:* Elongated
*Size of areas:* 10 to 200 acres

### Typical Profile

*Surface layer:*
0 to 6 inches—black sand

*Subsurface layer:*
6 to 9 inches—pinkish gray sand

*Subsoil:*
9 to 10 inches—dark brown sand
10 to 26 inches—strong brown, mottled sand
26 to 33 inches—brown, mottled sand

*Substratum:*
33 to 60 inches—brown gravelly coarse sand

### Soil Properties and Qualities

*Permeability:* Rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Very low
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The moderately well drained Croswell soils on low knolls or ridges
• The very poorly drained Leafriver and Wheatley soils in depressions and swales

*Similar inclusions:*
• Soils that have a loamy layer in the subsoil

### Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, building sites

#### Pasture

*Major management concerns:* Droughtiness, soil blowing, seasonal wetness
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

#### Woodland

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

#### Buildings

*Major management concerns:* Cutbanks cave, wetness
*Management considerations:*
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity, seasonal wetness
*Management considerations:*
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* IVw
*Woodland ordination symbol:* 5W
*Michigan soil management group:* 5b

## 30—Wheatley muck

### *Setting*

*Landform:* Depressions on lake terraces and in glacial drainageways
*Slope:* 0 to 1 percent
*Shape of areas:* Elongated and irregular
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 5 inches—black muck

*Substratum:*
5 to 9 inches—gray, mottled sand
9 to 34 inches—brown, mottled sand
34 to 60 inches—greenish gray gravelly sand

### *Soil Properties and Qualities*

*Permeability:* Rapid in the sandy part; very rapid in the lower part of the substratum
*Available water capacity:* Moderate
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The very poorly drained Leafriver soils, which are sandy throughout; in landscape positions similar to those of the Wheatley soil
• The somewhat poorly drained Battlefield soils on low ridges

*Similar inclusions:*
• Soils that have a loamy layer in the subsoil

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* Vw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* 5c

## 31B—Klacking loamy sand, 0 to 6 percent slopes

### *Setting*

*Landform:* Outwash plains

*Shape of areas:* Irregular
*Size of areas:* 10 to 300 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 3 inches—brown loamy sand

*Subsoil:*
3 to 19 inches—dark yellowish brown loamy sand
19 to 27 inches—yellowish brown loamy sand
27 to 40 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam
40 to 46 inches—dark brown sandy loam and light yellowish brown loamy sand
46 to 60 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained McGinn soils, which have more clay in the subsoil than the Klacking soil; on knolls
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Klacking soil

*Similar inclusions:*
• Soils that have thinner bands of sandy loam in the substratum

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Seasonal droughtiness, soil blowing, low organic matter content
*Management considerations:*
• A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture and reduces the hazard of soil blowing.
• Conservation tillage and additions of organic material increase the organic matter content and the available water capacity.

**Pasture**

*Major management concerns:* Seasonal droughtiness, soil blowing, overgrazing
*Management considerations:*
• Proper stocking rates, uniform distribution of grazing, and a planned grazing system help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Seedling mortality
*Management considerations:*
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* None

### Interpretive Groups

*Land capability classification:* IIIs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 4a

## 31C—Klacking loamy sand, 6 to 12 percent slopes

### Setting

*Landform:* Ridges and knolls on outwash plains and disintegration moraines

*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 3 inches—brown loamy sand

*Subsoil:*
3 to 19 inches—dark yellowish brown loamy sand
19 to 27 inches—yellowish brown loamy sand
27 to 40 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam
40 to 46 inches—dark brown sandy loam and light yellowish brown loamy sand
46 to 60 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained McGinn soils, which have more clay in the subsoil than the Klacking soil; in landscape positions similar to those of the Klacking soil
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Klacking soil

*Similar inclusions:*
• Soils that have thinner bands of sandy loam in the substratum

### Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, building sites

**Pasture**

*Major management concerns:* Droughtiness, soil blowing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Seedling mortality
*Management considerations:*
• Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
• Planting when the soil is moist can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

### Interpretive Groups

*Land capability classification:* IIIe
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 4a

## 31D—Klacking loamy sand, 12 to 18 percent slopes

### Setting

*Landform:* Ridges and knolls on disintegration moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 3 inches—brown loamy sand

*Subsoil:*
3 to 19 inches—dark yellowish brown loamy sand
19 to 27 inches—yellowish brown loamy sand
27 to 40 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam
40 to 46 inches—dark brown sandy loam and light yellowish brown loamy sand
46 to 60 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
- The well drained McGinn soils, which have more clay in the subsoil than the Klacking soil; in landscape positions similar to those of the Klacking soil
- The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Klacking soil

*Similar inclusions:*
- Soils that have thinner bands of sandy loam in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Seedling mortality
*Management considerations:*
- Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
- Planting when the soil is moist can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
- Because of the slope, this soil is poorly suited to building sites unless extensive land shaping is applied.
- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
- Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 4a

## 31E—Klacking loamy sand, 18 to 35 percent slopes

### *Setting*

*Landform:* Ridges and hills on disintegration moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 3 inches—brown loamy sand

*Subsoil:*
3 to 19 inches—dark yellowish brown loamy sand
19 to 27 inches—yellowish brown loamy sand
27 to 40 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam
40 to 46 inches—dark brown sandy loam and light yellowish brown loamy sand
46 to 60 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid
*Available water capacity:* Low
*Drainage class:* Well drained

*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained McGinn soils, which have more clay in the subsoil than the Klacking soil; in landscape positions similar to those of the Klacking soil
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Klacking soil

*Similar inclusions:*
• Soils that have thinner bands of sandy loam in the substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Because slope can hinder the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate.
• Planting when the soil is moist can also reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* 6R
*Michigan soil management group:* 4a

## 33B—Mancelona loamy sand, 0 to 6 percent slopes

### *Setting*

*Landform:* Stream terraces and terraces of glacial drainageways
*Shape of areas:* Irregular
*Size of areas:* 50 to 500 acres

### *Typical Profile*

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 5 inches—dark grayish brown loamy sand

*Subsoil:*
5 to 16 inches—dark yellowish brown loamy sand
16 to 31 inches—yellowish brown sand
31 to 36 inches—dark brown very gravelly sandy loam
36 to 39 inches—dark brown very gravelly sandy clay loam

*Substratum:*
39 to 60 inches—light yellowish brown, stratified very gravelly sand and sand

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
- The somewhat excessively drained Graycalm soils, which do not have very gravelly sand in the substratum; in landscape positions similar to those of the Mancelona soil
- The moderately well drained Glennie and well drained McGinn soils, which have a loamy substratum; in landscape positions similar to those of the Mancelona soil

*Similar inclusions:*
- Soils that are somewhat poorly drained
- Soils that do not have a loamy layer in the subsoil

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Seasonal droughtiness, soil blowing, low organic matter content, available water capacity, nutrient loss
*Management considerations:*
- A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture and reduces the hazard of soil blowing.
- Conservation tillage, vegetative barriers, and cover crops help to control soil blowing.
- Conservation tillage and additions of organic material increase the organic matter content and the available water capacity.
- Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.

**Pasture**

*Major management concerns:* Seasonal droughtiness, soil blowing, overgrazing
*Management considerations:*
- Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
- Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave
*Management considerations:*
- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity
*Management considerations:*
- The poor filtering capacity can result in the pollution of ground water.
- Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* IIIs
*Woodland ordination symbol:* 3A
*Michigan soil management group:* 4a

## 33C—Mancelona loamy sand, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on stream terraces and terraces of glacial drainageways
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 5 inches—dark grayish brown loamy sand

*Subsoil:*
5 to 16 inches—dark yellowish brown loamy sand
16 to 31 inches—yellowish brown sand
31 to 36 inches—dark brown very gravelly sandy loam
36 to 39 inches—dark brown very gravelly sandy clay loam

*Substratum:*
39 to 60 inches—light yellowish brown, stratified very gravelly sand and sand

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the surface layer and subsoil; very rapid in the substratum

*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The somewhat excessively drained Graycalm soils, which do not have very gravelly sand in the substratum; in landscape positions similar to those of the Mancelona soil
• The moderately well drained Glennie and well drained McGinn soils, which have a loamy substratum; in landscape positions similar to those of the Mancelona soil

*Similar inclusions:*
• Soils that do not have a loamy layer in the subsoil

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Seasonal droughtiness, soil blowing, low organic matter content, available water capacity, nutrient loss
*Management considerations:*
• Conservation tillage and additions of organic material increase the organic matter content and the available water capacity.
• Conservation tillage, vegetative barriers, and cover crops help to control soil blowing.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.

**Pasture**

*Major management concerns:* Seasonal droughtiness, soil blowing, overgrazing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity, slope
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

### Interpretive Groups

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3A
*Michigan soil management group:* 4a

## 33D—Mancelona loamy sand, 12 to 18 percent slopes

### Setting

*Landform:* Ridges and knolls on stream terraces and terraces of glacial drainageways
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 5 inches—dark grayish brown loamy sand

*Subsoil:*
5 to 16 inches—dark yellowish brown loamy sand

16 to 31 inches—yellowish brown sand
31 to 36 inches—dark brown very gravelly sandy loam
36 to 39 inches—dark brown very gravelly sandy clay loam

*Substratum:*
39 to 60 inches—light yellowish brown, stratified very gravelly sand and sand

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Glennie and McGinn soils, which have a loamy substratum; in landscape positions similar to those of the Mancelona soil

*Similar inclusions:*
• Soils that do not have a loamy layer in the subsoil

### Use and Management

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity, slope

*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### Interpretive Groups

*Land capability classification:* IVe
*Woodland ordination symbol:* 3A
*Michigan soil management group:* 4a

## 33E—Mancelona loamy sand, 18 to 35 percent slopes

### Setting

*Landform:* Ridges and escarpments on stream terraces and terraces of glacial drainageways
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 5 inches—dark grayish brown loamy sand

*Subsoil:*
5 to 16 inches—dark yellowish brown loamy sand
16 to 31 inches—yellowish brown sand
31 to 36 inches—dark brown very gravelly sandy loam
36 to 39 inches—dark brown very gravelly sandy clay loam

*Substratum:*
39 to 60 inches—light yellowish brown, stratified very gravelly sand and sand

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the surface layer and subsoil; very rapid in the substratum
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate

*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Glennie and McGinn soils, which have a loamy substratum; in landscape positions similar to those of the Mancelona soil
• The somewhat excessively drained Graycalm soils, which do not have very gravelly sand in the substratum; in landscape positions similar to those of the Mancelona soil

*Similar inclusions:*
• Soils that do not have a loamy layer in the subsoil

### Use and Management

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• The grade should be kept as low as possible.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Because of the erosion hazard, skid roads and trails should be established on the contour and water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.

**Buildings**

*Major management concerns:* Slope, cutbanks cave
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 4a

## 35—Kinross muck

### Setting

*Landform:* Depressions on lake plains and outwash plains
*Slope:* 0 to 1 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 150 acres

### Typical Profile

*Surface layer:*
0 to 3 inches—black muck

*Subsurface layer:*
3 to 8 inches—pinkish gray, mottled fine sand

*Subsoil:*
8 to 14 inches—dark reddish brown, mottled fine sand
14 to 22 inches—dark brown fine sand
22 to 26 inches—dark yellowish brown, mottled fine sand
26 to 30 inches—yellowish brown, mottled fine sand

*Substratum:*
30 to 60 inches—light brownish gray fine sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

Kinross and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils on low ridges

• The very poorly drained Loxley soils, which have thick organic layers; in the slightly lower landscape positions

*Similar inclusions:*
• Soils that have medium sand in the subsoil and substratum

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* 5c-a

## 36B—Alcona loamy very fine sand, moderately wet, 0 to 6 percent slopes

### *Setting*

*Landform:* Lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 35 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown, mottled loam and light yellowish brown, mottled very fine sandy loam
21 to 41 inches—dark brown, mottled loam

*Substratum:*
41 to 60 inches—light yellowish brown, mottled loamy very fine sand

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 6.0 feet from November through May
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The excessively drained Zimmerman soils in landscape positions similar to those of the Alcona soil
• The moderately well drained Negwegon soils in landscape positions similar to those of the Alcona soil

*Similar inclusions:*
• Soils that have more silt in the substratum

### *Use and Management*

**Land use:** Dominant uses—woodland, pasture; other uses—cropland, building sites

**Cropland**

*Major management concerns:* Water erosion, soil blowing
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Wetness may delay site preparation and planting in the spring.

**Pasture**

*Major management concerns:* Overgrazing, seasonal wetness, seasonal droughtiness
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* IIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3a-s

## 36C—Alcona loamy very fine sand, moderately wet, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 10 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown, mottled loam and light yellowish brown, mottled very fine sandy loam
21 to 41 inches—dark brown, mottled loam

*Substratum:*
41 to 60 inches—light yellowish brown, mottled loamy very fine sand

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 6.0 feet from November through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate

*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The excessively drained Zimmerman soils in landscape positions similar to those of the Alcona soil
• The moderately well drained Negwegon soils in landscape positions similar to those of the Alcona soil

*Similar inclusions:*
• Soils that have more silt in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—pasture, cropland, building sites

**Cropland**

*Major management concerns:* Water erosion, soil blowing
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Wetness may delay site preparation and planting in the spring.

**Pasture**

*Major management concerns:* Erosion hazard, overgrazing, seasonal wetness, seasonal droughtiness
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition, erosion hazard
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3a-s

## 37A—Richter loamy fine sand, 0 to 3 percent slopes

### *Setting*

*Landform:* Lake plains and glacial drainageways
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—black loamy fine sand

*Subsurface layer:*
8 to 12 inches—light gray loamy sand

*Subsoil:*
12 to 18 inches—dark brown, mottled loamy sand
18 to 26 inches—brown, mottled sandy loam and pale brown, mottled loamy sand

26 to 37 inches—stratified, mottled brown fine sandy loam and reddish brown clay loam

*Substratum:*
37 to 60 inches—stratified, mottled pinkish gray loamy sand and reddish brown silt loam

### Soil Properties and Qualities

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The excessively drained Zimmerman and moderately well drained Hoist soils in the higher positions on the landscape

*Similar inclusions:*
• Soils that are moderately well drained
• Soils that have more sand throughout
• Soils that have more clay throughout

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

#### Cropland

*Major management concerns:* Seasonal wetness, soil blowing
*Management considerations:*
• A subsurface drainage system can lower the water table.
• Subsurface drainage systems should be designed so that the rate of flowing water helps to keep fine sand and silt from plugging the tile lines. Also, suitable filtering material may be needed to keep the silt and fine sand from flowing into the tile lines.
• In some areas, improving drainage is difficult because adequate subsurface outlets are not available.
• Conservation tillage, windbreaks, vegetative barriers, cover crops, stripcropping, and cropping systems that include close-growing crops help to control soil blowing.

#### Pasture

*Major management concerns:* Seasonal wetness, overgrazing
*Management considerations:*
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

#### Woodland

*Major management concerns:* Equipment limitation, seedling mortality, windthrow hazard, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Trees that can withstand seasonal wetness should be selected for planting.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• Carefully managed reforestation helps to control undesirable understory plants.

#### Buildings

*Major management concerns:* Seasonal wetness, cutbanks cave
*Management considerations:*
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

#### Septic tank absorption fields

*Major management concerns:* Seasonal wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

### Interpretive Groups

*Land capability classification:* IIw

*Woodland ordination symbol:* 3W
*Michigan soil management group:* 3b-s

## 38—Tonkey silt loam

### *Setting*

*Landform:* Depressions on lake plains, on outwash plains, and in glacial drainageways
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 6 inches—black, mottled silt loam

*Subsoil:*
6 to 12 inches—pinkish gray, mottled very fine sandy loam
12 to 26 inches—stratified, mottled brown very fine sandy loam and brown silt loam

*Substratum:*
26 to 60 inches—stratified, mottled brown very fine sandy loam, silt loam, and silt

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The poorly drained Ensley soils, which are not stratified in the substratum; in landscape positions similar to those of the Tonkey soil
• The moderately well drained Alcona soils on knolls and ridges

*Similar inclusions:*
• Soils that are somewhat poorly drained
• Soils that have more sand in the profile
• Soils that have more clay in the profile

### *Use and Management*

**Land use:** Dominant use—woodland; other use—pasture

**Pasture**

*Major management concerns:* Seasonal wetness, overgrazing
*Management considerations:*
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* Vw
*Woodland ordination symbol:* 5W
*Michigan soil management group:* 3c-s

## 39B—Glennie loamy sand, moderately wet, 0 to 6 percent slopes

### Setting

*Landform:* Ground moraines
*Shape of areas:* Irregular
*Size of areas:* 50 to 500 acres

### Typical Profile

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown, mottled sandy clay loam and brown, mottled sandy loam
46 to 56 inches—dark reddish brown, mottled clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—reddish brown sandy clay loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the loamy sand part; very slow in the loamy and clayey parts
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 3.5 to 4.5 feet from November through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The very poorly drained Lupton soils in depressions

*Similar inclusions:*
• Soils that are well drained

### Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, cropland, building sites

#### Cropland

*Major management concerns:* Soil blowing, water erosion, droughtiness
*Management considerations:*
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• The water intake rate can be increased by growing cover crops, leaving crop residue on the surface, and regularly adding other organic material.
• Growing grasses and legumes in rotation can reduce nutrient losses, improve soil structure, and provide nitrogen for use by subsequent crops.
• Wetness may delay site preparation and planting in the spring.

#### Pasture

*Major management concerns:* Overgrazing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

#### Woodland

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.

• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Cutbanks cave, shrink-swell, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, very slow permeability
*Management considerations:*
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.
• Backfilling the trenches with porous material also helps to overcome the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIIs
*Woodland ordination symbol:* 5D
*Michigan soil management group:* 4/2a-f

## 39C—Glennie loamy sand, moderately wet, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on ground moraines
*Shape of areas:* Irregular
*Size of areas:* 10 to 250 acres

### *Typical Profile*

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown, mottled sandy clay loam and brown, mottled sandy loam
46 to 56 inches—dark reddish brown, mottled clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—reddish brown sandy clay loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the sandy part; very slow in the loamy and clayey parts
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 3.5 to 4.5 feet from November through May
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Graycalm soils, which are sandy throughout; in landscape positions similar to those of the Glennie soil

*Similar inclusions:*
• Soils that are well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Water erosion, soil blowing

*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

**Pasture**

*Major management concerns:* Overgrazing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Cutbanks cave, seasonal wetness, shrink-swell, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, seasonal wetness, slope
*Management considerations:*
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.
• Backfilling the trenches with porous material also helps to overcome the restricted permeability.
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 5D
*Michigan soil management group:* 4/2a-f

## 40A—Sprinkler sandy loam, 0 to 3 percent slopes

### *Setting*

*Landform:* Ground moraines
*Shape of areas:* Irregular
*Size of areas:* 10 to 150 acres

### *Typical Profile*

*Surface layer:*
0 to 5 inches—very dark gray sandy loam

*Subsurface layer:*
5 to 13 inches—brown, mottled sandy loam

*Subsoil:*
13 to 28 inches—brown, mottled sandy loam and loam
28 to 35 inches—dark brown, mottled loam
35 to 44 inches—brown, mottled loam

*Substratum:*
44 to 60 inches—brown, mottled loam

### *Soil Properties and Qualities*

*Permeability:* Moderate in the sandy loam part; moderately slow in the loam part
*Available water capacity:* Moderate
*Drainage class:* Somewhat poorly drained
*Seasonal high water table:* Perched at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow

*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The moderately well drained Glennie soils in the higher positions on the landscape

*Similar inclusions:*
• Soils that have a surface layer of loamy sand

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

#### Cropland

*Major management concerns:* Seasonal wetness, moderately slow permeability, soil blowing
*Management considerations:*
• Most adapted crops can be grown if an adequate drainage system is installed.
• Because of the moderately slow permeability, subsurface drains should be narrowly spaced.
• Nutrients in manure and fertilizer applications should not exceed the nutrient requirements of the plants.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

#### Pasture

*Major management concerns:* Overgrazing, seasonal wetness
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

#### Woodland

*Major management concerns:* Equipment limitation, windthrow hazard, and plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

#### Buildings

*Major management concerns:* Seasonal wetness, shrink-swell
*Management considerations:*
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

#### Septic tank absorption fields

*Major management concerns:* Seasonal wetness, moderately slow permeability
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

### Interpretive Groups

*Land capability classification:* IIw
*Woodland ordination symbol:* 3W
*Michigan soil management group:* 2.5b

## 41B—McGinn loamy sand, 0 to 6 percent slopes

### Setting

*Landform:* Ground moraines
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Typical Profile

*Organic mat:*
0 to 1 inch—black, partially decomposed leaf litter

*Surface layer:*
1 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 4 inches—light brownish gray loamy sand

*Subsoil:*
4 to 6 inches—strong brown loamy sand
6 to 16 inches—dark yellowish brown loamy sand
16 to 25 inches—grayish brown loamy sand and reddish brown sandy loam
25 to 35 inches—reddish brown sandy loam

*Substratum:*
35 to 80 inches—light reddish brown sandy loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the sandy part; moderate in the loamy part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Klacking soils, which contain less clay in the subsoil than the McGinn soil; in landscape positions similar to those of the McGinn soil

*Similar inclusions:*
• Soils that are moderately well drained
• Soils that have a surface layer of sandy loam

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

#### Cropland

*Major management concerns:* Soil blowing, low organic matter content, nutrient loss
*Management considerations:*
• Conservation tillage, windbreaks, crop residue management, stripcropping, vegetative barriers, and cover crops help to control soil blowing.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.

#### Pasture

*Major management concerns:* Overgrazing, erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

#### Woodland

*Major management concerns:* None

#### Buildings

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

#### Septic tank absorption fields

*Major management concerns:* None

### *Interpretive Groups*

*Land capability classification:* IIIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 4a

## 41C—McGinn loamy sand, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on ground moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Organic mat:*
0 to 1 inch—black, partially decomposed leaf litter

*Surface layer:*
1 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 4 inches—light brownish gray loamy sand

*Subsoil:*
4 to 6 inches—strong brown loamy sand
6 to 16 inches—dark yellowish brown loamy sand
16 to 25 inches—grayish brown loamy sand and reddish brown sandy loam
25 to 35 inches—reddish brown sandy loam

*Substratum:*
35 to 80 inches—light reddish brown sandy loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the sandy part; moderate in the loamy part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Klacking soils, which contain less clay in the subsoil than the McGinn soil; in landscape positions similar to those of the McGinn soil

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

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Soil blowing, low organic matter content, nutrient loss
*Management considerations:*
• Conservation tillage, windbreaks, crop residue management, stripcropping, vegetative barriers, and cover crops help to control soil blowing.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.

**Pasture**

*Major management concerns:* Overgrazing, erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### Interpretive Groups

*Land capability classification:* IIIe
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 4a

## 41D—McGinn loamy sand, 12 to 18 percent slopes

### Setting

*Landform:* Ridges and knolls on ground moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Organic mat:*
0 to 1 inch—black, partially decomposed leaf litter

*Surface layer:*
1 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 4 inches—light brownish gray loamy sand

*Subsoil:*
4 to 6 inches—strong brown loamy sand

6 to 16 inches—dark yellowish brown loamy sand
16 to 25 inches—grayish brown loamy sand and reddish brown sandy loam
25 to 35 inches—reddish brown sandy loam

*Substratum:*
35 to 80 inches—light reddish brown sandy loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the sandy part; moderate in the loamy part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Klacking soils, which contain less clay in the subsoil than the McGinn soil; in landscape positions similar to those of the McGinn soil

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

### Use and Management

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### Interpretive Groups

*Land capability classification:* IVe
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 4a

## 42A—Killmaster sandy loam, 0 to 3 percent slopes

### Setting

*Landform:* Ground moraines and drumlins
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### Typical Profile

*Surface layer:*
0 to 8 inches—dark brown sandy loam

*Subsurface layer*
8 to 13 inches—brown, mottled sandy loam

*Subsoil:*
13 to 23 inches—brown, mottled loamy sand and dark brown, mottled sandy loam
23 to 32 inches—dark brown, mottled sandy loam

*Substratum:*
32 to 80 inches—brown, mottled sandy loam

### Soil Properties and Qualities

*Permeability:* Moderate in the upper part; very slow in the substratum
*Available water capacity:* Moderate
*Drainage class:* Somewhat poorly drained
*Seasonal high water table:* Perched at a depth of 1 to 3 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The moderately well drained Hoist soils in the higher positions on the landscape

• The somewhat poorly drained Richter soils, which have stratified loamy sand and silt loam in the substratum; in landscape positions similar to those of the Killmaster soil
• The well drained Klacking soils in the higher positions on the landscape

*Similar inclusions:*
• Soils that have a surface layer of loamy sand

### *Use and Management*

**Land use:** Dominant use—pasture; other uses—woodland, cropland, building sites

#### Cropland

*Major management concerns:* Seasonal wetness, low organic matter content, soil blowing
*Management considerations:*
• Most adapted crops can be grown if an adequate drainage system is installed.
• In some areas, improving drainage is difficult because adequate subsurface outlets are not available.
• Keeping crop residue on the surface, regularly adding other organic material, and applying a system of no-till planting increase the organic matter content.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

#### Pasture

*Major management concerns:* Seasonal wetness, overgrazing
*Management considerations:*
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

#### Woodland

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Carefully managed reforestation helps to control undesirable understory plants.
• Competing vegetation generally can be controlled by mechanical means.

#### Buildings

*Major management concerns:* Wetness
*Management considerations:*
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

#### Septic tank absorption fields

*Major management concerns:* Wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* IIw
*Woodland ordination symbol:* 4W
*Michigan soil management group:* 3b

## 43—Wakeley mucky sand

### *Setting*

*Landform:* Lake terraces
*Slope:* 0 to 1 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 6 inches—black, mottled mucky sand

*Substratum:*
6 to 12 inches—gray sand
12 to 24 inches—grayish brown, mottled sand
24 to 29 inches—grayish brown, mottled, stratified sand and loamy sand
29 to 34 inches—pinkish gray, mottled clay
34 to 60 inches—pinkish gray, mottled, stratified clay and silty clay

### *Soil Properties and Qualities*

*Permeability:* Rapid in the sandy part; very slow in the clayey part
*Available water capacity:* Low
*Drainage class:* Very poorly drained

*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low in the upper part and high in the lower part

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Allendale soils in the higher positions on the landscape

*Similar inclusions:*
• Soils that have a surface layer of muck

### Use and Management

**Land use:** Dominant use—woodland; other use—pasture

**Pasture**

*Major management concerns:* Seasonal wetness, overgrazing
*Management considerations:*
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* Vw
*Woodland ordination symbol:* 3W
*Michigan soil management group:* 4/1c

## 44B—Bamfield fine sandy loam, moderately wet, 0 to 6 percent slopes

### Setting

*Landform:* Ground moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### Typical Profile

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown, mottled clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### Soil Properties and Qualities

*Permeability:* Very slow
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained

*Seasonal high water table:* Perched at a depth of 1.5 to 3.0 feet from November through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

## Composition

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

## Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Kawkawlin soils in the lower positions on the landscape
• The poorly drained Lupton soils in depressions

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

## Use and Management

**Land use:** Dominant uses—cropland, woodland; other use—building sites

### Cropland

*Major management concerns:* Water erosion, seasonal wetness, soil blowing
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Because of the very slow permeability, subsurface drains should be narrowly spaced.

### Pasture

*Major management concerns:* Erosion hazard, seasonal wetness, compaction
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.

### Woodland

*Major management concerns:* Equipment limitation, plant competition, seasonal wetness, windthrow hazard
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

### Buildings

*Major management concerns:* Shrink-swell, seasonal wetness
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

### Septic tank absorption fields

*Major management concerns:* Very slow permeability, seasonal wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Increasing the size of the absorption area and backfilling the trenches with porous material help to overcome the restricted permeability.

## Interpretive Groups

*Land capability classification:* IIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3/2a

## 45B—Hoist sandy loam, moderately wet, 0 to 6 percent slopes

### Setting

*Landform:* Till plains and drumlins
*Shape of areas:* Irregular
*Size of areas:* 50 to 300 acres

### Typical Profile

*Surface layer:*
0 to 9 inches—very dark grayish brown sandy loam

*Subsoil:*
9 to 14 inches—yellowish brown sandy loam
14 to 21 inches—brown and reddish brown sandy loam
21 to 27 inches—reddish brown loam
27 to 49 inches—light reddish brown, mottled sandy loam

*Substratum:*
49 to 80 inches—light reddish brown sandy loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the upper part of the subsoil; moderately slow in the lower part of the subsoil; very slow in the substratum
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 3.5 feet from November through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Negwegon soils, which have more clay in the subsoil than the Hoist soil; in landscape positions similar to those of the Hoist soil
• The somewhat excessively drained Graycalm soils on breaks to drainageways

*Similar inclusions:*
• Soils that have a surface layer of loam

### Use and Management

**Land use:** Dominant uses—woodland, cropland; other uses—pasture, building sites

**Cropland**

*Major management concerns:* Water erosion, soil blowing, tilth in the surface layer, seasonal wetness
*Management considerations:*
• A system of conservation tillage that leaves crop residue on the surface helps to control water erosion, helps to prevent crusting during periods of heavy rainfall, and increases the rate of water infiltration.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage help to maintain or improve tilth and increase the available water capacity and the organic matter content.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Subsurface drains can reduce the wetness if a suitable outlet is available.

**Pasture**

*Major management concerns:* Overgrazing, seasonal wetness
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes (fig. 9).

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Figure 9.—Grass-legume pasture in an area of Hoist sandy loam, moderately wet, 0 to 6 percent slopes. Proper management is needed to prevent surface compaction on this soil.**

### Buildings

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

### Septic tank absorption fields

*Major management concerns:* Seasonal wetness, very slow permeability
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

#### *Interpretive Groups*

*Land capability classification:* IIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3a

## 45C—Hoist sandy loam, moderately wet, 6 to 12 percent slopes

#### *Setting*

*Landform:* Ridges and knolls on till plains and drumlins
*Shape of areas:* Irregular
*Size of areas:* 20 to 150 acres

#### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark grayish brown sandy loam

*Subsoil:*
9 to 14 inches—yellowish brown sandy loam
14 to 21 inches—brown and reddish brown sandy loam
21 to 27 inches—reddish brown loam
27 to 49 inches—light reddish brown, mottled sandy loam

*Substratum:*
49 to 80 inches—light reddish brown sandy loam

## Soil Properties and Qualities

*Permeability:* Moderately rapid in the upper part of the subsoil; moderately slow in the lower part of the subsoil; very slow in the substratum
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 3.5 feet from November through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

## Composition

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

## Inclusions

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in the lower positions on the landscape
• The well drained Negwegon soils, which contain more clay than the Hoist soil; in landscape positions similar to those of the Hoist soil
• The somewhat excessively drained Graycalm soils on breaks to drainageways

*Similar inclusions:*
• Soils that have a surface layer of loam

## Use and Management

**Land use:** Dominant uses—woodland, cropland; other uses—pasture, building sites

### Cropland

*Major management concerns:* Water erosion, soil blowing, tilth in the surface layer
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage help to maintain or improve tilth and increase the available water capacity and the organic matter content.
• Wetness may delay site preparation and planting in the spring.

### Pasture

*Major management concerns:* Erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

### Woodland

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

### Buildings

*Major management concerns:* Cutbanks cave, slope, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

### Septic tank absorption fields

*Major management concerns:* Very slow permeability, seasonal wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3a

## 46—Ensley mucky sandy loam

### *Setting*

*Landform:* Depressions on till plains and wave-cut platforms
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 80 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—black mucky sandy loam

*Subsoil:*
8 to 15 inches—grayish brown, mottled sandy loam
15 to 29 inches—light reddish brown, mottled sandy loam

*Substratum:*
29 to 42 inches—pinkish gray, mottled sandy loam
42 to 60 inches—gray sandy loam

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Ensley and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The very poorly drained Leafriver soils, which have a sandy profile; in landscape positions similar to those of the Ensley soil

*Similar inclusions:*
• Soils that have a surface layer of muck

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* Vw
*Woodland ordination symbol:* 3W
*Michigan soil management group:* 3c

## 53B—Negwegon silt loam, moderately wet, 2 to 6 percent slopes

### *Setting*

*Landform:* Lake plains
*Shape of areas:* Irregular
*Size of areas:* 50 to 300 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—dark brown silt loam

*Subsoil:*
8 to 16 inches—reddish brown, mottled silty clay loam and brown, mottled silt loam
16 to 24 inches—reddish brown clay that has thin strata of yellowish brown silt loam
24 to 46 inches—reddish brown silty clay

*Substratum:*
46 to 60 inches—stratified brown silty clay loam and yellowish brown silt loam

### *Soil Properties and Qualities*

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 1 to 3 feet from November through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The poorly drained Springport soils in depressions and drainageways

*Similar inclusions:*
• Soils that are well drained

### *Use and Management*

**Land use:** Dominant uses—cropland, pasture; other uses—woodland, building sites

**Cropland**

*Major management concerns:* Erosion hazard, seasonal wetness, tilth in the surface layer, soil compaction, nutrient loss
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• A subsurface drainage system can lower the water table.
• Because of the very slow permeability, subsurface drains should be narrowly spaced.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Erosion hazard, seasonal wetness, compaction
*Management considerations:*
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates, uniform distribution of grazing, and a planned grazing system help to keep the pasture in good condition.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.

• Species preference can be managed by selective cutting.

**Buildings**

*Major management concerns:* Shrink-swell, seasonal wetness
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, seasonal wetness
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Increasing the size of the absorption area helps to compensate for the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1a

## 53C—Negwegon silt loam, moderately wet, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on lake plains
*Shape of areas:* Irregular
*Size of areas:* 25 to 150 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—dark brown silt loam

*Subsoil:*
8 to 16 inches—reddish brown, mottled silty clay loam and brown, mottled silt loam
16 to 24 inches—reddish brown clay that has thin strata of yellowish brown silt loam
24 to 46 inches—reddish brown silty clay

*Substratum:*
46 to 60 inches—stratified brown silty clay loam and yellowish brown silt loam

### *Soil Properties and Qualities*

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 1 to 3 feet from November through May
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The moderately well drained Alcona soils, which have coarser textures in the profile than the Negewegon soil; in the lower positions on the landscape

*Similar inclusions:*
• Soils that are well drained

### *Use and Management*

**Land use:** Dominant uses—cropland, pasture; other uses—woodland, building sites

**Cropland**

*Major management concerns:* Erosion hazard, seasonal wetness, tilth in the surface layer, soil compaction, nutrient loss
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.
• Wetness may delay site preparation and planting in the spring.

**Pasture**

*Major management concerns:* Erosion hazard, seasonal wetness, compaction
*Management considerations:*
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates, uniform distribution of grazing, and a planned grazing system help to keep the pasture in good condition.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Species preference can be managed by selective cutting.

**Buildings**

*Major management concerns:* Shrink-swell, seasonal wetness
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, seasonal wetness
*Management considerations:*
• Increasing the size of the absorption area helps to compensate for the restricted permeability.
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1a

## 54A—Algonquin silt loam, 0 to 3 percent slopes

### *Setting*

*Landform:* Lake plains
*Shape of areas:* Irregular
*Size of areas:* 5 to 400 acres

### *Typical Profile*

*Surface layer:*
0 to 7 inches—dark brown, mottled silt loam

*Subsoil:*
7 to 11 inches—reddish brown, mottled silty clay
11 to 14 inches—reddish brown, mottled silty clay loam
14 to 29 inches—light reddish brown, mottled silty clay
29 to 60 inches—light reddish brown, mottled silty clay loam

### *Soil Properties and Qualities*

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Somewhat poorly drained
*Seasonal high water table:* Perched at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The moderately well drained Negwegon soils in the higher positions on the landscape
• The somewhat poorly drained Allendale soils, which have sand or loamy sand in the surface layer and the upper part of the subsoil; on small ridges near the edges of the unit
• The moderately well drained Alcona soils in the higher positions on the landscape

*Similar inclusions:*
• Soils that have a thin surface layer of sandy loam

### *Use and Management*

**Land use:** Dominant uses—cropland, pasture; other uses—woodland, building sites

**Cropland**

*Major management concerns:* Seasonal wetness, very slow permeability, soil compaction, tilth in the surface layer
*Management considerations:*
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Because of the very slow permeability, subsurface drains should be narrowly spaced.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling and harvesting at the proper soil moisture content help to prevent excessive compaction and maintain tilth (fig. 10).

**Pasture**

*Major management concerns:* Compaction, seasonal wetness
*Management considerations:*
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition, seedling mortality
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Carefully managed reforestation helps to control undesirable understory plants.

**Buildings**

*Major management concerns:* Shrink-swell, seasonal wetness
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, very slow permeability
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Increasing the size of the absorption area helps to compensate for the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIIw
*Woodland ordination symbol:* 6W
*Michigan soil management group:* 1b

## 55—Springport clay loam

### *Setting*

*Landform:* Depressions on lake plains
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 50 to 150 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—very dark gray clay loam

*Subsoil:*
8 to 12 inches—grayish brown, mottled clay
12 to 27 inches—reddish brown, mottled silty clay

*Substratum:*
27 to 60 inches—reddish brown, mottled silty clay

### *Soil Properties and Qualities*

*Permeability:* Very slow

**Figure 10.—Corn in an area of Algonquin silt loam, 0 to 3 percent slopes. Because of a relatively short growing season, most of the corn is used for silage.**

*Available water capacity:* High
*Drainage class:* Poorly drained
*Seasonal high water table:* Perched 1 foot above to 1 foot below the surface from September through June
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### Composition

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

### Inclusions

*Contrasting inclusions:*
- The moderately well drained Negwegon soils on low knolls or ridges
- The somewhat poorly drained Algonquin soils in the slightly higher positions on the landscape

*Similar inclusions:*
- Soils that have a mucky surface layer

### Use and Management

**Land use:** Dominant uses—woodland, pasture; other use—cropland

#### Cropland

*Major management concerns:* Seasonal wetness, tilth in the surface layer, soil compaction, very slow permeability, ponding
*Management considerations:*
- Shallow surface ditches help to remove surface water after heavy rains.
- Subsurface drains can reduce the wetness if a suitable outlet is available.

• Because of the very slow permeability, subsurface drains should be narrowly spaced.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Applying a system of conservation tillage and deferring tillage when the soil is wet help to prevent the deterioration of tilth.

**Pasture**

*Major management concerns:* Seasonal wetness, compaction
*Management considerations:*
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality, windthrow hazard, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding
*Management considerations:*
• Because of ponding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* IIIw
*Woodland ordination symbol:* 6W
*Michigan soil management group:* 1c

## 56B—Nester loam, moderately wet, 0 to 6 percent slopes

### *Setting*

*Landform:* Till plains
*Shape of areas:* Irregular
*Size of areas:* 50 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark grayish brown loam

*Subsoil:*
9 to 14 inches—brown, mottled sandy loam and reddish brown, mottled clay loam
14 to 25 inches—reddish brown, mottled clay loam
25 to 40 inches—reddish brown clay loam

*Substratum:*
40 to 60 inches—light reddish brown clay loam

### *Soil Properties and Qualities*

*Permeability:* Slow
*Available water capacity:* High
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 5.0 feet from November through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Moderate

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained, strongly sloping Nester soils on breaks to drainageways

*Similar inclusions:*
• Soils that do not have mottles in the subsoil

### *Use and Management*

**Land use:** Dominant uses—cropland, pasture; other uses—woodland, building sites

**Cropland**

*Major management concerns:* Erosion hazard, tilth in the surface layer, seasonal wetness, nutrient loss
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion (fig. 11).
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Because of the slow permeability, subsurface drains should be narrowly spaced.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.

**Pasture**

*Major management concerns:* Erosion hazard, seasonal wetness, compaction
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Seasonal wetness, shrink-swell
*Management considerations:*
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, slow permeability
*Management considerations:*
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.
• Backfilling the trenches with porous material and increasing the size of the absorption area help to overcome the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1.5a

## 56C—Nester loam, moderately wet, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on till plains and moraines
*Shape of areas:* Irregular
*Size of areas:* 25 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark grayish brown loam

*Subsoil:*
9 to 14 inches—brown, mottled sandy loam and reddish brown, mottled clay loam
14 to 25 inches—reddish brown, mottled clay loam
25 to 40 inches—reddish brown clay loam

*Substratum:*
40 to 60 inches—light reddish brown clay loam

### *Soil Properties and Qualities*

*Permeability:* Slow
*Available water capacity:* High
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 5.0 feet from November through May
*Surface runoff:* Medium
*Flooding:* None

**Figure 11.—A grassed waterway and conservation tillage in an area of Nester loam, moderately wet, 0 to 6 percent slopes.**

*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Moderate

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
- The well drained Nester soils on strongly sloping breaks to drainageways
- The somewhat poorly drained Kawkawlin soils in depressions

*Similar inclusions:*
- Soils that do not have mottles in the subsoil
- Soils that have a surface layer of sandy loam

### *Use and Management*

**Land use:** Dominant uses—woodland, pasture; other uses—cropland, building sites

#### Cropland

*Major management concerns:* Erosion hazard, tilth in the surface layer, seasonal wetness, nutrient loss
*Management considerations:*
- Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
- Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
- Wetness may delay site preparation and planting in the spring.
- Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based

rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Erosion hazard, seasonal wetness, compaction
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Because of low strength, suitable surfacing material is needed on year-round logging roads and landings.
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Seasonal wetness, shrink-swell, slope
*Management considerations:*
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, slow permeability, slope
*Management considerations:*
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.
• Backfilling the trenches with porous material and increasing the size of the absorption area help to overcome the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

***Interpretive Groups***

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1.5a

## 57B—Kawkawlin loam, 1 to 4 percent slopes

***Setting***

*Landform:* Till plains
*Shape of areas:* Irregular
*Size of areas:* 5 to 150 acres

***Typical Profile***

*Surface layer:*
0 to 10 inches—very dark grayish brown loam

*Subsoil:*
10 to 13 inches—dark brown, mottled clay loam and brown, mottled loam
13 to 30 inches—strong brown, mottled clay loam

*Substratum:*
30 to 60 inches—reddish brown, mottled clay loam

***Soil Properties and Qualities***

*Permeability:* Slow
*Available water capacity:* High
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 1 to 2 feet from October through May
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Moderate

***Composition***

Kawkawlin and similar soils: About 95 percent
Contrasting inclusions: About 5 percent

***Inclusions***

*Contrasting inclusions:*
• The poorly drained Tonkey soils in depressions
• The well drained Nester soils in the higher positions on the landscape

*Similar inclusions:*
• Soils that have a surface layer of loamy sand

### *Use and Management*

**Land use:** Dominant use—cropland; other uses—woodland, pasture, building sites

**Cropland**

*Major management concerns:* Erosion hazard, seasonal wetness, tilth in the surface layer, nutrient loss
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Shallow surface ditches help to remove surface water after heavy rains.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage help to maintain or improve tilth and increase the available water capacity and the organic matter content.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Seasonal wetness, overgrazing, compaction
*Management considerations:*
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Skidders should not be used during wet periods, when ruts form easily.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Carefully managed reforestation helps to control undesirable understory plants.

**Buildings**

*Major management concerns:* Seasonal wetness
*Management considerations:*
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, slow permeability
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIe
*Woodland ordination symbol:* 3W
*Michigan soil management group:* 1.5b

## 59B—Algonquin-Springport complex, 0 to 6 percent slopes

### *Setting*

*Landform:* Algonquin—low knolls; Springport—depressions on lake plains
*Shape of areas:* Irregular
*Size of areas:* 50 to 300 acres

### *Typical Profile*

**Algonquin**

*Surface layer:*
0 to 7 inches—dark brown, mottled silt loam

*Subsoil:*
7 to 11 inches—reddish brown, mottled silty clay
11 to 14 inches—reddish brown, mottled silty clay loam

14 to 29 inches—light reddish brown, mottled silty clay
29 to 60 inches—light reddish brown, mottled silty clay loam

**Springport**

*Surface layer:*
0 to 8 inches—very dark gray clay loam

*Subsoil:*
8 to 12 inches—grayish brown, mottled clay
12 to 27 inches—reddish brown, mottled silty clay

*Substratum:*
27 to 60 inches—reddish brown, mottled silty clay

## Soil Properties and Qualities

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Algonquin—somewhat poorly drained; Springport—poorly drained
*Seasonal high water table:* Algonquin—perched at a depth of 0.5 foot to 1.5 feet from October through May; Springport—perched 1.0 foot above to 1.0 foot below the surface from September through June
*Surface runoff:* Algonquin—slow or medium; Springport—very slow or ponded
*Flooding:* None
*Organic matter content:* Algonquin—moderate; Springport—high
*Hazard of water erosion:* Algonquin—moderate; Springport—slight
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

## Composition

Algonquin and similar soils: 55 to 65 percent
Springport and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 10 percent

## Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Allendale soils, which have a sandy surface layer and subsoil; in landscape positions similar to those of the Algonquin soil
• The very poorly drained Wakeley soils, which have a sandy surface layer and subsoil; in landscape positions similar to those of the Springport soil

*Similar inclusions:*
• Soils that have a mucky surface layer

## Use and Management

**Land use:** Dominant uses—woodland, pasture; other uses—cropland, building sites

**Cropland**

*Major management concerns:* Algonquin—seasonal wetness, very slow permeability, compaction, tilth in the surface layer, erosion hazard; Springport—seasonal wetness, very slow permeability, compaction, tilth in the surface layer, ponding
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Both surface and subsurface drainage systems are needed to reduce the wetness.
• In some areas, improving drainage is difficult because adequate subsurface outlets are not available.
• Because of the very slow permeability, subsurface drains should be narrowly spaced.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.

**Pasture**

*Major management concerns:* Seasonal wetness, compaction
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Because of the very slow permeability and the

sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Algonquin—shrink-swell, seasonal wetness; Springport—ponding
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• A surface or subsurface drainage system helps to lower the water table.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Because of ponding, Springport soils are generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Algonquin—seasonal wetness, very slow permeability; Springport—ponding
*Management considerations:*
• Filling or mounding with suitable material helps to raise the absorption field above the water table.
• Increasing the size of the absorption area helps to compensate for the very slow permeability.
• Because of ponding, the Springport soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* Algonquin—6W; Springport—6W
*Michigan soil management group:* Algonquin—1b; Springport—1c

## 60D—Glennie loamy sand, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges and knolls on ground moraines
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### *Typical Profile*

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown sandy clay loam and brown sandy loam
46 to 56 inches—dark reddish brown clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—dark reddish brown sandy clay loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the sandy part; very slow in the loamy and clayey parts
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Graycalm soils, which have a sandy profile; in landscape positions similar to those of the Glennie soil
• The well drained Bamfield soils, which contain more clay than the Glennie soil; in landscape positions similar to those of the Glennie soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Cutbanks cave, slope, shrink-swell
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, slope
*Management considerations:*
• Increasing the size of the absorption area helps to compensate for the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* 5D
*Michigan soil management group:* 4/2a-f

## 60E—Glennie loamy sand, 18 to 35 percent slopes

### *Setting*

*Landform:* Ridges and knolls on ground moraines
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### *Typical Profile*

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown sandy clay loam and brown sandy loam
46 to 56 inches—dark reddish brown clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—dark reddish brown sandy clay loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the sandy part; very slow in the loamy and clayey parts
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Graycalm soils, which have a sandy profile; in landscape positions similar to those of the Glennie soil

• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Glennie soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Erosion hazard, equipment limitation, windthrow hazard, plant competition, slope
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• The hazard of erosion can be reduced by seeding logging roads, landings, and areas that have been cut and filled and by installing water bars and culverts.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Slope, cutbanks cave, shrink-swell
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* 5R
*Michigan soil management group:* 4/2a-f

## 61C—Manistee loamy sand, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on lake plains and outwash plains
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 4 inches—black loamy sand

*Subsurface layer:*
4 to 6 inches—pinkish gray loamy sand

*Subsoil:*
6 to 24 inches—strong brown loamy sand
24 to 27 inches—reddish brown clay and pinkish gray sandy loam
27 to 50 inches—reddish brown clay

*Substratum:*
50 to 60 inches—reddish brown clay

### *Soil Properties and Qualities*

*Permeability:* Rapid in the sandy part; very slow in the clayey part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and high in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The moderately well drained Alcona soils in the lower positions on the landscape
• The moderately well drained Hoist soils, which have a substratum of sandy loam; in the lower positions on the landscape

*Similar inclusions:*
• Soils that have thicker sandy layers

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Soil blowing, water erosion, nutrient loss
*Management considerations:*
• Soil blowing can be controlled by windbreaks, a system of conservation tillage that leaves all or part of the crop residue on the surface, stripcropping, or a combination of these. Maintaining a permanent plant cover also helps to control soil blowing.
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Timing fertilizer applications so that they meet the nutrient needs of the crop, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.

**Pasture**

*Major management concerns:* Erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave, shrink-swell, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Filling or mounding with suitable material helps to raise the absorption field and increases the thickness of the filtering material.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3A
*Michigan soil management group:* 4/1a

## 61D—Manistee loamy sand, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges on lake plains
*Shape of areas:* Irregular
*Size of areas:* 10 to 80 acres

### *Typical Profile*

*Surface layer:*
0 to 4 inches—black loamy sand

*Subsurface layer:*
4 to 6 inches—pinkish gray loamy sand

*Subsoil:*
6 to 24 inches—strong brown loamy sand
24 to 27 inches—reddish brown clay and pinkish gray sandy loam
27 to 50 inches—reddish brown clay

*Substratum:*
50 to 60 inches—reddish brown clay

### *Soil Properties and Qualities*

*Permeability:* Rapid in the sandy part; very slow in the clayey part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and high in the lower part

### *Composition*

Manistee and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The well drained Hoist soils, which have a

substratum of sandy loam; in landscape positions similar to those of the Manistee soil

*Similar inclusions:*
• Soils that have thicker sandy layers

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Slope, cutbanks cave, shrink-swell
*Management considerations:*
• Land shaping may be necessary to develop a suitable building site.
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

**Septic tank absorption fields**

*Major management concerns:* Slope, poor filtering capacity, very slow permeability
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Filling or mounding with suitable material helps to raise the absorption field and increases the thickness of the filtering material.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* 3A
*Michigan soil management group:* 4/1a

## 61F—Manistee loamy sand, 25 to 45 percent slopes

### *Setting*

*Landform:* Escarpments on lake plains
*Shape of areas:* Elongated
*Size of areas:* 5 to 40 acres

### *Typical Profile*

*Surface layer:*
0 to 4 inches—black loamy sand

*Subsurface layer:*
4 to 6 inches—pinkish gray loamy sand

*Subsoil:*
6 to 24 inches—strong brown loamy sand
24 to 27 inches—reddish brown clay and pinkish gray sandy loam
27 to 50 inches—reddish brown clay

*Substratum:*
50 to 60 inches—reddish brown clay

### *Soil Properties and Qualities*

*Permeability:* Rapid in the sandy part; very slow in the clayey part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and high in the lower part

### *Composition*

Manistee and similar soils: 95 to 98 percent
Contrasting inclusions: 2 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The well drained Negwegon soils, which have more clay in the upper layers than the Manistee soil; in landscape positions similar to those of the Manistee soil

*Similar inclusions:*
• Soils that have thicker sandy layers

### *Use and Management*

**Land use:** Woodland

**Woodland**

*Major management concerns:* Equipment hazard, erosion hazard, plant competition
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

• The grade should be kept as low as possible.
• In the steepest areas, cable yarding systems are generally safer than other logging methods and result in less surface disturbance.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Carefully managed reforestation helps to control undesirable understory plants.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 4/1a

## 62A—Allendale loamy sand, 0 to 3 percent slopes

### *Setting*

*Landform:* Lake terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 11 inches—very dark grayish brown loamy sand

*Subsurface layer:*
11 to 13 inches—pale brown, mottled sand

*Subsoil:*
13 to 20 inches—dark brown, mottled sand
20 to 22 inches—yellowish brown, mottled sand
22 to 25 inches—reddish brown, mottled sandy loam
25 to 60 inches—reddish brown, mottled silty clay

### *Soil Properties and Qualities*

*Permeability:* Rapid in the sandy part; very slow in the clayey part
*Available water capacity:* Moderate
*Drainage class:* Somewhat poorly drained
*Seasonal high water table:* Perched at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and high in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Algonquin soils, which contain more clay in the surface layer and subsoil than the Allendale soil; in landscape positions similar to those of the Allendale soil
• The very poorly drained Wakeley soils in drainageways

*Similar inclusions:*
• Soils that have a silty or loamy substratum

### *Use and Management*

**Land use:** Dominant uses—woodland, cropland; other uses—pasture, building sites

**Cropland**

*Major management concerns:* Seasonal wetness, soil blowing, nutrient loss, low organic matter content
*Management considerations:*
• Subsurface drains can reduce the wetness if a suitable outlet is available.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Nutrients in manure and fertilizer applications should not exceed the nutrient requirements of the plants.
• Including green manure crops in the cropping sequence, using no-till planting, and managing crop residue increase the organic matter content.

**Pasture**

*Major management concerns:* Overgrazing, seasonal wetness
*Management considerations:*
• Proper stocking rates, a planned grazing system, and deferred grazing during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

**Woodland**

*Major management concerns:* Seasonal wetness, equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Special harvest methods may be needed to control undesirable plants.
• If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.
• Trees that can withstand seasonal wetness should be selected for planting.

**Buildings**

*Major management concerns:* Seasonal wetness, shrink-swell, cutbanks cave
*Management considerations:*
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Because cutbanks are not stable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, very slow permeability, poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Mounding or adding suitable fill material helps to raise the absorption field above the water table and increases the thickness of the filtering material.

### *Interpretive Groups*

*Land capability classification:* IIIw
*Woodland ordination symbol:* 4W
*Michigan soil management group:* 4/1b

## 63C—Bamfield fine sandy loam, 6 to 12 percent slopes

### *Setting*

*Landform:* Ridges and knolls on ground moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid in the fine sandy loam part; very slow in the clay loam part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Bamfield soil

*Similar inclusions:*
• Soils that have a surface layer of loamy sand

### *Use and Management*

**Land use:** Dominant uses—woodland, pasture; other uses—cropland, building sites

**Cropland**

*Major management concerns:* Water erosion, soil blowing
*Management considerations:*
• A system of conservation tillage that leaves crop residue on the surface helps to control water erosion, helps to prevent crusting during periods of heavy rainfall, and increases the rate of water infiltration.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.

**Pasture**

*Major management concerns:* Erosion hazard, compaction
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Because of low strength, suitable surfacing material is needed on year-round logging roads and landings.
• Skidders should not be used during wet periods, when ruts form easily.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Shrink-swell, slope
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability
*Management considerations:*
• Increasing the size of the absorption area and backfilling the trenches with porous material help to overcome the restricted permeability.
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1.5a

## 63D—Bamfield fine sandy loam, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges and knolls on ground moraines and disintegration moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 75 acres

### *Typical Profile*

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the fine sandy loam part; very slow in the clay loam part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Nester soils, which contain more clay in the upper part of the subsoil than the Bamfield soil; in landscape positions similar to those of the Bamfield soil
• The poorly drained Lupton soils in closed depressions

*Similar inclusions:*
• Soils that are moderately well drained
• Soils that have a surface layer of loam

### Use and Management

**Land use:** Dominant use—woodland; other use—pasture

**Pasture**

*Major management concerns:* Erosion hazard, compaction
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Because of low strength, suitable surfacing material is needed on year-round logging roads and landings.
• Skidders should not be used during wet periods, when ruts form easily.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Slope, shrink-swell
*Management considerations:*
• Land shaping may be necessary to develop a suitable building site.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

**Septic tank absorption fields**

*Major management concerns:* Slope, very slow permeability
*Management considerations:*
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• Increasing the size of the absorption area and backfilling the trenches with porous material help to overcome the restricted permeability.

### Interpretive Groups

*Land capability classification:* IVe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1.5a

## 63F—Bamfield fine sandy loam, 25 to 45 percent slopes

### Setting

*Landform:* Ridges and knolls on disintegration moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 40 acres

### Typical Profile

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the fine sandy loam part; very slow in the clay loam part
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and moderate in the lower part

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Sprinkler soils in drainageways

*Similar inclusions:*
• Soils that have a sandy surface layer

### Use and Management

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, plant competition
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• The grade should be kept as low as possible.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• In the steepest areas, cable yarding systems are generally safer than other logging methods and result in less surface disturbance.
• Because of the erosion hazard, skid roads and skid trails should be established on the contour and water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 1.5a

## 66D—Alcona loamy very fine sand, 12 to 18 percent slopes

### Setting

*Landform:* Ridges and knolls on lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 20 to 100 acres

### Typical Profile

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown loam and light yellowish brown very fine sandy loam
21 to 41 inches—dark brown loam

*Substratum:*
41 to 60 inches—light yellowish brown loamy very fine sand

### Soil Properties and Qualities

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The excessively drained Zimmerman soils in landscape positions similar to those of the Alcona soil

*Similar inclusions:*
• Soils that are moderately well drained

### Use and Management

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### Interpretive Groups

*Land capability classification:* IVe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3a-s

## 66E—Alcona loamy very fine sand, 18 to 35 percent slopes

### Setting

*Landform:* Escarpments on lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### Typical Profile

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown loam and light yellowish brown very fine sandy loam
21 to 41 inches—dark brown loam

*Substratum:*
41 to 60 inches—light yellowish brown loamy very fine sand

### Soil Properties and Qualities

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### *Inclusions*

*Contrasting inclusions:*
• The excessively drained Zimmerman soils in landscape positions similar to those of the Alcona soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland

#### Woodland

*Major management concerns:* Equipment limitation, erosion hazard, plant competition, slope
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• The grade should be kept as low as possible.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

#### Buildings

*Major management concerns:* Slope, cutbanks cave
*Management considerations:*
• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

#### Septic tank absorption fields

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 3a-s

## 68—Rondeau muck

### *Setting*

*Landform:* Depressions on lake plains
*Slope:* 0 to 1 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 25 acres

### *Typical Profile*

*Surface layer:*
0 to 6 inches—black muck

*Subsoil:*
6 to 19 inches—dark reddish brown muck

*Substratum:*
19 to 60 inches—light gray marl

### *Soil Properties and Qualities*

*Permeability:* Moderately slow to moderately rapid in the muck part; slow or very slow in the marl part
*Available water capacity:* Very high
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate

### *Composition*

Rondeau and similar soils: 100 percent

### *Inclusions*

*Similar inclusions:*
• Soils that have a mucky surface layer less than 16 inches thick

### *Use and Management*

**Land use:** Dominant use—wetland wildlife habitat

#### Buildings

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to building site development.

#### Septic tank absorption fields

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is

generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIw
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* M/mc

## 69—Loxley peat

### Setting

*Landform:* Closed depressions on lake plains and outwash plains
*Slope:* 0 to 1 percent
*Shape of areas:* Oval
*Size of areas:* 5 to 200 acres

### Typical Profile

*Surface layer:*
0 to 18 inches—dark brown peat

*Substratum:*
18 to 28 inches—dark brown muck
28 to 60 inches—black muck

### Soil Properties and Qualities

*Permeability:* Moderately slow to moderately rapid
*Available water capacity:* Very high
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight

### Composition

Loxley and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### Inclusions

*Contrasting inclusions:*
• The very poorly drained Kinross soils, which have a thin organic surface layer; near the edges of the unit

*Similar inclusions:*
• Soils that have a sandy substratum

### Use and Management

**Land use:** Dominant use—wetland wildlife habitat (fig. 12)

**Buildings**

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIIw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* Mc-a

## 70—Lupton muck

### Setting

*Landform:* Depressions on lake plains, outwash plains, and till plains
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Typical Profile

*Surface layer:*
0 to 5 inches—black muck

*Substratum:*
5 to 60 inches—dark reddish brown muck

### Soil Properties and Qualities

*Permeability:* Moderately slow to moderately rapid
*Available water capacity:* Very high
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate

### Composition

Lupton and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### Inclusions

*Contrasting inclusions:*
• The very poorly drained Leafriver soils, which have

**Figure 12.—Leatherleaf and blueberries are the major vegetation in areas of Loxley peat. A few tamarack and black spruce also grow on this soil, which is used mainly as habitat for wetland wildlife.**

less than 16 inches of organic material over mineral soil material; near the edges of the unit
• The very poorly drained Tawas soils, which have less than 51 inches of muck over mineral soil material; near the edges of the unit

*Similar inclusions:*
• Soils having organic layers in the lower part of the substratum that are less decomposed

## *Use and Management*

**Land use:** Dominant use—woodland

### Woodland

*Major management concerns:* Equipment limitation, plant competition, seedling mortality, windthrow hazard
*Management considerations:*
• Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Selective cutting or cutting in strips and leaving desirable seed trees along the edge of the openings can enhance natural regeneration.

### Buildings

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to building site development.

### Septic tank absorption fields

*Major management concerns:* Ponding, low strength

*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* Mc

## 71—Tawas muck

### *Setting*

*Landform:* Depressions on lake terraces
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 300 acres

### *Typical Profile*

*Surface layer:*
0 to 5 inches—black muck

*Subsoil:*
5 to 17 inches—black muck

*Substratum:*
17 to 60 inches—brown and dark brown sand

### *Soil Properties and Qualities*

*Permeability:* Moderately slow to moderately rapid in the muck part; rapid in the sand part
*Available water capacity:* High
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the substratum

### *Composition*

Tawas and similar soils: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

### *Inclusions*

*Contrasting inclusions:*
• The very poorly drained Kinross soils, which have less than 7 inches of muck in the surface layer; near the edges of the unit
• The very poorly drained Leafriver soils, which have less than 16 inches of muck in the surface layer; near the edges of the unit
• The somewhat poorly drained Au Gres soils on low ridges

*Similar inclusions:*
• Soils that have thin loamy layers in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, plant competition, seedling mortality, windthrow hazard
*Management considerations:*
• Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Selective cutting or cutting in strips and leaving desirable seed trees along the edge of the openings can enhance natural regeneration.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIw
*Woodland ordination symbol:* 5W
*Michigan soil management group:* M/4c

## 72—Dorval muck

### *Setting*

*Landform:* Depressions on lake plains
*Slope:* 0 to 2 percent

*Shape of areas:* Irregular
*Size of areas:* 5 to 150 acres

### Typical Profile

*Surface layer:*
0 to 6 inches—black muck

*Subsoil:*
6 to 27 inches—black muck

*Substratum:*
27 to 60 inches—brown, mottled silty clay

### Soil Properties and Qualities

*Permeability:* Moderately slow to moderately rapid in the muck part; very slow in the silty clay part
*Available water capacity:* Very high
*Drainage class:* Very poorly drained
*Seasonal high water table:* Perched 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* High in the substratum

### Composition

Dorval and similar soils: About 95 percent
Contrasting inclusions: About 5 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Algonquin soils on low knolls
• The very poorly drained Lupton soils, which have more than 51 inches of muck; in landscape positions similar to those of the Dorval soil

*Similar inclusions:*
• Soils that have a thin layer of sand above the clayey substratum

### Use and Management

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• Because of wetness and low strength, special harvesting equipment is needed. The equipment can be used only during periods in winter when skid roads and access roads are frozen.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Selective cutting or cutting in strips and leaving desirable seed trees along the edge of the openings can enhance natural regeneration.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* Vw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* M/1c

## 73—Markey muck

### Setting

*Landform:* Depressions on lake plains
*Slope:* 0 to 1 percent
*Shape of areas:* Irregular
*Size of areas:* 100 to 200 acres

### Typical Profile

*Surface layer:*
0 to 4 inches—black muck

*Subsoil:*
4 to 28 inches—very dark brown muck

*Substratum:*
28 to 60 inches—grayish brown sand

### Soil Properties and Qualities

*Permeability:* Moderately slow to moderately rapid in the muck part; rapid in the sand part
*Available water capacity:* High
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot

below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

Markey and similar soils: 100 percent

### Inclusions

*Similar inclusions:*
• Soils that have a thinner surface layer of muck

### Use and Management

**Land use:** Dominant use—wetland wildlife habitat

#### Buildings

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to building site development.

#### Septic tank absorption fields

*Major management concerns:* Ponding, low strength
*Management considerations:*
• Because of ponding and low strength, this soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* Vw
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* M/4c

## 74C2—Negwegon silty clay loam, moderately wet, 6 to 12 percent slopes, eroded

### Setting

*Landform:* Ridges and knolls on lake plains
*Distinctive landscape features:* Eroded surface
*Shape of areas:* Irregular
*Size of areas:* 25 to 150 acres

### Typical Profile

*Surface layer:*
0 to 8 inches—dark brown silty clay loam and reddish brown silty clay

*Subsoil:*
8 to 10 inches—reddish brown, mottled silty clay loam and silty clay
10 to 40 inches—reddish brown silty clay

*Substratum:*
40 to 60 inches—stratified reddish brown silty clay loam and yellowish brown silt loam

### Soil Properties and Qualities

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 1 to 3 feet from November through May
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Alcona soils in the lower positions on the landscape

*Similar inclusions:*
• Soils that are well drained
• Soils that have a darker surface layer

### Use and Management

**Land use:** Dominant uses—cropland, pasture

#### Cropland

*Major management concerns:* Erosion hazard, seasonal wetness, low organic matter content, tilth in the surface layer, soil compaction, nutrient loss
*Management considerations:*
• Crop rotations that include close-growing crops, conservation tillage, grassed waterways, cover crops, and crop residue management help to control runoff and water erosion.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Wetness may delay site preparation and planting in the spring.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling and harvesting at the

proper soil moisture content help to prevent excessive compaction and maintain tilth.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Erosion hazard, seasonal wetness, compaction
*Management considerations:*
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Buildings**

*Major management concerns:* Shrink-swell, seasonal wetness
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, seasonal wetness
*Management considerations:*
• Increasing the size of the absorption area helps to compensate for the restricted permeability.
• Filling or mounding with suitable material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* IIIe
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* 1a

## 77—Waucedah muck, frequently flooded

### *Setting*

*Landform:* Flood plains
*Slope:* 0 to 1 percent
*Shape of areas:* Long and narrow
*Size of areas:* 60 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark gray muck

*Subsurface layer:*
9 to 13 inches—black, mottled silt loam

*Substratum:*
13 to 18 inches—dark gray, mottled silt loam
18 to 55 inches—dark grayish brown and black loamy sand and sandy loam
55 to 60 inches—brown silty clay

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Very high
*Drainage class:* Very poorly drained
*Seasonal high water table:* 2 feet above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* Frequent
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Waucedah and similar soils: About 95 percent
Contrasting inclusions: About 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Colonville soils in the slightly higher areas on flood plains

*Similar inclusions:*
• Soils that have a thinner surface layer of muck

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.

• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Seasonal flooding
*Management considerations:*
• Because of flooding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Seasonal flooding
*Management considerations:*
• Because of flooding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* Vw
*Woodland ordination symbol:* 3W
*Michigan soil management group:* L-2c

## 78—Pits, borrow

### *Setting*

*Slope:* 0 to 35 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 150 acres

### *Typical Profile*

0 to 80 inches—colors and textures variable

### *Composition*

Pits: 100 percent

### *Use and Management*

**Land use:** Source of gravel, sand, or fill material. Some areas have been excavated below the seasonal high water table and are ponded. A few pits contain small deposits of rubbish and trash.

*Management considerations:*
• Onsite investigation is needed to determine the suitability for specific uses.

### *Interpretive Groups*

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned

## 80F—Zimmerman-Alcona complex, 25 to 60 percent slopes

### *Setting*

*Landform:* Steep and very steep areas on dissected lake plains
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### *Typical Profile*

**Zimmerman**

*Surface layer:*
0 to 2 inches—black loamy fine sand

*Subsurface layer:*
2 to 4 inches—grayish brown loamy fine sand

*Subsoil:*
4 to 7 inches—strong brown loamy fine sand
7 to 24 inches—yellowish brown loamy fine sand
24 to 80 inches—yellowish brown fine sand that has thin bands of strong brown loamy fine sand

**Alcona**

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown loam and light yellowish brown very fine sandy loam
21 to 41 inches—dark brown loam

*Substratum:*
41 to 60 inches—light yellowish brown loamy very fine sand

### *Soil Properties and Qualities*

*Permeability:* Zimmerman—rapid; Alcona—moderate
*Available water capacity:* Zimmerman—low; Alcona—moderate
*Drainage class:* Zimmerman—excessively drained; Alcona—well drained

*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Zimmerman—low; Alcona—moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

Zimmerman and similar soils: 50 to 60 percent
Alcona and similar soils: 35 to 50 percent
Contrasting inclusions: 0 to 5 percent

### Inclusions

*Contrasting inclusions:*
• The well drained Hoist soils, which have a substratum of sandy loam; in landscape positions similar to those of the major soils

*Similar inclusions:*
• Soils that are medium sand

### Use and Management

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Zimmerman—equipment limitation, erosion hazard, slope, seedling mortality; Alcona—equipment limitation, erosion hazard, slope, plant competition
*Management considerations:*
• Ordinary crawler tractors and rubber-tired skidders cannot be operated safely because of the slope. As a result, special logging methods, such as yarding the logs with a cable, may be needed.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Seedling survival rates can be increased on the Zimmerman soil by carefully planting vigorous nursery stock.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species on the Alcona soil.
• If trees are planted, site preparation is needed to control competing vegetation on the Alcona soil. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, these soils are generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, these soils are generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIIe
*Woodland ordination symbol:* Zimmerman—8R; Alcona—3R
*Michigan soil management group:* Zimmerman—4a; Alcona—3a-s

## 81B—Grayling sand, 0 to 6 percent slopes

### Setting

*Landform:* Outwash plains and deltas
*Shape of areas:* Irregular
*Size of areas:* 50 to 1,000 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 80 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona and East Lake soils
• The moderately well drained Croswell soils in the lower positions on the landscape

*Similar inclusions:*
• Soils that have bands of loamy sand in the substratum

### Use and Management

**Land use:** Dominant use—woodland; other use—building sites

#### Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

#### Buildings

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a

## 81C—Grayling sand, 6 to 12 percent slopes

### Setting

*Landform:* Ridges and knolls on outwash plains and deltas
*Shape of areas:* Irregular
*Size of areas:* 5 to 150 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 80 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The well drained Glennie and McGinn soils in the higher positions on the landscape
• The somewhat excessively drained Mancelona soils
• The moderately well drained Croswell soils in the lower positions on the landscape

*Similar inclusions:*
• Soils that have bands of loamy sand in the substratum

### Use and Management

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a

## 81E—Grayling sand, 18 to 35 percent slopes

### *Setting*

*Landform:* Escarpments and breaks to drainageways on deltas and outwash plains
*Shape of areas:* Elongated
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 80 inches—light yellowish brown sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

Grayling and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona soils

*Similar inclusions:*
• Soils that have bands of loamy sand in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, seedling mortality
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Because loose sand and the slope can hinder the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes. Also, logging roads should be stabilized.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Planting special nursery stock or containerized

seedlings can reduce the seedling mortality rate.
• Planting when the soil is moist can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Slope, cutbanks cave
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIs
*Woodland ordination symbol:* 4R
*Michigan soil management group:* 5.7a

## 82C—Udorthents, loamy, nearly level to gently rolling

### *Setting*

*Landform:* Ridges and knolls on lake plains and moraines
*Slope:* 0 to 12 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 25 acres

### *Typical Profile*

*Surface layer:*
0 to 3 inches—reddish brown loam

*Substratum:*
3 to 60 inches—reddish brown loam

### *Soil Properties and Qualities*

*Permeability:* Moderate or moderately slow
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow to rapid
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight to severe
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Udorthents and similar soils: 100 percent

### *Inclusions*

*Similar inclusions:*
• Soils that have more clay in the substratum
• Soils that are sandy loam

### *Use and Management*

**Land use:** Former use—source of borrow material; current use—none

*Management considerations:*
• Onsite investigation is needed to determine the suitability for specific uses.

### *Interpretive Groups*

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned

## 83F—Udipsamments, nearly level to very steep

### *Setting*

*Landform:* Ridges and knolls on lake plains, outwash plains, and moraines
*Slope:* 0 to 40 percent
*Shape of areas:* Irregular
*Size of areas:* 5 to 25 acres

### *Typical Profile*

*Surface layer:*
0 to 6 inches—yellowish brown sand

*Substratum:*
6 to 60 inches—light yellowish brown sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Very low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow to medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

Udipsamments and similar soils: About 95 percent
Contrasting inclusions: About 5 percent

### Inclusions

*Contrasting inclusions:*
• The very poorly drained Aquents in depressions

*Similar inclusions:*
• Soils that have loamy bands in the substratum

### Use and Management

**Land use:** Former use—source of borrow material; current use—idle land

*Management considerations:*
• Onsite investigation is needed to determine the suitability for specific uses.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned

## 84B—Zimmerman loamy fine sand, 0 to 6 percent slopes

### Setting

*Landform:* Lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 10 to 400 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy fine sand

*Subsurface layer:*
2 to 4 inches—grayish brown loamy fine sand

*Subsoil:*
4 to 7 inches—strong brown loamy fine sand
7 to 24 inches—yellowish brown loamy fine sand
24 to 80 inches—yellowish brown fine sand that has thin bands of strong brown loamy fine sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The moderately well drained Alcona soils, which contain more clay than the Zimmerman soil; in landscape positions similar to those of the Zimmerman soil

*Similar inclusions:*
• Soils that are medium sand

### Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, building sites

**Pasture**

*Major management concerns:* Seasonal droughtiness, erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow

trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### Interpretive Groups

*Land capability classification:* IVs
*Woodland ordination symbol:* 8S
*Michigan soil management group:* 4a

## 84C—Zimmerman loamy fine sand, 6 to 12 percent slopes

### Setting

*Landform:* Ridges and knolls on lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 5 to 300 acres

### Typical Profile

*Surface layer:*
0 to 2 inches—black loamy fine sand

*Subsurface layer:*
2 to 4 inches—grayish brown loamy fine sand

*Subsoil:*
4 to 7 inches—strong brown loamy fine sand
7 to 24 inches—yellowish brown loamy fine sand
24 to 80 inches—yellowish brown fine sand that has thin bands of strong brown loamy fine sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The moderately well drained Alcona soils, which contain more clay than the Zimmerman soil; in landscape positions similar to those of the Zimmerman soil

*Similar inclusions:*
• Soils that are medium sand

### Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, building sites

#### Pasture

*Major management concerns:* Seasonal droughtiness, erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

#### Woodland

*Major management concerns:* Seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

#### Buildings

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

#### Septic tank absorption fields

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 8S
*Michigan soil management group:* 4a

## 84D—Zimmerman loamy fine sand, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges and knolls on lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 2 inches—black loamy fine sand

*Subsurface layer:*
2 to 4 inches—grayish brown loamy fine sand

*Subsoil:*
4 to 7 inches—strong brown loamy fine sand
7 to 24 inches—yellowish brown loamy fine sand
24 to 80 inches—yellowish brown fine sand that has thin bands of strong brown loamy fine sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Alcona soils, which contain more clay than the Zimmerman soil; in landscape positions similar to those of the Zimmerman soil

*Similar inclusions:*
• Soils that have coarser sand

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Seedling survival rates can be increased by carefully planting vigorous nursery stock.

**Buildings**

*Major management concerns:* Slope, cutbanks cave
*Management considerations:*
• Land shaping may be necessary to develop a suitable building site.
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* Slope, poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 8S
*Michigan soil management group:* 4a

## 85B—Zimmerman-Alcona, moderately wet, complex, 0 to 6 percent slopes

### *Setting*

*Landform:* Lake terraces and deltas
*Shape of areas:* Irregular
*Size of areas:* 20 to 1,000 acres

### *Typical Profile*

**Zimmerman**

*Surface layer:*
0 to 2 inches—black loamy fine sand

*Subsurface layer:*
2 to 4 inches—grayish brown loamy fine sand

*Subsoil:*
4 to 7 inches—strong brown loamy fine sand

7 to 24 inches—yellowish brown loamy fine sand
24 to 80 inches—yellowish brown fine sand that has thin bands of strong brown loamy fine sand

**Alcona**

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown, mottled loam and light yellowish brown, mottled very fine sandy loam
21 to 41 inches—dark brown, mottled loam

*Substratum:*
41 to 60 inches—light yellowish brown, mottled loamy very fine sand

## Soil Properties and Qualities

*Permeability:* Zimmerman—rapid; Alcona—moderate
*Available water capacity:* Zimmerman—low; Alcona—moderate
*Drainage class:* Zimmerman—excessively drained; Alcona—moderately well drained
*Seasonal high water table:* Zimmerman—at a depth of more than 6 feet; Alcona—perched at a depth of 2.5 to 6.0 feet from November through May
*Surface runoff:* Zimmerman—very slow; Alcona—slow
*Flooding:* None
*Organic matter content:* Zimmerman—low; Alcona—moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

## Composition

Zimmerman and similar soils: 50 to 60 percent
Alcona and similar soils: 40 to 50 percent
Contrasting inclusions: 0 to 10 percent

## Inclusions

*Contrasting inclusions:*
• The moderately well drained Hoist soils

*Similar inclusions:*
• Soils that have coarser sand

## Use and Management

**Land use:** Dominant use—woodland; other uses—pasture, cropland, building sites

**Cropland**

*Major management concerns:* Zimmerman—soil blowing, seasonal droughtiness, low organic matter content, nutrient loss; Alcona—soil blowing
*Management considerations:*
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Leaving crop residue on the surface and adding other organic material conserve moisture.
• Conservation tillage and additions of organic material increase the organic matter content and the available water capacity.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.
• Seasonal wetness may delay site preparation and planting in the spring in areas of the Alcona soil.

**Pasture**

*Major management concerns:* Zimmerman—seasonal droughtiness, erosion hazard; Alcona—overgrazing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Zimmerman—equipment limitation, seedling mortality; Alcona—equipment limitation, plant competition
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate on the Zimmerman soil.
• Because of low strength, suitable surfacing

material is needed on year-round logging roads and landings in areas of the Alcona soil.
• Skidders should not be used in areas of the Alcona soil during wet periods, when ruts form easily.
• If trees are planted, site preparation is needed to control competing vegetation on the Alcona soil. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Cutbanks cave
*Management considerations:*
• Caving of cutbanks is a concern affecting shallow excavations. Trench walls should be reinforced on both soils.
• Wetness in areas of the Alcona soil can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Zimmerman—poor filtering capacity; Alcona—seasonal wetness
*Management considerations:*
• The poor filtering capacity of the Zimmerman soil can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.
• Filling or mounding with suitable material helps to raise the absorption field above the water table in areas of the Alcona soil.

### *Interpretive Groups*

*Land capability classification:* IVs
*Woodland ordination symbol:* Zimmerman—8S; Alcona—3L
*Michigan soil management group:* Zimmerman—4a; Alcona—3a-s

## 85D—Zimmerman-Alcona, moderately wet, complex, 6 to 18 percent slopes

### *Setting*

*Landform:* Ridges on dissected lake plains
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### *Typical Profile*

**Zimmerman**

*Surface layer:*
0 to 2 inches—black loamy fine sand

*Subsurface layer:*
2 to 4 inches—grayish brown loamy fine sand

*Subsoil:*
4 to 7 inches—strong brown loamy fine sand
7 to 24 inches—yellowish brown loamy fine sand
24 to 80 inches—yellowish brown fine sand that has thin bands of strong brown loamy fine sand

**Alcona**

*Surface layer:*
0 to 1 inch—black loamy very fine sand

*Subsurface layer:*
1 to 3 inches—grayish brown loamy very fine sand

*Subsoil:*
3 to 8 inches—dark brown loamy very fine sand
8 to 12 inches—yellowish brown loamy very fine sand
12 to 16 inches—brown loamy very fine sand
16 to 21 inches—brown, mottled loam and light yellowish brown, mottled very fine sandy loam
21 to 41 inches—dark brown, mottled loam

*Substratum:*
41 to 60 inches—light yellowish brown, mottled loamy very fine sand

### *Soil Properties and Qualities*

*Permeability:* Zimmerman—rapid; Alcona—moderate
*Available water capacity:* Zimmerman—low; Alcona—moderate
*Drainage class:* Zimmerman—excessively drained; Alcona—moderately well drained
*Seasonal high water table:* Zimmerman—at a depth of more than 6 feet; Alcona—perched at a depth of 2.5 to 6.0 feet from November through May
*Surface runoff:* Zimmerman—slow or medium; Alcona—medium
*Flooding:* None
*Organic matter content:* Zimmerman—low; Alcona—moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Zimmerman and similar soils: 50 to 60 percent
Alcona and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 10 percent

### *Inclusions*

*Contrasting inclusions:*
• The well drained Hoist soils in landscape positions similar to those of the major soils

*Similar inclusions:*
• Soils that are medium sand

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

#### Woodland

*Major management concerns:* Zimmerman—equipment limitation, seedling mortality; Alcona—equipment limitation, plant competition, erosion hazard
*Management considerations:*
• Because loose sand in areas of the Zimmerman soil can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Because of low strength, suitable surfacing material is needed on year-round logging roads and landings in areas of the Alcona soil.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Planting special nursery stock or containerized seedlings can reduce the seedling mortality rate on the Zimmerman soil.
• Planting seedlings that can withstand droughty conditions can reduce the seedling mortality rate. Replanting is needed in some areas of the Zimmerman soil.
• If trees are planted, site preparation is needed to control competing vegetation on the Alcona soil. Subsequent control of the invasion and growth of hardwoods may be needed.

#### Buildings

*Major management concerns:* Zimmerman—cutbanks cave, slope; Alcona—cutbanks cave, slope, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.
• Seasonal wetness in areas of the Alcona soil can be reduced by installing a drainage system around structures that have basements and crawl spaces.

#### Septic tank absorption fields

*Major management concerns:* Zimmerman—poor filtering capacity, slope; Alcona—seasonal wetness
*Management considerations:*
• The poor filtering capacity of the Zimmerman soil can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.
• Filling or mounding with suitable material helps to raise the absorption field above the water table in areas of the Alcona soil.
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* Zimmerman—8S; Alcona—3L
*Michigan soil management group:* Zimmerman—4a; Alcona—3a-s

## 86—Histosols and Aquents, ponded

### *Setting*

*Landform:* Depressions on lake terraces, outwash plains, and flood plains
*Slope:* 0 to 1 percent
*Shape of areas:* Oval, elongated, or irregular
*Size of areas:* 5 to 100 acres

### *Soil Properties and Qualities*

*Texture:* Histosols—muck; Aquents—sandy or loamy material
*Permeability:* Rapid to slow
*Available water capacity:* Low to high
*Drainage class:* Very poorly drained
*Seasonal high water table:* At the surface to 1 foot above the surface year-round
*Surface runoff:* Ponded
*Flooding:* None to frequent
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight

### *Composition*

Aquents: 0 to 100 percent
Histosols: 0 to 100 percent
Contrasting inclusions: 0 to 5 percent

### *Contrasting Inclusions*

• Small areas of poorly drained or somewhat poorly drained soils on islands

### *Use and Management*

**Land use:** Wetland wildlife habitat

*Management considerations:*
• Onsite investigation is needed to determine the suitability for specific uses.

### *Interpretive Groups*

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned

## 87—Ausable muck, frequently flooded

### *Setting*

*Landform:* Flood plains
*Slope:* 0 to 1 percent
*Shape of areas:* Long and narrow
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—black muck

*Substratum:*
8 to 17 inches—dark grayish brown, mottled loamy sand that has thin bands of black muck
17 to 35 inches—olive, mottled loamy sand
35 to 60 inches—olive gray sand

### *Soil Properties and Qualities*

*Permeability:* Moderate and moderately rapid in the upper part of the surface layer and in the subsoil; rapid in the substratum
*Available water capacity:* Very high
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Ponded
*Flooding:* Frequent
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Ausable and similar soils: 95 to 100 percent
Contrasting inclusions: 0 to 5 percent

### *Inclusions*

*Contrasting inclusions:*
• Aquents, which are ponded year-round

*Similar inclusions:*
• Soils that have thicker layers of muck in the surface layer and subsoil

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, seedling mortality, plant competition
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen or has an adequate snow cover.
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Landing sites generally can be used only during the driest time of the year.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

**Buildings**

*Major management concerns:* Seasonal flooding
*Management considerations:*
• Because of flooding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Seasonal flooding
*Management considerations:*
• Because of flooding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIw
*Woodland ordination symbol:* 2W
*Michigan soil management group:* L-4c

## 88D—Hoist sandy loam, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges and knolls on till plains and drumlins

*Shape of areas:* Irregular
*Size of areas:* 10 to 50 acres

### Typical Profile

*Surface layer:*
0 to 9 inches—very dark grayish brown sandy loam

*Subsoil:*
9 to 14 inches—yellowish brown sandy loam
14 to 21 inches—brown and reddish brown sandy loam
21 to 27 inches—reddish brown loam
27 to 49 inches—light reddish brown sandy loam

*Substratum:*
49 to 80 inches—light reddish brown sandy loam

### Soil Properties and Qualities

*Permeability:* Moderately rapid in the upper part of the subsoil; moderately slow in the lower part of the subsoil; very slow in the substratum
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### Composition

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

### Inclusions

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in the lower positions on the landscape
• The well drained Negwegon soils, which contain more clay than the Hoist soil
• The somewhat excessively drained Graycalm soils on breaks to drainageways

*Similar inclusions:*
• Soils that have a surface layer of loam

### Use and Management

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

#### Cropland

*Major management concerns:* Erosion hazard, soil blowing, tilth in the surface layer
*Management considerations:*
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Conservation tillage, crop residue management, stripcropping, vegetative barriers, cover crops, and crop rotations that include small grain and hay help to control soil blowing.
• Crop residue management, green manure crops, applications of manure, cover crops, and conservation tillage can maintain or improve tilth and increase the available water capacity and the organic matter content.

#### Pasture

*Major management concerns:* Erosion hazard
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

#### Woodland

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Skidders should not be used during wet periods, when ruts form easily. Year-round logging roads require a gravel base.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

#### Buildings

*Major management concerns:* Cutbanks cave, slope
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Moderately slow permeability, slope
*Management considerations:*
• Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 3a

## 89F—Bamfield-Lupton complex, 0 to 45 percent slopes

### *Setting*

*Landform:* Bamfield—steep and very steep areas; Lupton—depressions on dissected moraines
*Distinctive landscape features:* Pitted landscape
*Shape of areas:* Irregular
*Size of areas:* 25 to 300 acres

### *Typical Profile*

**Bamfield**

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 31 inches—reddish brown clay loam and pinkish gray fine sandy loam
31 to 60 inches—light reddish brown clay loam

**Lupton**

*Surface layer:*
0 to 5 inches—black muck

*Substratum:*
5 to 60 inches—dark reddish brown muck

### *Soil Properties and Qualities*

*Permeability:* Bamfield—very slow; Lupton—moderately slow to moderately rapid
*Available water capacity:* Bamfield—moderate; Lupton—very high
*Drainage class:* Bamfield—well drained; Lupton—very poorly drained
*Seasonal high water table:* Bamfield—at a depth of more than 6 feet; Lupton—at the surface to 2 feet above the surface year-round
*Surface runoff:* Bamfield—rapid and very rapid; Lupton—ponded
*Flooding:* None
*Organic matter content:* Bamfield—moderate; Lupton—high
*Hazard of water erosion:* Bamfield—severe; Lupton—slight
*Hazard of soil blowing:* Bamfield—moderate; Lupton—slight
*Shrink-swell potential:* Bamfield—low in the upper part and moderate in the lower part; Lupton—none

### *Composition*

Bamfield and similar soils: 55 to 70 percent
Lupton and similar soils: 25 to 45 percent
Contrasting inclusions: 5 to 10 percent

### *Inclusions*

*Contrasting inclusions:*
• The well drained Nester soils, which have more clay in the upper part of the subsoil; in landscape positions similar to those of the major soils
• The somewhat excessively drained Graycalm soils in landscape positions similar to those of the major soils

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, plant competition
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment in areas of the Bamfield soil. Logging roads should be designed so that they conform to the topography.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.

• Because of the erosion hazard on the Bamfield soil, logging roads and skid roads should be established on the contour and water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of ponding, the Lupton soil does not support trees.

**Buildings**

*Major management concerns:* Bamfield—shrink-swell, slope; Lupton—ponding
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling on the Bamfield soil.
• Land shaping may be necessary to develop a suitable building site.
• In areas where slopes are more than 25 percent, the Bamfield soil is generally unsuited to building site development.
• Because of ponding, the Lupton soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Bamfield—restricted permeability, slope; Lupton—ponding
*Management considerations:*
• Increasing the size of the absorption area helps to compensate for the restricted permeability of the Bamfield soil.
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly in areas of the Bamfield soil.
• In areas where slopes are more than 15 percent, the Bamfield soil is generally unsuited to septic tank absorption fields.
• Because of ponding, the Lupton soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* Bamfield—3R; Lupton—none assigned
*Michigan soil management group:* Bamfield—1.5a; Lupton—Mc

## 90B—Chinwhisker sand, 0 to 4 percent slopes

### *Setting*

*Landform:* Stream terraces, outwash plains, and lake terraces
*Shape of areas:* Irregular
*Size of areas:* 5 to 100 acres

### *Typical Profile*

*Surface layer:*
0 to 2 inches—black sand

*Subsurface layer:*
2 to 3 inches—dark grayish brown sand

*Subsoil:*
3 to 8 inches—dark brown sand
8 to 21 inches—yellowish brown sand
21 to 25 inches—light yellowish brown sand
25 to 36 inches—light yellowish brown, mottled sand
36 to 80 inches—pale brown, mottled sand that has thin bands of dark brown loamy sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Moderately well drained
*Depth to the water table:* 2.5 to 4.0 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

Chinwhisker and similar soils: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Richter soils in depressions
• The poorly drained Leafriver soils in depressions

*Similar inclusions:*
• Soils that have a calcareous substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—pasture, building sites

**Pasture**

*Major management concerns:* Seasonal droughtiness, soil blowing
*Management considerations:*
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting seedlings that can withstand droughty conditions can lower the seedling mortality rate. Replanting is needed in some areas.

**Buildings**

*Major management concerns:* Cutbanks cave, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Buildings can be constructed on well compacted fill material, which raises the site a sufficient distance above the water table.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Mounding or adding suitable fill material helps to raise the absorption field above the water table.

### *Interpretive Groups*

*Land capability classification:* IVs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a

## 91E—Glennie-Lupton complex, 0 to 35 percent slopes

### *Setting*

*Landform:* Glennie—steep and very steep areas; Lupton—depressions on disintegration moraines
*Shape of areas:* Irregular
*Size of areas:* 50 to 300 acres

### *Typical Profile*

**Glennie**

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter
*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown sandy clay loam and brown sandy loam
46 to 56 inches—dark reddish brown clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—reddish brown sandy clay loam

**Lupton**

*Surface layer:*
0 to 5 inches—black muck

*Subsurface layer:*
5 to 60 inches—dark reddish brown muck

### *Soil Properties and Qualities*

*Permeability:* Glennie—rapid in the sandy part, very slow in the loamy and clayey parts; Lupton—moderately slow to moderately rapid
*Available water capacity:* Glennie—moderate; Lupton—very high
*Drainage class:* Glennie—well drained; Lupton—very poorly drained
*Seasonal high water table:* Glennie—at a depth of more than 6 feet; Lupton—at the surface to 2 feet above the surface year-round
*Surface runoff:* Glennie—rapid; Lupton—ponded

*Flooding:* None
*Organic matter content:* Glennie—moderate; Lupton—high
*Hazard of water erosion:* Glennie—severe; Lupton—slight
*Hazard of soil blowing:* Glennie—moderate; Lupton—slight
*Shrink-swell potential:* Glennie—low in the upper part and moderate in the lower part; Lupton—none

### Composition

Glennie and similar soils: 60 to 70 percent
Lupton and similar soils: 20 to 40 percent
Contrasting inclusions: 0 to 10 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat excessively drained Graycalm soils, which have a sandy profile; in landscape positions similar to those of the major soils
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the major soils
• The very poorly drained Loxley soils in closed depressions

### Use and Management

**Land use:** Dominant use—woodland; other use—building sites

#### Woodland

*Major management concerns:* Equipment limitation, erosion hazard, windthrow hazard, plant competition
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment in areas of the Glennie soil. Logging roads should be designed so that they conform to the topography.
• Small areas of nearly level included soils, if any are available, and suitable nearly level adjacent areas should be selected as sites for landings.
• Because of the erosion hazard on the Glennie soil, logging roads and skid roads should be established on the contour and water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.
• Because of ponding, the Lupton soil does not support trees.

#### Buildings

*Major management concerns:* Glennie—shrink-swell, cutbanks cave, slope; Lupton—ponding
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling of the Glennie soil.
• Land shaping may be necessary to develop a suitable building site.
• In areas where slopes are more than 25 percent, the Glennie soil is generally unsuited to building site development.
• Because of ponding, the Lupton soil is generally unsuited to building site development.

#### Septic tank absorption fields

*Major management concerns:* Glennie—very slow permeability, slope; Lupton—ponding
*Management considerations:*
• Increasing the size of the absorption area helps to compensate for the restricted permeability of the Glennie soil.
• Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly in areas of the Glennie soil.
• In areas where slopes are more than 15 percent, the Glennie soil is generally unsuited to septic tank absorption fields.
• Because of ponding, the Lupton soil is generally unsuited to septic tank absorption fields.

### Interpretive Groups

*Land capability classification:* VIe
*Woodland ordination symbol:* Glennie—5R; Lupton—none assigned
*Michigan soil management group:* Glennie—4/2a-f; Lupton—Mc

## 92B—Klacking-McGinn loamy sands, 0 to 6 percent slopes

### Setting

*Landform:* Ground moraines
*Shape of areas:* Irregular

*Size of areas:* 40 to 150 acres

### *Typical Profile*

**Klacking**

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 3 inches—brown loamy sand

*Subsoil:*
3 to 19 inches—dark yellowish brown loamy sand
19 to 27 inches—yellowish brown loamy sand
27 to 40 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam
40 to 46 inches—dark brown sandy loam and light yellowish brown loamy sand
46 to 60 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam

**McGinn**

*Organic mat:*
0 to 1 inch—black, partially decomposed leaf litter

*Surface layer:*
1 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 4 inches—light brownish gray loamy sand

*Subsoil:*
4 to 6 inches—strong brown loamy sand
6 to 16 inches—dark yellowish brown loamy sand
16 to 25 inches—grayish brown loamy sand and reddish brown sandy loam
25 to 35 inches—reddish brown sandy loam

*Substratum:*
35 to 80 inches—light reddish brown sandy loam

### *Soil Properties and Qualities*

*Permeability:* Klacking—moderately rapid; McGinn—moderately rapid in the sandy part, moderate in the loamy part
*Available water capacity:* Klacking—low; McGinn—moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Klacking and similar soils: 60 to 70 percent
McGinn and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 10 percent

### *Inclusions*

*Contrasting inclusions:*
- The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the major soils
- The very poorly drained Lupton soils in depressions

*Similar inclusions:*
- Soils that are moderately well drained
- Soils that have a surface layer of sandy loam

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Seedling mortality
*Management considerations:*
- Seedling survival rates can be increased by carefully planting vigorous nursery stock.
- If trees are planted, site preparation is needed to control competing vegetation. Subsequent control of the invasion and growth of hardwoods may be needed.

**Buildings**

*Major management concerns:* Cutbanks cave
*Management considerations:*
- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

**Septic tank absorption fields**

*Major management concerns:* None

### *Interpretive Groups*

*Land capability classification:* IIIs
*Woodland ordination symbol:* Klacking—6S; McGinn—4S
*Michigan soil management group:* Klacking—4a; McGinn—4a

## 93B—Au Gres, clayey substratum-Wakeley complex, 0 to 4 percent slopes

### *Setting*

*Landform:* Au Gres—ridges; Wakeley—swales on lake terraces

*Shape of areas:* Elongated
*Size of areas:* 40 to 500 acres

### Typical Profile

**Au Gres**

*Organic mat:*
0 to 1 inch—black, partially decomposed forest leaf litter

*Surface layer:*
1 to 15 inches—dark gray and light gray sand

*Subsoil:*
15 to 23 inches—very dusky red and strong brown, mottled sand
23 to 32 inches—pale brown, stratified, mottled sand and loamy sand
32 to 44 inches—strong brown and grayish brown, mottled loamy sand

*Substratum:*
44 to 58 inches—pinkish gray sand
58 to 80 inches—reddish brown, mottled silty clay

**Wakeley**

*Surface layer:*
0 to 6 inches—black, mottled mucky sand

*Subsoil:*
6 to 12 inches—gray sand

*Substratum:*
12 to 24 inches—grayish brown, mottled sand
24 to 29 inches—grayish brown, mottled, stratified sand and loamy sand
29 to 34 inches—pinkish gray, mottled clay
34 to 60 inches—pinkish gray, mottled, stratified clay and silty clay

### Soil Properties and Qualities

*Permeability:* Rapid in the sandy part; very slow in the clayey part
*Available water capacity:* Low
*Drainage class:* Au Gres—somewhat poorly drained; Wakeley—very poorly drained
*Seasonal high water table:* Au Gres—perched at a depth of 1 to 3 feet from October through May; Wakeley—1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Au Gres—very slow; Wakeley—ponded
*Flooding:* None
*Organic matter content:* Au Gres—low; Wakeley—high
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low in the upper part and high in the lower part

### Composition

Au Gres and similar soils: 50 to 60 percent
Wakeley and similar soils: 35 to 50 percent
Contrasting inclusions: 5 to 10 percent

### Inclusions

*Contrasting inclusions:*
• The very poorly drained Leafriver soils, which have clay below a depth of 60 inches; in landscape positions similar to those of the Wakeley soil

*Similar inclusions:*
• Soils that have thinner sandy layers

### Use and Management

**Land use:** Dominant use—woodland; other use—pasture

**Pasture**

*Major management concerns:* Seasonal wetness
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Hay and pasture plants that can withstand periodic inundation and seasonal wetness should be seeded.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants.

**Woodland**

*Major management concerns:* Au Gres—equipment limitation, windthrow hazard, plant competition; Wakeley—equipment limitation, windthrow hazard, plant competition, seedling mortality
*Management considerations:*
• Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
• Equipment can be used only during dry summer months and during periods in winter when the snow cover is adequate or the soil is frozen.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Carefully managed reforestation helps to control undesirable understory plants.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.

• Because of wetness, seedling mortality, and plant competition, trees are generally not planted on the Wakeley soil.

**Buildings**

*Major management concerns:* Au Gres—cutbanks cave, seasonal wetness; Wakeley—ponding
*Management considerations:*
• Because cutbanks in areas of the Au Gres soil are not stable and are subject to caving, trench walls should be reinforced.
• Because of ponding, the Wakeley soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Au Gres—poor filtering capacity, very slow permeability, seasonal wetness; Wakeley—ponding
*Management considerations:*
• The poor filtering capacity of the Au Gres soil can result in the pollution of ground water.
• Increasing the size of the absorption area helps to compensate for the restricted permeability of the Au Gres soil.
• In areas of the Au Gres soil, mounding or adding suitable fill material helps to raise the absorption field above the water table and increases the thickness of the filtering material.
• Because of ponding, the Wakeley soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* IVw
*Woodland ordination symbol:* Au Gres—7W; Wakeley—3W
*Michigan soil management group:* Au Gres—5b; Wakeley—4/1c

## 94F—Klacking-McGinn loamy sands, 8 to 50 percent slopes, dissected

### *Setting*

*Landform:* Klacking—sides of valleys; McGinn—ridgetops on dissected moraines
*Distinctive landscape features:* Dissected landscape
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### *Typical Profile*

**Klacking**

*Surface layer:*
0 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 3 inches—brown loamy sand

*Subsoil:*
3 to 19 inches—dark yellowish brown loamy sand
19 to 27 inches—yellowish brown loamy sand
27 to 40 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam
40 to 46 inches—dark brown sandy loam and light yellowish brown loamy sand
46 to 60 inches—light yellowish brown loamy sand that has bands of dark brown sandy loam

**McGinn**

*Organic mat:*
0 to 1 inch—black, partially decomposed leaf litter

*Surface layer:*
1 to 2 inches—black loamy sand

*Subsurface layer:*
2 to 4 inches—light brownish gray loamy sand

*Subsoil:*
4 to 6 inches—strong brown loamy sand
6 to 16 inches—dark yellowish brown loamy sand
16 to 25 inches—grayish brown loamy sand and reddish brown sandy loam
25 to 35 inches—reddish brown sandy loam

*Substratum:*
35 to 80 inches—light reddish brown sandy loam

### *Soil Properties and Qualities*

*Permeability:* Klacking—moderately rapid; McGinn—moderately rapid in the sandy part, moderate in the loamy part
*Available water capacity:* Klacking—low; McGinn—moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

Klacking and similar soils: 60 to 70 percent
McGinn and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 10 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat excessively drained Mancelona

soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the major soils
• The poorly drained Lupton soils in valley bottoms

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, seedling mortality
*Management considerations:*
• Ordinary crawler tractors and rubber-tired skidders cannot be operated safely on the very steep side slopes of ravines.
• Skid roads and trails should be located in the less sloping areas between the ravines.
• Control of concentrated water on logging roads and skid roads reduces the hazard of erosion.
• Seedling survival rates can be increased by carefully planting vigorous nursery stock.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species in areas of the McGinn soil.
• Carefully managed reforestation helps to control undesirable understory plants in areas of the McGinn soil.

**Buildings**

*Major management concerns:* Slope, cutbanks cave
*Management considerations:*
• Land shaping may be necessary to develop a suitable building site.
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• In areas that have slopes of more than 25 percent, these soils are generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.
• In areas that have slopes of more than 15 percent, these soils are generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* Klacking—6R; McGinn—4R
*Michigan soil management group:* Klacking—4a; McGinn—4a

## 96D2—Negwegon silty clay loam, 12 to 18 percent slopes, eroded

### *Setting*

*Landform:* Ridges and knolls on lake plains
*Distinctive landscape features:* Eroded surface
*Shape of areas:* Irregular
*Size of areas:* 10 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 6 inches—dark brown silty clay loam and reddish brown silty clay

*Subsoil:*
6 to 10 inches—reddish brown silty clay loam and silty clay
10 to 40 inches—reddish brown silty clay

*Substratum:*
40 to 60 inches—stratified brown silty clay loam and yellowish brown silt loam

### *Soil Properties and Qualities*

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### *Composition*

Negwegon and similar soils: About 95 percent
Contrasting inclusions: About 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Algonquin soils in drainageways

*Similar inclusions:*
• Soils that have a darker surface layer

### *Use and Management*

**Land use:** Dominant use—cropland; other use—pasture

**Cropland**

*Major management concerns:* Erosion hazard, low organic matter content, tilth in the surface layer, soil compaction, nutrient loss
*Management considerations:*
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Erosion hazard, compaction
*Management considerations:*
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates and short-duration grazing during the summer help to control soil blowing and water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Buildings**

*Major management concerns:* Shrink-swell, slope
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, slope
*Management considerations:*
• Backfilling the trenches with porous material and increasing the size of the absorption area help to overcome the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* 1a

## 97—Colonville very fine sandy loam, occasionally flooded

### *Setting*

*Landform:* Flood plains
*Slope:* 0 to 2 percent
*Shape of areas:* Long and narrow
*Size of areas:* 60 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 11 inches—very dark gray very fine sandy loam

*Substratum:*
11 to 22 inches—yellowish brown and very dark grayish brown, mottled, stratified loamy fine sand and fine sandy loam
22 to 38 inches—dark gray and brown, mottled, stratified fine sandy loam and loamy fine sand
38 to 52 inches—very dark grayish brown, mottled very fine sand
52 to 60 inches—gray, mottled silt loam

### *Soil Properties and Qualities*

*Permeability:* Moderately rapid
*Available water capacity:* High
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 1 to 2 feet from October through May
*Surface runoff:* Very slow
*Flooding:* Occasional
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The very poorly drained Waucedah soils in the lower positions on the flood plain

*Similar inclusions:*
• Soils that have a surface layer of mucky very fine sandy loam

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Equipment should be used only when the soil is relatively dry or has an adequate snow cover.
• Skidders should not be used during wet periods, when ruts form easily.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced and by using such harvest methods as selective cutting and strip cutting.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Carefully managed reforestation helps to control undesirable understory plants.

**Buildings**

*Major management concerns:* Seasonal flooding
*Management considerations:*
• Because of flooding, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Seasonal flooding
*Management considerations:*
• Because of flooding, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* Vw
*Woodland ordination symbol:* 3W
*Michigan soil management group:* L-2c

## 98C—Graycalm sand, pitted outwash, 0 to 12 percent slopes

### *Setting*

*Landform:* Outwash plains
*Distinctive landscape features:* Pitted landscape
*Shape of areas:* Irregular
*Size of areas:* 100 to 200 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—black sand
*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand
46 to 80 inches—light yellowish brown sand that has bands of brown loamy sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat excessively drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very slow or slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe
*Shrink-swell potential:* Low

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The moderately well drained Chinwhisker soils in depressions
• The somewhat excessively drained Mancelona soils, which have very gravelly sand in the substratum; in landscape positions similar to those of the Graycalm soil
• The very poorly drained Lupton soils in closed depressions

*Similar inclusions:*
• Soils that do not have bands in the substratum

### *Use and Management*

**Land use:** Dominant use—woodland; other use—building sites

**Woodland**

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• Planting special nursery stock or containerized seedlings can also reduce the seedling mortality rate.

**Buildings**

*Major management concerns:* Cutbanks cave, slope

*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Some land grading may be needed.

**Septic tank absorption fields**

*Major management concerns:* Poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Large lots, an absorption system of shallow trenches with shrubbery planted around the perimeter of the system, and low, uniform application rates help to prevent the pollution of ground water.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a

## 102D—Nester loam, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges and knolls on till plains and moraines
*Shape of areas:* Irregular
*Size of areas:* 20 to 75 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark grayish brown loam

*Subsoil:*
9 to 14 inches—brown sandy loam and reddish brown clay loam
14 to 40 inches—reddish brown clay loam

*Substratum:*
40 to 60 inches—light reddish brown clay loam

### *Soil Properties and Qualities*

*Permeability:* Slow
*Available water capacity:* High
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Moderate

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Bamfield and Glennie soils, which contain less clay in the subsoil than the Nester soil; in landscape positions similar to those of the Nester soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—cropland, pasture, building sites

**Cropland**

*Major management concerns:* Erosion hazard, tilth in the surface layer, nutrient loss
*Management considerations:*
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Erosion hazard, compaction
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Proper stocking rates, uniform distribution of grazing, and a planned grazing system help to keep the pasture in good condition.

**Woodland**

*Major management concerns:* Equipment limitation, plant competition
*Management considerations:*
• Because of low strength, suitable surfacing

material is needed on year-round logging roads and landings.
• Skidders should not be used during wet periods, when ruts form easily.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Slope, shrink-swell
*Management considerations:*
• Land shaping may be necessary to develop a suitable building site.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1.5a

## 102E—Nester loam, 18 to 25 percent slopes

### *Setting*

*Landform:* Steep areas on moraines
*Shape of areas:* Irregular
*Size of areas:* 10 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark grayish brown loam

*Subsoil:*
9 to 14 inches—brown sandy loam and reddish brown clay loam
14 to 40 inches—reddish brown clay loam

*Substratum:*
40 to 60 inches—light reddish brown clay loam

### *Soil Properties and Qualities*

*Permeability:* Slow
*Available water capacity:* High
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Moderate

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Alcona soils, which contain less clay in the subsoil than the Nester soil; in landscape positions similar to those of the Nester soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other use—pasture

**Pasture**

*Major management concerns:* Erosion hazard, compaction
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Proper stocking rates and short-duration grazing during the summer help to control water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Erosion hazard, equipment limitation, plant competition
*Management considerations:*
• Because of low strength, suitable surfacing material is needed on year-round logging roads and landings.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.

• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is poorly suited to building site development unless extensive land shaping is applied.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 1.5a

## 102F—Nester loam, 25 to 45 percent slopes

### *Setting*

*Landform:* Very steep areas on moraines
*Shape of areas:* Irregular
*Size of areas:* 5 to 40 acres

### *Typical Profile*

*Surface layer:*
0 to 9 inches—very dark grayish brown loam

*Subsoil:*
9 to 14 inches—brown sandy loam and reddish brown clay loam
14 to 40 inches—reddish brown clay loam

*Substratum:*
40 to 60 inches—light reddish brown clay loam

### *Soil Properties and Qualities*

*Permeability:* Slow
*Available water capacity:* High
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* Moderate

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Alcona soils, which contain less clay in the subsoil than the Nester soil; in landscape positions similar to those of the Nester soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, plant competition
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• Because of low strength, suitable surfacing material is needed on year-round logging roads and landings.
• Because of the slope, ordinary crawler tractors and rubber-tired skidders cannot be operated safely in some areas. As a result, special logging methods, such as yarding the logs with a cable, may be needed.
• Because of the erosion hazard, water should be removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• The grade should be kept as low as possible.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Special harvest methods may be needed to control undesirable plants.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope

*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 1.5a

## 110D—Negwegon silt loam, 12 to 18 percent slopes

### *Setting*

*Landform:* Ridges on dissected lake plains
*Shape of areas:* Irregular
*Size of areas:* 10 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 8 inches—dark brown silt loam

*Subsoil:*
8 to 16 inches—reddish brown silty clay loam and brown silt loam
16 to 46 inches—reddish brown silty clay

*Substratum:*
46 to 60 inches—stratified brown silty clay loam and yellowish brown silt loam

### *Soil Properties and Qualities*

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The well drained Alcona soils, which contain less clay than the Negwegon soil; in landscape positions similar to those of the Negwegon soil

*Similar inclusions:*
• Soils that are moderately well drained

### *Use and Management*

**Land use:** Dominant use—woodland; other uses—pasture, cropland, building sites

**Cropland**

*Major management concerns:* Erosion hazard, tilth in the surface layer, soil compaction, nutrient loss
*Management considerations:*
• Water erosion can be controlled by diversions, crop residue management, contour stripcropping, field stripcropping, cover crops, grassed waterways, conservation tillage, crop rotations that include grasses and legumes, grade-stabilization structures, or a combination of these.
• Growing grasses and legumes for pasture or hay is effective in controlling erosion.
• Returning crop residue to the soil, adding other organic material, and including grasses and legumes in the cropping sequence improve soil structure, permeability, and the rate of water infiltration.
• Minimizing tillage and tilling at the proper soil moisture content help to maintain good tilth.
• Crop rotations and the use of legumes may reduce the need for commercial fertilizer. Sod-based rotations significantly reduce dissolved and particulate nitrogen and phosphorus losses by minimizing runoff losses.

**Pasture**

*Major management concerns:* Erosion hazard, compaction
*Management considerations:*
• Restricted grazing during wet periods helps to prevent compaction and poor tilth.
• Proper stocking rates and short-duration grazing during the summer help to control water erosion, maintain plant density and hardiness, and help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* Equipment limitation, windthrow hazard, plant competition
*Management considerations:*
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.

• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Species preference can be managed by selective cutting.

**Buildings**

*Major management concerns:* Shrink-swell, slope
*Management considerations:*
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Land shaping may be necessary to develop a suitable building site.

**Septic tank absorption fields**

*Major management concerns:* Very slow permeability, slope
*Management considerations:*
• Increasing the size of the absorption area helps to compensate for the restricted permeability.
• Land shaping, pressurizing the absorption field, and installing the distribution lines on the contour help to overcome the slope.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* 3L
*Michigan soil management group:* 1a

## 110F—Negwegon silt loam, 25 to 45 percent slopes

### *Setting*

*Landform:* Escarpments and ridges on dissected lake plains
*Shape of areas:* Irregular
*Size of areas:* 5 to 40 acres

### *Typical Profile*

*Surface layer:*
0 to 1 inch—very dark grayish brown silt loam

*Subsurface layer:*
1 to 4 inches—brown silt loam

*Subsoil:*
4 to 16 inches—reddish brown silty clay loam and brown silt loam
16 to 40 inches—reddish brown silty clay

*Substratum:*
40 to 60 inches—stratified brown silty clay loam and yellowish brown silt loam

### *Soil Properties and Qualities*

*Permeability:* Very slow
*Available water capacity:* High
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Very rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Slight
*Shrink-swell potential:* High

### *Composition*

Negwegon and similar soils: About 95 percent
Contrasting inclusions: About 5 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Algonquin soils in drainageways

*Similar inclusions:*
• Soils that have a thin surface layer of very fine sandy loam

### *Use and Management*

**Land use:** Dominant use—woodland

**Woodland**

*Major management concerns:* Equipment limitation, erosion hazard, windthrow hazard, plant competition
*Management considerations:*
• Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
• In the steepest areas, cable yarding systems are generally safer than other logging methods and result in less surface disturbance.
• The grade should be kept as low as possible.
• Because of the very slow permeability and the sticky and plastic subsoil, logging roads should be graveled and, in some areas, landings should be stabilized.
• Skidders should not be used during wet periods, when ruts form easily.
• Because of the erosion hazard, water should be

removed from logging roads by water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures. Building logging roads on the contour or on the gentler slopes and seeding logging roads, skid roads, and landings after the trees are logged also help to prevent excessive soil loss.
• Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
• After cutting, competition from brush can delay or prevent the natural regeneration of desired species.
• Species preference can be managed by selective cutting.

**Buildings**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to building site development.

**Septic tank absorption fields**

*Major management concerns:* Slope
*Management considerations:*
• Because of the slope, this soil is generally unsuited to septic tank absorption fields.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* 3R
*Michigan soil management group:* 1a

## 111B—Manistee loamy sand, moderately wet, 0 to 6 percent slopes

### *Setting*

*Landform:* Lake plains and outwash plains
*Shape of areas:* Irregular
*Size of areas:* 5 to 50 acres

### *Typical Profile*

*Surface layer:*
0 to 4 inches—black loamy sand

*Subsurface layer:*
4 to 6 inches—pinkish gray loamy sand

*Subsoil:*
6 to 24 inches—strong brown loamy sand
24 to 27 inches—reddish brown clay and pinkish gray, mottled sandy loam
27 to 32 inches—reddish brown, mottled clay
32 to 50 inches—reddish brown clay

*Substratum:*
50 to 60 inches—reddish brown clay

### *Soil Properties and Qualities*

*Permeability:* Rapid in the upper part; very slow in the lower part
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Perched at a depth of 2.5 to 4.0 feet from November through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate
*Shrink-swell potential:* Low in the upper part and high in the lower part

### *Composition*

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

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Allendale soils in the lower positions on the landscape
• The very poorly drained Wakeley soils in depressions and drainageways

*Similar inclusions:*
• Soils that are well drained

### *Use and Management*

**Land use:** Dominant uses—woodland, pasture; other uses—cropland, building sites

**Cropland**

*Major management concerns:* Soil blowing, nutrient loss, low organic matter content, seasonal wetness
*Management considerations:*
• Conservation tillage, vegetative barriers, and cover crops help to control soil blowing.
• Timing fertilizer applications so that they meet the nutrient needs of the crop, using split fertilizer applications, and applying fertilizer in bands may reduce the risk of nutrient leaching.
• Increasing the content of organic matter in the root zone may improve the ability of the soil to hold water, nutrients, and pesticides and can help to prevent ground-water pollution.
• Including green manure crops in the cropping sequence, using no-till planting, and managing crop residue increase the organic matter content.
• Subsurface drains can reduce the wetness if a suitable outlet is available.

**Pasture**

*Major management concerns:* Overgrazing, seasonal wetness
*Management considerations:*
• Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.
• Applying lime and fertilizer according to soil tests helps to ensure the maximum growth of plants, especially legumes.

**Woodland**

*Major management concerns:* None

**Buildings**

*Major management concerns:* Cutbanks cave, shrink-swell, seasonal wetness
*Management considerations:*
• Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
• Properly designing and strengthening footings and foundations can help to prevent the structural damage caused by shrinking and swelling.
• Wetness can be reduced by installing a drainage system around structures that have basements and crawl spaces.

**Septic tank absorption fields**

*Major management concerns:* Seasonal wetness, slow permeability, poor filtering capacity
*Management considerations:*
• The poor filtering capacity can result in the pollution of ground water.
• Mounding or adding suitable fill material helps to raise the absorption field above the water table and increases the thickness of the filtering material.
• Increasing the size of the absorption area helps to compensate for the restricted permeability.

### *Interpretive Groups*

*Land capability classification:* IIIs
*Woodland ordination symbol:* 3A
*Michigan soil management group:* 4/1a

## 209B—Grayling sand, calcareous substratum, nearly level and undulating

### *Setting*

*Landform:* Deltas and river terraces
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 200 to 2,000 acres

### *Reference Profile*

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 70 inches—light yellowish brown sand
70 to 180 inches—yellowish brown, calcareous sand that has strata of fine sand, coarse sand, or gravelly sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### *Composition*

Grayling and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Haplaquods, Alfic Haplaquods, and Au Gres soils and the very poorly drained, dysic Borosaprists; in depressions

*Similar inclusions:*
• Sandy soils that have a banded substratum
• Sandy soils that have a gray subsurface layer
• Sandy soils that are moderately well drained

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a

*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 210B—Grayling sand, nearly level and undulating

### Setting

*Landform:* Outwash plains
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 80 to 600 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Grayling and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Haplaquods, Alfic Haplaquods, and Au Gres soils and the very poorly drained, dysic Borosaprists; in depressions

*Similar inclusions:*
• Sandy soils that have a banded substratum
• Sandy soils that have a gray subsurface layer
• Sandy soils that are moderately well drained

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality

*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 210C—Grayling sand, rolling

### Setting

*Landform:* Outwash plains and overwashed moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Grayling and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• Alfic Haplorthods, sandy, and Entic Haplorthods, sandy, loamy substratum, which are more fertile than

the Grayling soil; in landscape positions similar to those of the Grayling soil

*Similar inclusions:*
- Sandy soils that have deep bands
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 210D—Grayling sand, hilly

### Setting

*Landform:* Overwashed sandy moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe

### Composition

Grayling and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- Alfic Haplorthods, sandy, and Entic Haplorthods, sandy, loamy substratum, which are more fertile than the Grayling soil; in landscape positions similar to those of the Grayling soil

*Similar inclusions:*
- Sandy soils that have deep bands
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained
- Sandy soils that have gravelly textures in the substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Because of the hazard of erosion, the use of logging equipment and the construction of roads in steep areas should be avoided.
- The hazard of erosion can be reduced by seeding logging roads, landings, and areas that have been cut and filled and by installing water bars and culverts.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* 4R
*Michigan soil management group:* 5.7a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 211B—Grayling sand, banded substratum, nearly level and undulating

### Setting

*Landform:* Outwash plains
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 80 to 600 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—black sand

*Subsoil:*
3 to 15 inches—dark yellowish brown sand
15 to 35 inches—yellowish brown sand

*Substratum:*
35 to 60 inches—light yellowish brown sand
60 to 80 inches—light yellowish brown sand and bands of yellowish brown loamy sand
80 to 180 inches—light yellowish brown sand that has strata of fine sand, coarse sand, or loamy sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Grayling and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions
- Entic Haplorthods, sandy, loamy substratum, in landscape positions similar to those of the Grayling soil

*Similar inclusions:*
- Sandy soils that are not banded
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained
- Sandy soils that have gravelly textures in the substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 211C—Grayling sand, banded substratum, rolling

### Setting

*Landform:* Rolling areas on overwashed moraines and ice-contact moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 80 to 600 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—black sand

*Subsoil:*
3 to 15 inches—dark yellowish brown sand
15 to 35 inches—yellowish brown sand

*Substratum:*
35 to 60 inches—light yellowish brown sand
60 to 80 inches—light yellowish brown sand and bands of yellowish brown loamy sand
80 to 180 inches—light yellowish brown sand that has strata of fine sand, coarse sand, or loamy sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet

*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Grayling and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions
• Entic Haplorthods, sandy, loamy substratum
• Alfic Haplorthods, sandy, in landscape positions similar to those of the Grayling soil

*Similar inclusions:*
• Sandy soils that are not banded
• Sandy soils that have a gray subsurface layer
• Sandy soils that are moderately well drained
• Sandy soils that have gravelly textures in the substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 212B—Grayling sand, very deep water table, nearly level and undulating

### Setting

*Landform:* Outwash plains
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 80 to 600 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—black sand

*Subsoil:*
3 to 10 inches—dark yellowish brown sand
10 to 30 inches—yellowish brown sand

*Substratum:*
30 to 70 inches—light yellowish brown sand
70 to 100 inches—light yellowish brown, mottled sand
100 to 180 inches—yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* 6 to 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Grayling and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions

*Similar inclusions:*
• Sandy soils that have deep bands
• Sandy soils that have a gray subsurface layer
• Sandy soils that are moderately well drained
• Sandy soils that have a water table below a depth of 15 feet
• Sandy soils that have gravelly textures in the substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 4S
*Michigan soil management group:* 5.7a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 213B—Graycalm sand, nearly level and undulating

### Setting

*Landform:* Outwash plains and overwashed moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 80 to 400 acres

### Reference Profile

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand
46 to 70 inches—light yellowish brown sand that has bands of brown loamy sand

*Substratum:*
70 to 180 inches—stratified coarse sand to loamy sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Graycalm and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods and the very poorly drained, dysic Borosaprists; in depressions

*Similar inclusions:*
• Sandy soils that have a gray subsurface horizon
• Sandy soils that are moderately well drained
• Sandy soils that have spodic development
• Sandy soils that have a banded substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* IVs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 213C—Graycalm sand, rolling

### Setting

*Landform:* Ice-contact moraines and overwashed moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 80 to 400 acres

### Reference Profile

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand

46 to 70 inches—light yellowish brown sand that has bands of brown loamy sand

*Substratum:*
70 to 180 inches—stratified coarse sand to loamy sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Graycalm and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods and the very poorly drained, dysic Borosaprists; in depressions

*Similar inclusions:*
• Sandy soils that have a gray subsurface layer
• Sandy soils that are moderately well drained
• Sandy soils that have spodic development
• Sandy soils that have a gravelly substratum
• Sandy soils that have a banded substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* 6S
*Michigan soil management group:* 5a
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 215C—Typic Udipsamments, loamy substratum, rolling

### Setting

*Landform:* Outwash plains and overwashed moraines
*Slope:* 0 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark grayish brown sand

*Subsoil:*
2 to 15 inches—dark yellowish brown sand
15 to 25 inches—yellowish brown sand

*Substratum:*
25 to 75 inches—brownish yellow sand
75 to 95 inches—strong brown sandy clay loam

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
• Alfic Haplorthods, sandy, and Glossic Eutroboralfs; in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
• Sandy soils that are moderately well drained
• Sandy soils that have a coarse textured substratum

- Sandy soils that have a surface layer of loamy sand or fine sand
- Sandy soils that have a banded substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Black oak-White oak-Blueberry
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 220B—Typic Udipsamments, nearly level and undulating

### Setting

*Landform:* Sandy moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—light brownish gray sand

*Subsoil:*
4 to 12 inches—dark yellowish brown sand
12 to 40 inches—yellowish brown sand

*Substratum:*
40 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the very poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- The well drained Glossic Eutroboralfs in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
- Sandy soils that are moderately well drained
- Sandy soils that have a fine textured substratum
- Sandy soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 220C—Typic Udipsamments, rolling

### Setting

*Landform:* Sandy moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—light brownish gray sand

*Subsoil:*
4 to 12 inches—strong brown sand
12 to 40 inches—brownish yellow sand

*Substratum:*
40 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- The well drained Glossic Eutroboralfs, fine-loamy, in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
- Sandy soils that are moderately well drained
- Sandy soils that have a fine textured substratum
- Sandy soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 220D—Typic Udipsamments, hilly

### Setting

*Landform:* Sandy moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—light brownish gray sand

*Subsoil:*
4 to 12 inches—yellowish brown sand
12 to 40 inches—brownish yellow sand

*Substratum:*
40 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• Glossic Eutroboralfs in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
• Sandy soils that have a banded substratum
• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that have a gravelly substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, steep slopes
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Special care is needed in laying out logging roads and in operating logging equipment. The hazard of erosion can be reduced by seeding logging roads and landings and by installing water bars and culverts.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 220E—Typic Udipsamments, steep

### Setting

*Landform:* Sandy moraines
*Slope:* 30 to 50 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—light brownish gray sand

*Subsoil:*
4 to 12 inches—yellowish brown sand
12 to 40 inches—brownish yellow sand

*Substratum:*
40 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• Alfic Haplorthods, sandy over loamy, and Glossic Eutroboralfs; in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
• Sandy soils that have a fine textured, banded substratum
• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that have a gravelly substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced, management practices that disturb the soil should be avoided in the steep areas.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 221B—Typic Udipsamments, banded substratum, nearly level and undulating

### Setting

*Landform:* Sandy moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—very dark gray sand

*Subsoil:*
3 to 6 inches—dark brown sand
6 to 20 inches—strong brown sand
20 to 30 inches—brownish yellow sand

*Substratum:*
30 to 45 inches—light yellowish brown sand
45 to 75 inches—light yellowish brown sand that has bands of dark yellowish brown loamy sand
75 to 85 inches—brown loamy sand
85 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- Glossic Eutoboralfs and Alfic Haplorthods, sandy over loamy; in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
- Sandy soils that are moderately well drained
- Sandy soils that have a fine textured, banded substratum
- Sandy soils that have a surface layer of loamy sand or fine sand
- Sandy soils that have a gravelly substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 221C—Typic Udipsamments, banded substratum, rolling

### Setting

*Landform:* Sandy moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—very dark gray sand

*Subsoil:*
3 to 6 inches—dark brown sand
6 to 20 inches—strong brown sand
20 to 30 inches—brownish yellow sand

*Substratum:*
30 to 45 inches—light yellowish brown sand
45 to 75 inches—light yellowish brown sand that has bands of dark yellowish brown loamy sand
75 to 85 inches—brown loamy sand
85 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
• Glossic Eutroboralfs and Alfic Haplorthods, sandy over loamy; in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
• Sandy soils that are moderately well drained
• Sandy soils that have a fine textured, banded substratum
• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that have a gravelly substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 221D—Typic Udipsamments, banded substratum, hilly

### Setting

*Landform:* Sandy moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—very dark gray sand

*Subsoil:*
3 to 6 inches—dark brown sand
6 to 20 inches—strong brown sand
20 to 30 inches—brownish yellow sand

*Substratum:*
30 to 45 inches—light yellowish brown sand
45 to 75 inches—light yellowish brown sand that has bands of dark yellowish brown loamy sand
75 to 85 inches—brown loamy sand
85 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe

### Composition

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• Alfic Haplorthods, sandy over loamy, and Entic Haplorthods, sandy, loamy substratum; in landscape positions similar to those of the Typic Udipsamments

*Similar inclusions:*
• Sandy soils that have a fine textured, banded substratum

• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that have a gravelly substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Special care is needed in laying out logging roads and in operating logging equipment. The hazard of erosion can be reduced by seeding logging roads and landings and by installing water bars and culverts.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### *Interpretive Groups*

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 222B—Typic Udipsamments, very deep water table, nearly level and undulating

### *Setting*

*Landform:* Outwash plains
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### *Reference Profile*

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsoil:*
2 to 5 inches—dark brown sand
5 to 15 inches—strong brown sand
15 to 30 inches—yellowish brown sand

*Substratum:*
30 to 80 inches—light yellowish brown, mottled sand
80 to 90 inches—yellowish brown, mottled sand
90 to 100 inches—yellowish brown, saturated sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* 5 to 10 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### *Composition*

Typic Udipsamments and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that have a fine textured substratum
• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that do not have a mottled substratum
• Sandy soils that have a gravelly substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 223B—Graycalm-Grayling sands, nearly level and undulating

### Setting

*Landform:* Sandy ground moraines and end moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

**Graycalm**

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand
46 to 70 inches—light yellowish brown sand that has bands of brown loamy sand

*Substratum:*
70 to 180 inches—stratified coarse sand to loamy sand

**Grayling**

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Graycalm and Grayling soils and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and sandy Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that are moderately well drained
• Sandy soils that do not have bands in the substratum
• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that have gravelly textures in the substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* IVs
*Woodland ordination symbol:* Graycalm—6S; Grayling—4S
*Michigan soil management group:* Graycalm—5a; Grayling—5.7a
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 223C—Graycalm-Grayling sands, rolling

### Setting

*Landform:* Sandy ground moraines and end moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### Reference Profile

**Graycalm**

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand
46 to 70 inches—light yellowish brown sand that has bands of brown loamy sand

*Substratum:*
70 to 180 inches—stratified coarse sand to loamy sand

**Grayling**

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Graycalm and Grayling soils and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
• Alfic Haplorthods, sandy over loamy, and Glossic Eutroboralfs; in landscape positions similar to those of the Graycalm and Grayling soils

*Similar inclusions:*
• Sandy soils that are moderately well drained
• Sandy soils that have a gravelly substratum
• Sandy soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* Graycalm—6S; Grayling—4S
*Michigan soil management group:* Graycalm—5a; Grayling—5.7a
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 223D—Graycalm-Grayling sands, hilly

### Setting

*Landform:* Sandy ground moraines and end moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

**Graycalm**

*Surface layer:*
0 to 1 inch—black sand

*Subsoil:*
1 to 4 inches—strong brown sand
4 to 46 inches—strong brown loamy sand
46 to 70 inches—light yellowish brown sand that has bands of brown loamy sand

*Substratum:*
70 to 180 inches—stratified coarse sand to loamy sand

**Grayling**

*Surface layer:*
0 to 2 inches—black sand

*Subsoil:*
2 to 4 inches—dark yellowish brown sand
4 to 29 inches—yellowish brown sand

*Substratum:*
29 to 180 inches—light yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained

*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe

### Composition

Graycalm and Grayling soils and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• Alfic Haplorthods, sandy over loamy, and Glossic Eutroboralfs; in landscape positions similar to those of the Graycalm and Grayling soils

*Similar inclusions:*
• Sandy soils that have coarse textured bands in the substratum
• Sandy soils that have a surface layer of loamy sand or fine sand
• Sandy soils that have a gravelly substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Special care is needed in laying out logging roads and in operating logging equipment. The hazard of erosion can be reduced by seeding logging roads and landings and by installing water bars and culverts.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* Graycalm—6R; Grayling—4R
*Michigan soil management group:* Graycalm—5a; Grayling—5.7a
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 224B—Croswell sand, nearly level and undulating

### Setting

*Landform:* Outwash plains
*Slope:* 0 to 4 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

*Organic mat:*
0 to 1 inch—black, well decomposed forest leaf litter

*Surface layer:*
1 to 4 inches—dark grayish brown sand

*Subsoil:*
4 to 10 inches—dark brown sand
10 to 20 inches—strong brown sand
20 to 29 inches—brownish yellow, mottled sand

*Substratum:*
29 to 80 inches—yellowish brown and light yellowish brown, mottled sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Moderately well drained
*Depth to the water table:* 3 to 5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Croswell and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils, the somewhat poorly drained Alfic Haplaquods, and the very poorly drained, dysic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that have a banded substratum
• Sandy soils that have a surface layer of loamy sand
• Sandy soils that do not have a mottled substratum
• Sandy soils that are moderately well drained

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* IVs
*Woodland ordination symbol:* 5S
*Michigan soil management group:* 5a
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Black oak-White oak-Blueberry

## 225B—Entic Haplorthods, sandy, loamy substratum, nearly level and undulating

### Setting

*Landform:* Overwashed sandy moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—grayish brown sand

*Subsoil:*
4 to 8 inches—dark brown sand
8 to 15 inches—dark yellowish brown sand
15 to 30 inches—yellowish brown sand

*Substratum:*
30 to 55 inches—strong brown sand
55 to 80 inches—reddish brown sandy clay loam

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Entic Haplorthods and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
• Glossic Eutroboralfs in landscape positions similar to those of the Entic Haplorthods

*Similar inclusions:*
• Sandy soils that are moderately well drained
• Sandy soils that have a coarse textured substratum
• Sandy soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Northern red oak-Red maple-Mapleleaf viburnum

## 225C—Entic Haplorthods, sandy, loamy substratum, rolling

### Setting

*Landform:* Overwashed end moraines and ground moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—grayish brown sand

*Subsoil:*
4 to 8 inches—dark brown sand
8 to 15 inches—strong brown sand
15 to 30 inches—yellowish brown sand

*Substratum:*
30 to 55 inches—strong brown sand
55 to 80 inches—reddish brown sandy clay loam

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Entic Haplorthods and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils and Alfic Haplaquods, the poorly drained Leafriver and Wakeley soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- Glossic Eutroboralfs in landscape positions similar to those of the Entic Haplorthods

*Similar inclusions:*
- Sandy soils that are moderately well drained
- Sandy soils that have a coarse textured substratum
- Sandy soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed oak-Red maple-Starflower
*Secondary plant association:* Northern red oak-Red maple-Mapleleaf viburnum

## 230C—Entic Haplorthods, sandy-Alfic Haplorthods, sandy, complex, rolling

### Setting

*Landform:* Sandy moraines
*Slope:* 0 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—pale brown sand

*Subsoil:*
4 to 8 inches—dark brown sand
8 to 20 inches—strong brown sand
20 to 35 inches—reddish yellow sand

*Substratum:*
35 to 180 inches—light yellowish brown sand

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### *Composition*

Entic Haplorthods and similar soils: 40 to 70 percent
Alfic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 30 percent

### *Inclusions*

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils and the very poorly drained, dysic and euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that have a fine textured substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### *Interpretive Groups*

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 231B—Entic Haplorthods, sandy, banded substratum-Alfic Haplorthods, sandy, complex, nearly level and undulating

### *Setting*

*Landform:* Sandy moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### *Reference Profile*

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—brown sand

*Subsoil:*
4 to 8 inches—dark brown sand
8 to 20 inches—strong brown sand
20 to 30 inches—brownish yellow sand

*Substratum:*
30 to 60 inches—light yellowish brown sand
60 to 75 inches—light yellowish brown sand that has bands of dark yellowish brown loamy sand
75 to 85 inches—brown loamy sand
85 to 180 inches—light yellowish brown sand

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low

*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### Composition

Entic Haplorthods and similar soils: 40 to 70 percent
Alfic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils and the very poorly drained, dysic and euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that have a loamy substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 231C—Entic Haplorthods, sandy, banded substratum-Alfic Haplorthods, sandy, complex, rolling

### Setting

*Landform:* Sandy end moraines and ground moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—brown sand

*Subsoil:*
4 to 8 inches—dark brown sand
8 to 20 inches—strong brown sand
20 to 30 inches—brownish yellow sand

*Substratum:*
30 to 60 inches—light yellowish brown sand
60 to 75 inches—light yellowish brown sand that has bands of dark yellowish brown loamy sand
75 to 85 inches—brown loamy sand
85 to 180 inches—light yellowish brown sand

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### Composition

Entic Haplorthods and similar soils: 40 to 70 percent
Alfic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic and dysic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that have a loamy substratum

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 231D—Entic Haplorthods, sandy, banded substratum-Alfic Haplorthods, sandy, complex, hilly

### Setting

*Landform:* Sandy end moraines and ground moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—brown sand

*Subsoil:*
4 to 8 inches—dark brown sand
8 to 20 inches—strong brown sand
20 to 30 inches—brownish yellow sand

*Substratum:*
30 to 60 inches—light yellowish brown sand
60 to 75 inches—light yellowish brown sand that has bands of dark yellowish brown loamy sand
75 to 85 inches—brown loamy sand
85 to 180 inches—light yellowish brown sand

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate or severe

### Composition

Entic Haplorthods and similar soils: 40 to 70 percent
Alfic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Alfic Haplaquods and the very poorly drained, dysic and euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
- Sandy soils that have a loamy substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Management practices that disturb the soil should be limited in steep areas. Special care is needed in the placement of roads and trails.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### *Interpretive Groups*

*Land capability classification:* VIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 232B—Entic Haplorthods, sandy-Alfic Haplorthods, sandy, complex, very deep water table, nearly level and undulating

### *Setting*

*Landform:* Outwash
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 100 acres

### *Reference Profile*

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 3 inches—grayish brown sand

*Subsoil:*
3 to 7 inches—dark brown sand
7 to 15 inches—strong brown sand
15 to 30 inches—yellowish brown sand

*Substratum:*
30 to 80 inches—light yellowish brown, mottled sand
80 to 90 inches—yellowish brown, mottled sand
90 to 100 inches—yellowish brown, saturated sand

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 70 inches—reddish yellow, mottled sand
70 to 100 inches—brownish yellow, saturated sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* 6 to 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### *Composition*

Entic Haplorthods and similar soils: 40 to 70 percent
Alfic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 30 percent

### *Inclusions*

*Contrasting inclusions:*
- The poorly drained Leafriver and Wakeley soils and the very poorly drained, dysic and euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
- Sandy soils that have a loamy substratum
- Sandy soils that have a water table at a depth of more than 6 feet
- Sandy soils that have a banded substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### *Interpretive Groups*

*Land capability classification:* VIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 233B—Alfic Haplorthods, sandy-Entic Haplorthods, sandy, fine-loamy banded substratum, complex, nearly level and undulating

### *Setting*

*Landform:* Sandy moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### *Reference Profile*

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—dark grayish brown sand

*Subsurface layer:*
2 to 3 inches—pale brown sand

*Subsoil:*
3 to 6 inches—dark brown sand
6 to 15 inches—strong brown sand
15 to 30 inches—yellowish brown sand
30 to 55 inches—light yellowish brown sand

*Substratum:*
55 to 70 inches—yellowish brown sand that has bands of sandy clay loam
70 to 180 inches—light yellowish brown, stratified sands

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### *Composition*

Alfic Haplorthods and similar soils: 40 to 75 percent
Entic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Sandy soils that do not have a fine-loamy substratum

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* IIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 233C—Alfic Haplorthods, sandy-Entic Haplorthods, sandy, fine-loamy banded substratum, complex, rolling

### Setting

*Landform:* Sandy moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—dark grayish brown sand

*Subsurface layer:*
2 to 3 inches—pale brown sand

*Subsoil:*
3 to 6 inches—dark brown sand
6 to 15 inches—strong brown sand
15 to 30 inches—yellowish brown sand
30 to 55 inches—light yellowish brown sand

*Substratum:*
55 to 70 inches—yellowish brown sand that has bands of sandy clay loam
70 to 180 inches—light yellowish brown, stratified sands

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### Composition

Alfic Haplorthods and similar soils: 40 to 75 percent
Entic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
- Sandy soils that do not have a fine-loamy substratum
- Sandy soils that do not have a dark brown subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* IVe
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 233D—Alfic Haplorthods, sandy-Entic Haplorthods, sandy, fine-loamy banded substratum, complex, hilly

### Setting

*Landform:* Sandy moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

**Alfic Haplorthods**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

**Entic Haplorthods**

*Surface layer:*
0 to 2 inches—dark grayish brown sand

*Subsurface layer:*
2 to 3 inches—pale brown sand

*Subsoil:*
3 to 6 inches—dark brown sand
6 to 15 inches—strong brown sand
15 to 30 inches—yellowish brown sand
30 to 55 inches—light yellowish brown sand

*Substratum:*
55 to 70 inches—yellowish brown sand that has bands of sandy clay loam
70 to 180 inches—light yellowish brown, stratified sands

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate or severe

### Composition

Alfic Haplorthods and similar soils: 40 to 75 percent
Entic Haplorthods and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
- Sandy soils that do not have a fine-loamy substratum
- Sandy soils that do not have a dark brown subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- Management practices that disturb the soil should be limited in steep areas. Special care is needed in the placement of roads and trails.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* VIIe
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Mixed oak-Red maple-Starflower

## 235B—Alfic Haplorthods, sandy over loamy-Alfic Haplorthods, sandy, complex, nearly level and undulating

### Setting

*Landform:* Sandy end moraines and ground moraines
*Slope:* 0 to 6 percent

*Shape of areas:* Irregular
*Size of areas:* 20 to 400 acres

### *Reference Profile*

**Alfic Haplorthods, sandy over loamy**

*Organic mat:*
0 to 2 inches—black, partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark grayish brown sand

*Subsurface layer:*
4 to 6 inches—grayish brown sand

*Subsoil:*
6 to 9 inches—dark brown loamy sand
9 to 27 inches—strong brown sand
27 to 44 inches—brown sandy clay loam

*Substratum:*
44 to 52 inches—yellowish brown loamy sand
52 to 120 inches—brownish yellow sand

**Alfic Haplorthods, sandy**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### *Composition*

Alfic Haplorthods, sandy over loamy, and similar soils: 40 to 70 percent
Alfic Haplorthods, sandy, and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic Borosaprists; in depressions and drainageways
• Glossic Eutroboralfs in landscape positions similar to those of the major soils

*Similar inclusions:*
• Sandy soils that do not have a dark brown subsoil
• Sandy soils that do not have loamy textures in the profile

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### *Interpretive Groups*

*Land capability classification:* IIIs
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 235C—Alfic Haplorthods, sandy over loamy-Alfic Haplorthods, sandy, complex, rolling

### *Setting*

*Landform:* Sandy end moraines and ground moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### *Reference Profile*

**Alfic Haplorthods, sandy over loamy**

*Organic mat:*
0 to 2 inches—black, partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark grayish brown sand

*Subsurface layer:*
4 to 6 inches—grayish brown sand

*Subsoil:*
6 to 9 inches—dark brown loamy sand
9 to 27 inches—strong brown sand
27 to 44 inches—brown sandy clay loam

*Substratum:*
44 to 52 inches—yellowish brown loamy sand
52 to 120 inches—brownish yellow sand

**Alfic Haplorthods, sandy**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate or severe

### *Composition*

Alfic Haplorthods, sandy over loamy, and similar soils: 40 to 70 percent
Alfic Haplorthods, sandy, and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
• The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic Borosaprists; in depressions and drainageways
• The somewhat poorly drained Alfic Haplaquods in depressions and drainageways
• Glossic Eutroboralfs in landscape positions similar to those of the major soils

*Similar inclusions:*
• Sandy soils that do not have a dark brown subsoil
• Sandy soils that do not have loamy textures in the profile

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### *Interpretive Groups*

*Land capability classification:* IVe
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 235D—Alfic Haplorthods, sandy over loamy-Alfic Haplorthods, sandy, complex, hilly

### *Setting*

*Landform:* Overwashed end moraines and ground moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### *Reference Profile*

**Alfic Haplorthods, sandy over loamy**

*Organic mat:*
0 to 2 inches—black, partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark grayish brown sand

*Subsurface layer:*
4 to 6 inches—grayish brown sand

*Subsoil:*
6 to 9 inches—dark brown loamy sand
9 to 27 inches—strong brown sand
27 to 44 inches—brown sandy clay loam

*Substratum:*
44 to 52 inches—yellowish brown loamy sand
52 to 120 inches—brownish yellow sand

**Alfic Haplorthods, sandy**

*Organic mat:*
0 to 2 inches—partially decomposed hardwood leaf litter

*Surface layer:*
2 to 4 inches—very dark gray loamy sand

*Subsurface layer:*
4 to 7 inches—grayish brown sand

*Subsoil:*
7 to 10 inches—dark brown loamy sand
10 to 17 inches—strong brown sand
17 to 37 inches—yellowish brown sand
37 to 42 inches—dark brown sandy loam

*Substratum:*
42 to 77 inches—reddish yellow sand
77 to 180 inches—brownish yellow sand

### *Soil Properties and Qualities*

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Excessively drained
*Depth to the water table:* More than 15 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate or severe

### *Composition*

Alfic Haplorthods, sandy over loamy, and similar soils: 40 to 70 percent
Alfic Haplorthods, sandy, and similar soils: 20 to 50 percent
Contrasting inclusions: 5 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
- The poorly drained Leafriver and Wakeley soils and the very poorly drained, euic Borosaprists; in depressions and drainageways
- The somewhat poorly drained Alfic Haplaquods in depressions and drainageways
- Glossic Eutroboralfs in landscape positions similar to those of the major soils

*Similar inclusions:*
- Sandy soils that do not have a dark brown subsoil
- Sandy soils that do not have loamy textures in the profile

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
- Management practices that disturb the soil should be limited in steep areas. Special care is needed in the placement of roads and trails.
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soil is moist can reduce the seedling mortality rate.
- The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### *Interpretive Groups*

*Land capability classification:* VIIe
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 236B—Arenic Eutroboralfs, nearly level and undulating

### *Setting*

*Landform:* Overwashed end moraines and ground moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—light brownish gray sand

*Subsoil:*
4 to 10 inches—dark yellowish brown sand
10 to 30 inches—yellowish brown loamy sand
30 to 35 inches—strong brown sandy loam

*Substratum:*
35 to 45 inches—dark brown sandy clay loam
45 to 70 inches—yellowish brown loamy sand
70 to 100 inches—light yellowish brown, stratified sands

### Soil Properties and Qualities

*Permeability:* Moderate or moderately slow
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Slow
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Arenic Eutroboralfs and similar soils: 60 to 80 percent
Contrasting inclusions: 20 to 40 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Alfic Haplaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Soils that are moderately well drained
• Soils that have a loamy surface layer
• Soils that have a dark brown subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 236C—Arenic Eutroboralfs, rolling

### Setting

*Landform:* Overwashed end moraines and ground moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

*Surface layer:*
0 to 2 inches—very dark gray sand

*Subsurface layer:*
2 to 4 inches—light brownish gray sand

*Subsoil:*
4 to 10 inches—dark yellowish brown sand
10 to 30 inches—yellowish brown loamy sand
30 to 35 inches—strong brown sandy loam

*Substratum:*
35 to 45 inches—dark brown sandy clay loam
45 to 70 inches—yellowish brown loamy sand
70 to 100 inches—light yellowish brown, stratified sands

### Soil Properties and Qualities

*Permeability:* Moderate or moderately slow
*Available water capacity:* Low
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Low
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Severe

### Composition

Arenic Eutroboralfs and similar soils: 60 to 80 percent

Contrasting inclusions: 20 to 40 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Alfic Haplaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Soils that are moderately well drained
• Soils that have a loamy surface layer
• Soils that have a dark brown subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality
*Management considerations:*
• Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
• Planting when the soil is moist can reduce the seedling mortality rate.
• The seedling mortality rate may be higher in areas that have southern exposures than in other areas.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Mapleleaf viburnum
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 237B—Glossic Eutroboralfs, nearly level and undulating

### Setting

*Landform:* Ground moraines and end moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—very dark gray sandy loam

*Subsoil:*
3 to 12 inches—brown and dark brown loamy sand
12 to 29 inches—reddish brown sandy clay loam and brown sandy loam
29 to 43 inches—brown loamy sand

*Substratum:*
43 to 58 inches—reddish brown loamy sand
58 to 84 inches—stratified reddish brown and yellowish brown loam

### Soil Properties and Qualities

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate

### Composition

Glossic Eutroboralfs and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The excessively drained, sandy Entic Haplorthods in landscape positions similar to those of the Glossic Eutroboralfs
• The somewhat poorly drained Allendale soils, the poorly drained Typic Haplaquods, and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
• Soils that are moderately well drained
• Soils that have a dark subsoil
• Soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Compaction
*Management considerations:*
• The use of heavy equipment may cause compaction in areas where the soils have a loamy surface layer. Using the equipment only during dry periods or during winter helps to prevent surface compaction.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Trefoil

*Secondary plant association:* Northern red oak-Red maple-Mapleleaf viburnum

## 237C—Glossic Eutroboralfs, rolling

### *Setting*

*Landform:* Ground moraines and end moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### *Reference Profile*

*Surface layer:*
0 to 3 inches—very dark gray sandy loam

*Subsoil:*
3 to 12 inches—brown and dark brown loamy sand
12 to 29 inches—reddish brown sandy clay loam and brown sandy loam
29 to 43 inches—brown loamy sand

*Substratum:*
43 to 58 inches—reddish brown loamy sand
58 to 84 inches—stratified reddish brown and yellowish brown loam

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate

### *Composition*

Glossic Eutroboralfs and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### *Inclusions*

*Contrasting inclusions:*
- The excessively drained, sandy Entic Haplorthods in landscape positions similar to those of the Glossic Eutroboralfs
- The somewhat poorly drained Allendale soils, the poorly drained Typic Haplaquods, and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
- Soils that are moderately well drained
- Soils that have a dark subsoil
- Soils that have a surface layer of loamy sand or fine sand

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Compaction
*Management considerations:*
- The use of heavy equipment may cause compaction in areas where the soils have a loamy surface layer. Using the equipment only during dry periods or during winter helps to prevent surface compaction.

### *Interpretive Groups*

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Trefoil
*Secondary plant association:* Northern red oak-Red maple-Mapleleaf viburnum

## 237D—Glossic Eutroboralfs, hilly

### *Setting*

*Landform:* Ground moraines and end moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 200 acres

### *Reference Profile*

*Surface layer:*
0 to 3 inches—very dark gray sandy loam

*Subsoil:*
3 to 12 inches—brown and dark brown loamy sand
12 to 29 inches—reddish brown sandy clay loam and brown sandy loam
29 to 43 inches—brown loamy sand

*Substratum:*
43 to 58 inches—reddish brown loamy sand
58 to 84 inches—stratified reddish brown and yellowish brown loam

### *Soil Properties and Qualities*

*Permeability:* Moderate
*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None

*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate

### Composition

Glossic Eutroboralfs and similar soils: 70 to 90 percent
Contrasting inclusions: 10 to 30 percent

### Inclusions

*Contrasting inclusions:*
- The excessively drained, sandy Entic Haplorthods in landscape positions similar to those of the Glossic Eutroboralfs
- The somewhat poorly drained Allendale soils, the poorly drained Typic Haplaquods, and the very poorly drained, euic Borosaprists; in depressions and drainageways

*Similar inclusions:*
- Soils that are moderately well drained
- Soils that have a dark subsoil
- Soils that have a surface layer of loamy sand or fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Compaction and erosion hazard
*Management considerations:*
- The use of heavy equipment may cause compaction in areas where the soils have a loamy surface layer. Using the equipment only during dry periods or during winter helps to prevent surface compaction.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Trefoil
*Secondary plant association:* Northern red oak-Red maple-Mapleleaf viburnum

## 247B—Glennie-Bamfield complex, nearly level and undulating

### Setting

*Landform:* End moraines and ground moraines
*Slope:* 0 to 6 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### Reference Profile

**Glennie**

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown, mottled sandy clay loam and brown, mottled sandy loam
46 to 56 inches—dark reddish brown, mottled clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—reddish brown sandy clay loam

**Bamfield**

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown, mottled clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### Soil Properties and Qualities

*Permeability:* Glennie—moderately rapid in the upper

part, very slow in the lower part; Bamfield—very slow
*Available water capacity:* Moderate
*Drainage class:* Moderately well drained
*Seasonal high water table:* Glennie—perched at a depth of 3.5 to 4.5 feet from November through May; Bamfield—perched at a depth of 1.5 to 3.0 feet from November through May
*Surface runoff:* Very slow to medium
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate

### Composition

Glennie and similar soils: 35 to 50 percent
Bamfield and similar soils: 35 to 50 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• The somewhat poorly drained Alfic Haplaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways
• The excessively drained, sandy Entic Haplorthods in landscape positions similar to those of the major soils

*Similar inclusions:*
• Sandy soils that are moderately well drained
• Soils that have a surface layer of fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Compaction
*Management considerations:*
• The use of heavy equipment may cause compaction in areas where the soils have a loamy surface layer. Using the equipment only during dry periods or during winter helps to prevent surface compaction.

### Interpretive Groups

*Land capability classification:* IIIe
*Woodland ordination symbol:* Glennie—5D; Bamfield—3L
*Michigan soil management group:* Glennie—4/2a-f; Bamfield—3/2a
*Primary plant association:* Sugar maple-White ash-Sweet cicely
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 247C—Glennie-Bamfield complex, rolling

### Setting

*Landform:* End moraines and ground moraines
*Slope:* 6 to 18 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### Reference Profile

**Glennie**

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown sandy clay loam and brown sandy loam
46 to 56 inches—dark reddish brown clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—reddish brown sandy clay loam

**Bamfield**

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### Soil Properties and Qualities

*Permeability:* Glennie—moderately rapid in the upper part, very slow in the lower part; Bamfield—very slow
*Available water capacity:* Moderate

*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Medium or rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of soil blowing:* Moderate

### Composition

Glennie and similar soils: 35 to 60 percent
Bamfield and similar soils: 35 to 50 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained, sandy Alfic Haplaquods, the somewhat poorly drained Allendale soils, and the very poorly drained, euic Borosaprists; in depressions and drainageways
- The excessively drained, sandy Entic Haplorthods in landscape positions similar to those of the major soils

*Similar inclusions:*
- Sandy soils that are moderately well drained
- Soils that have a surface layer of fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Compaction, equipment limitation
*Management considerations:*
- The use of heavy equipment may cause compaction in areas where the soils have a loamy surface layer. Using the equipment only during dry periods or during winter helps to prevent surface compaction.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.

### Interpretive Groups

*Land capability classification:* IVe
*Woodland ordination symbol:* Glennie—5D; Bamfield—3L
*Michigan soil management group:* Glennie—4/2a-f; Bamfield—3/2a
*Primary plant association:* Sugar maple-White ash-Sweet cicely
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 247D—Glennie-Bamfield complex, hilly

### Setting

*Landform:* End moraines and ground moraines
*Slope:* 18 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 100 acres

### Reference Profile

**Glennie**

*Organic mat:*
0 to 2 inches—black, partially decomposed forest litter

*Surface layer:*
2 to 3 inches—black loamy sand

*Subsurface layer:*
3 to 7 inches—grayish brown loamy sand

*Subsoil:*
7 to 11 inches—dark brown sandy loam
11 to 20 inches—strong brown loamy sand
20 to 40 inches—brown loamy sand and reddish brown loam
40 to 46 inches—reddish brown sandy clay loam and brown sandy loam
46 to 56 inches—dark reddish brown clay
56 to 85 inches—reddish brown sandy clay loam

*Substratum:*
85 to 99 inches—dark reddish brown sandy clay loam

**Bamfield**

*Organic mat:*
0 to 1 inch—partially decomposed leaf litter

*Surface layer:*
1 to 6 inches—very dark grayish brown fine sandy loam

*Subsoil:*
6 to 11 inches—yellowish brown fine sandy loam
11 to 18 inches—pinkish gray fine sandy loam
18 to 21 inches—reddish brown clay loam and pinkish gray fine sandy loam
21 to 31 inches—reddish brown clay loam

*Substratum:*
31 to 60 inches—light reddish brown clay loam

### Soil Properties and Qualities

*Permeability:* Glennie—moderately rapid in the upper part, very slow in the lower part; Bamfield—very slow

*Available water capacity:* Moderate
*Drainage class:* Well drained
*Depth to the water table:* More than 6 feet
*Surface runoff:* Rapid
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Severe
*Hazard of soil blowing:* Moderate

### Composition

Glennie and similar soils: 35 to 60 percent
Bamfield and similar soils: 35 to 50 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Alfic Haplaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways
- The excessively drained, sandy Entic Haplorthods in landscape positions similar to those of the major soils

*Similar inclusions:*
- Sandy soils that are moderately well drained
- Soils that have a surface layer of fine sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Compaction, equipment limitation, erosion hazard
*Management considerations:*
- The use of heavy equipment may cause compaction in areas of soils that have a fine textured surface layer. Using the equipment only during dry periods or during winter helps to prevent surface compaction.
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography.
- The hazard of erosion can be reduced by seeding logging roads, landings, and areas that have been cut and filled and by installing water bars and culverts.

### Interpretive Groups

*Land capability classification:* VIe
*Woodland ordination symbol:* Glennie—5R; Bamfield—3R
*Michigan soil management group:* Glennie—4/2a-f; Bamfield—3/2a
*Primary plant association:* Sugar maple-White ash-Sweet cicely
*Secondary plant association:* Northern red oak-Red maple-Trefoil

## 250D—Glossic Eutroboralfs-Borosaprists, euic, complex, nearly level to hilly

### Setting

*Landform:* Pitted moraines
*Slope:* 0 to 30 percent
*Shape of areas:* Irregular
*Size of areas:* 40 to 300 acres

### Reference Profile

**Glossic Eutroboralfs**

*Surface layer:*
0 to 3 inches—very dark gray sandy loam

*Subsoil:*
3 to 12 inches—brown and dark brown loamy sand
12 to 29 inches—reddish brown sandy clay loam and brown sandy loam
29 to 43 inches—brown loamy sand

*Substratum:*
43 to 58 inches—reddish brown loamy sand
58 to 84 inches—stratified reddish brown and yellowish brown loam

**Borosaprists**

*Surface layer:*
0 to 9 inches—black muck

*Subsoil:*
9 to 15 inches—dark reddish brown muck
15 to 20 inches—black muck
20 to 60 inches—gray sand and loamy sand

### Soil Properties and Qualities

*Permeability:* Glossic Eutroboralfs—moderate; Borosaprists—slow
*Available water capacity:* Glossic Eutroboralfs—moderate; Borosaprists—high
*Drainage class:* Glossic Eutroboralfs—well drained; Borosaprists—very poorly drained
*Seasonal high water table:* Glossic Eutroboralfs—at a depth of more than 6 feet; Borosaprists—1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Glossic Eutroboralfs—rapid; Borosaprists—very slow or ponded
*Flooding:* None
*Organic matter content:* Glossic Eutroboralfs—moderate; Borosaprists—high

*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Glossic Eutroboralfs—moderate; Borosaprists—slight

### Composition

Glossic Eutroboralfs and similar soils: 60 to 70 percent
Borosaprists and similar soils: 20 to 40 percent
Contrasting inclusions: 0 to 10 percent

### Inclusions

*Contrasting inclusions:*
- The very poorly drained, dysic Borosaprists in depressions
- The excessively drained, sandy Entic Haplorthods on uplands

*Similar inclusions:*
- Sandy soils that have a fine textured substratum
- Soils that have a surface layer of sand or loamy sand

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation
*Management considerations:*
- Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment in areas of the Glossic Eutroboralfs. Logging roads should be designed so that they conform to the topography.
- Because of wetness and low strength in areas of the Borosaprists, harvesting is not recommended.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* None assigned
*Secondary plant association:* None assigned

## 252A—Borosaprists, euic-Au Gres complex, nearly level

### Setting

*Landform:* Lake terraces
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 60 to 300 acres

### Reference Profile

**Borosaprists**

*Surface layer:*
0 to 9 inches—black muck

*Subsoil:*
9 to 15 inches—dark reddish brown muck
15 to 20 inches—black muck
20 to 60 inches—gray sand and loamy sand

**Au Gres**

*Surface layer:*
0 to 3 inches—black sand

*Subsurface layer:*
3 to 10 inches—pinkish gray sand

*Subsoil:*
10 to 14 inches—dark brown, mottled sand
14 to 27 inches—dark yellowish brown, mottled sand
27 to 33 inches—yellowish brown, mottled sand

*Substratum:*
33 to 60 inches—pale brown, mottled sand

### Soil Properties and Qualities

*Permeability:* Borosaprists—slow; Au Gres—rapid
*Available water capacity:* Borosaprists—high; Au Gres—low
*Drainage class:* Borosaprists—very poorly drained; Au Gres—somewhat poorly drained
*Seasonal high water table:* Borosaprists—1 foot above to 1 foot below the surface from October through May; Au Gres—at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Borosaprists—very slow or ponded; Au Gres—very slow
*Flooding:* None
*Organic matter content:* Borosaprists—high; Au Gres—moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Borosaprists—slight; Au Gres—severe

### Composition

Borosaprists and similar soils: 35 to 60 percent
Au Gres and similar soils: 35 to 55 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
- The excessively drained, sandy Entic Haplorthods on uplands

*Similar inclusions:*
- Sandy soils that have a fine textured substratum
- Organic soils that are acid

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, windthrow
*Management considerations:*
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
- Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.
- Because of wetness and low strength, harvesting is not recommended.

### *Interpretive Groups*

*Land capability classification:* None assigned
*Woodland ordination symbol:* Borosaprists—none assigned; Au Gres—6W
*Michigan soil management group:* Borosaprists—none assigned; Au Gres—5b
*Primary plant association:* Northern red oak-Red maple-Leatherleaf-Blueberry
*Secondary plant association:* Red maple-Balsam fir-Bunchberry

## 253A—Au Gres-Allendale-Croswell sands, nearly level

### *Setting*

*Landform:* Outwash plains and lake plains
*Slope:* 0 to 4 percent
*Shape of areas:* Irregular
*Size of areas:* 40 to 400 acres

### *Reference Profile*

**Au Gres**

*Surface layer:*
0 to 3 inches—black sand

*Subsurface layer:*
3 to 10 inches—pinkish gray sand

*Subsoil:*
10 to 14 inches—dark brown, mottled sand
14 to 27 inches—dark yellowish brown, mottled sand
27 to 33 inches—yellowish brown, mottled sand

*Substratum:*
33 to 60 inches—pale brown, mottled sand

**Allendale**

*Surface layer:*
0 to 11 inches—very dark grayish brown sand

*Subsurface layer:*
11 to 13 inches—pale brown, mottled sand

*Subsoil:*
13 to 20 inches—dark brown, mottled sand
20 to 22 inches—yellowish brown, mottled sand
22 to 25 inches—reddish brown, mottled sandy loam
25 to 60 inches—reddish brown, mottled silty clay

**Croswell**

*Organic mat:*
0 to 1 inch—black, well decomposed forest leaf litter

*Surface layer:*
1 to 4 inches—dark grayish brown sand

*Subsoil:*
4 to 10 inches—dark brown sand
10 to 20 inches—strong brown sand
20 to 29 inches—brownish yellow, mottled sand

*Substratum:*
29 to 80 inches—yellowish brown and light yellowish brown, mottled sand

### *Soil Properties and Qualities*

*Permeability:* Au Gres—rapid; Allendale—rapid in the upper part, very slow in the lower part; Croswell—rapid
*Available water capacity:* Au Gres—low; Allendale—moderate; Croswell—low
*Drainage class:* Au Gres and Allendale—somewhat poorly drained; Croswell—moderately well drained
*Seasonal high water table:* Au Gres—at a depth of 0.5 foot to 1.5 feet (clay likely below the depth of observation) from October through May; Allendale—perched at a depth of 0.5 foot to 1.5 feet from October through May; Croswell—at a depth of 2.0 to 3.5 feet (clay likely below the depth of observation) from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Au Gres and Allendale—moderate; Croswell—low
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### *Composition*

Au Gres and similar soils: 30 to 50 percent
Allendale and similar soils: 15 to 40 percent

Croswell and similar soils: 15 to 40 percent
Contrasting inclusions: 10 to 20 percent

### Inclusions

*Contrasting inclusions:*
• The excessively drained, sandy Entic Haplorthods on uplands
• The very poorly drained, dysic Borosaprists in depressions

*Similar inclusions:*
• Moderately well drained soils that have a fine textured substratum
• Soils that have a finer textured surface layer

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality, windthrow
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Skidders should not be used during wet periods.
• Trees that can withstand seasonal wetness should be selected for planting.
• Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.

### Interpretive Groups

*Land capability classification:* IVw
*Woodland ordination symbol:* Au Gres—6W; Allendale—4W; Croswell—5S
*Michigan soil management group:* Au Gres—5b; Allendale—4/1b; Croswell—5a
*Primary plant association:* None assigned
*Secondary plant association:* None assigned

## 262A—Au Gres sand, nearly level

### Setting

*Landform:* Outwash plains and sandy lake plains
*Slope:* 0 to 4 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—black sand

*Subsurface layer:*
3 to 10 inches—pinkish gray sand

*Subsoil:*
10 to 14 inches—dark brown, mottled sand
14 to 27 inches—dark yellowish brown, mottled sand
27 to 33 inches—yellowish brown, mottled sand

*Substratum:*
33 to 60 inches—pale brown, mottled sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Au Gres and similar soils: 70 to 80 percent
Contrasting inclusions: 20 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The excessively drained, sandy Entic Haplorthods on knolls
• The very poorly drained, dysic Borosaprists in depressions

*Similar inclusions:*
• Sandy soils that have a fine textured substratum
• Soils that have organic accumulation at the surface
• Soils that have a cemented subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality, windthrow
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Skidders should not be used during wet periods.
• Trees that can withstand seasonal wetness should be selected for planting.
• Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.

### Interpretive Groups

*Land capability classification:* IVw
*Woodland ordination symbol:* 6W

*Michigan soil management group:* 5b
*Primary plant association:* Northern red oak-Red maple-Leatherleaf-Blueberry
*Secondary plant association:* Red maple-Balsam fir-Bunchberry

## 263A—Alfic Haplaquods, nearly level

### Setting

*Landform:* Outwash plains and sandy lake plains
*Slope:* 0 to 4 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 300 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—very dark gray sand

*Subsurface layer:*
3 to 8 inches—light brownish gray sand

*Subsoil:*
8 to 20 inches—strong brown sand
20 to 35 inches—strong brown loamy sand

*Substratum:*
35 to 70 inches—yellowish brown sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Moderate
*Drainage class:* Somewhat poorly drained
*Depth to the water table:* 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow
*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Severe

### Composition

Alfic Haplaquods and similar soils: 70 to 80 percent
Contrasting inclusions: 20 to 30 percent

### Inclusions

*Contrasting inclusions:*
- The excessively drained, sandy Entic Haplorthods on knolls
- The very poorly drained, dysic Borosaprists in depressions

*Similar inclusions:*
- Sandy soils that have a fine textured substratum
- Soils that have organic accumulation at the surface
- Soils that have a cemented subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality, windthrow
*Management considerations:*
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
- Skidders should not be used during wet periods.
- Trees that can withstand seasonal wetness should be selected for planting.
- Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Red maple-Balsam fir-Bunchberry
*Secondary plant association:* Northern red oak-Red maple-Leatherleaf-Blueberry

## 264A—Allendale loamy sand, nearly level

### Setting

*Landform:* Outwash plains and sandy lake plains
*Slope:* 0 to 4 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 100 acres

### Reference Profile

*Surface layer:*
0 to 11 inches—very dark grayish brown loamy sand

*Subsurface layer:*
11 to 13 inches—pale brown, mottled sand

*Subsoil:*
13 to 20 inches—dark brown, mottled sand
20 to 22 inches—yellowish brown, mottled sand
22 to 25 inches—reddish brown, mottled sandy loam
25 to 60 inches—reddish brown, mottled silty clay

### Soil Properties and Qualities

*Permeability:* Rapid in the upper part; very slow in the lower part
*Available water capacity:* Moderate
*Drainage class:* Somewhat poorly drained
*Seasonal high water table:* Perched at a depth of 0.5 foot to 1.5 feet from October through May
*Surface runoff:* Very slow

*Flooding:* None
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Moderate

### Composition

Allendale and similar soils: 70 to 80 percent
Contrasting inclusions: 20 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The excessively drained, sandy Entic Haplorthods on knolls
• The very poorly drained, dysic Borosaprists in depressions

*Similar inclusions:*
• Sandy soils that do not have a fine textured substratum
• Soils that have organic accumulation at the surface

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, seedling mortality, windthrow
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Skidders should not be used during wet periods.
• Trees that can withstand seasonal wetness should be selected for planting.
• Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.

### Interpretive Groups

*Land capability classification:* IIIw
*Woodland ordination symbol:* 4W
*Michigan soil management group:* 4/1b
*Primary plant association:* Mixed ash-Basswood-Downy yellow violet
*Secondary plant association:* Red maple-Balsam fir-Bunchberry

## 272—Haplaquods-Fluvaquents complex

### Setting

*Landform:* Outwash plains, deltas, and flood plains
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

**Haplaquods**

*Surface layer:*
0 to 3 inches—very dark gray sand

*Subsurface layer:*
3 to 8 inches—light brownish gray, mottled sand

*Subsoil:*
8 to 20 inches—strong brown, mottled sand
20 to 35 inches—strong brown, mottled loamy sand

*Substratum:*
35 to 70 inches—yellowish brown sand

**Fluvaquents**

*Surface layer:*
0 to 3 inches—black muck
3 to 8 inches—very dark gray, mottled loamy sand

*Subsurface layer:*
8 to 15 inches—brown, mottled loamy sand
15 to 38 inches—yellowish brown, mottled sand

*Subsoil:*
38 to 60 inches—pale brown, mottled sand that has thin layers of silt, silty clay, and clay

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Haplaquods—low; Fluvaquents—moderate
*Drainage class:* Poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow
*Flooding:* Haplaquods—none; Fluvaquents—frequent
*Organic matter content:* Moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight

### Composition

Haplaquods and similar soils: 40 to 60 percent
Fluvaquents and similar soils: 30 to 50 percent
Contrasting inclusions: 20 to 30 percent

### Inclusions

*Contrasting inclusions:*
• The excessively drained, sandy Entic Haplorthods on knolls
• The very poorly drained, dysic and euic Borosaprists in depressions

*Similar inclusions:*
• Sandy soils that have a fine textured substratum

- Soils that have more organic accumulation at the surface
- Soils that have a finer textured surface layer
- Soils that have a cemented subsoil

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, windthrow
*Management considerations:*
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
- Skidders should not be used during wet periods.
- Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.

### *Interpretive Groups*

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern red oak-Red maple-Leatherleaf-Blueberry
*Secondary plant association:* Red maple-Balsam fir-Bunchberry

## 273—Leafriver-Wakeley complex

### *Setting*

*Landform:* Outwash plains and lake plains
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 20 to 200 acres

### *Reference Profile*

**Leafriver**

*Surface layer:*
0 to 9 inches—black muck

*Subsoil:*
9 to 21 inches—brown, mottled sand

*Substratum:*
21 to 27 inches—grayish brown, mottled sand
27 to 60 inches—dark grayish brown sand

**Wakeley**

*Surface layer:*
0 to 6 inches—black, mottled mucky sand

*Substratum:*
6 to 12 inches—gray sand
12 to 24 inches—grayish brown, mottled sand
24 to 29 inches—grayish brown, mottled, stratified sand and loamy sand
29 to 34 inches—pinkish gray, mottled clay
34 to 60 inches—pinkish gray, mottled, stratified clay and silty clay

### *Soil Properties and Qualities*

*Permeability:* Leafriver—rapid; Wakeley—rapid in the upper part, very slow in the lower part
*Available water capacity:* Moderate
*Drainage class:* Very poorly drained
*Seasonal high water table:* Leafriver—1 foot above to 1 foot below the surface (clay likely below the depth of observation) from October through May; Wakeley—perched 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* Leafriver—high; Wakeley—moderate
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight

### *Composition*

Leafriver and similar soils: 35 to 60 percent
Wakeley and similar soils: 40 to 55 percent
Contrasting inclusions: 10 to 20 percent

### *Inclusions*

*Contrasting inclusions:*
- The moderately well drained, sandy Entic Haplorthods on knolls
- The very poorly drained, dysic Borosaprists in depressions

*Similar inclusions:*
- Sandy soils that have a fine textured surface layer
- Soils that have deep organic accumulation

### *Use and Management*

**Land use:** Woodland

*Major management concerns:* Equipment limitation, windthrow
*Management considerations:*
- The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
- Skidders should not be used during wet periods.
- Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.
- Because of the wetness and low strength, harvesting is not recommended in areas of organic soils.

### Interpretive Groups

*Land capability classification:* VIw
*Woodland ordination symbol:* Leafriver—2W; Wakeley—3W
*Michigan soil management group:* Leafriver—5c; Wakeley—4/1c
*Primary plant association:* Red maple-Balsam fir-Bunchberry
*Secondary plant association:* Northern red oak-Red maple-Leatherleaf-Blueberry

## 274—Typic Haplaquods

### Setting

*Landform:* Outwash plains and lake plains
*Slope:* 0 to 2 percent
*Shape of areas:* Irregular
*Size of areas:* 10 to 100 acres

### Reference Profile

*Surface layer:*
0 to 3 inches—black muck

*Subsurface layer:*
3 to 8 inches—pinkish gray, mottled fine sand

*Subsoil:*
8 to 14 inches—dark reddish brown, mottled fine sand
14 to 22 inches—dark brown fine sand
22 to 26 inches—dark yellowish brown, mottled fine sand
26 to 30 inches—yellowish brown, mottled fine sand

*Substratum:*
30 to 60 inches—light brownish gray fine sand

### Soil Properties and Qualities

*Permeability:* Rapid
*Available water capacity:* Low
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* None
*Hazard of soil blowing:* None

### Composition

Typic Haplaquods and similar soils: 75 to 95 percent
Contrasting inclusions: 5 to 15 percent

### Inclusions

*Contrasting inclusions:*
• The moderately well drained, sandy Entic Haplorthods on knolls
• The very poorly drained, dysic Borosaprists in depressions

*Similar inclusions:*
• Poorly drained soils that have sandy textures

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation, windthrow
*Management considerations:*
• The seasonal high water table restricts the use of equipment to midsummer, when the soil is dry, or midwinter, when the soil is frozen.
• Skidders should not be used during wet periods.
• Harvesting is not recommended.
• Windthrow can be minimized by employing harvest methods that do not leave the remaining trees widely spaced.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Mixed ash-Basswood-Downy yellow violet
*Secondary plant association:* Northern whitecedar-Eastern hemlock-Canada violet

## 280—Aquents and Histosols, ponded

### Setting

*Landform:* Outwash plains and flood plains
*Slope:* Nearly level
*Shape of areas:* Oval
*Size of areas:* 5 to 100 acres

### Reference Profile

**Aquents**

0 to 60 inches—variable

**Histosols**

0 to 60 inches—black muck

### Soil Properties and Qualities

*Permeability:* Variable

*Available water capacity:* Variable
*Drainage class:* Very poorly drained
*Seasonal high water table:* At the surface to 1 foot above the surface year-round
*Surface runoff:* Ponded
*Flooding:* Frequent
*Organic matter content:* High
*Hazard of water erosion:* None
*Hazard of soil blowing:* None

### Composition

Aquents: 50 to 70 percent
Histosols: 30 to 40 percent
Contrasting inclusions: 0 to 10 percent

### Inclusions

*Contrasting inclusions:*
- Small areas of somewhat poorly drained soils at the edges of the unit
- Small areas of open water

### Use and Management

**Land use:** Wetland wildlife habitat

*Major management concerns:* Onsite investigation is needed to determine the suitability for specific uses.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* None assigned
*Secondary plant association:* None assigned

## 281—Borosaprists, dysic

### Setting

*Landform:* Shallow closed depressions on outwash plains, lake plains, and flood plains
*Slope:* Nearly level
*Shape of areas:* Oval
*Size of areas:* 5 to 200 acres

### Reference Profile

*Surface layer:*
0 to 12 inches—black muck

*Subsoil:*
12 to 33 inches—black muck

*Substratum:*
33 to 60 inches—gray sand

### Soil Properties and Qualities

*Permeability:* Moderately slow to moderately rapid in the upper part, rapid in the lower part
*Available water capacity:* High
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* None
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight

### Composition

Borosaprists: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

### Inclusions

*Contrasting inclusions:*
- The somewhat poorly drained Au Gres soils on low knolls and ridges

*Similar inclusions:*
- Soils that have organic material less than 16 inches thick or more than 50 inches thick

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation
*Management considerations:*
- Because of wetness and low strength, woodland management is not recommended.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Black spruce-Tamarack-Labrador tea
*Secondary plant association:* None assigned

## 282—Borosaprists, euic

### Setting

*Landform:* Depressions on end moraines, till plains, ground moraines, and alluvial plains
*Slope:* None
*Shape of areas:* Oval and irregular
*Size of areas:* 20 to 200 acres

### Reference Profile

*Surface layer:*
0 to 9 inches—black muck

*Subsoil:*
9 to 38 inches—dark reddish brown muck
38 to 60 inches—black muck

### Soil Properties and Qualities

*Permeability:* Moderately slow to moderately rapid
*Available water capacity:* High
*Drainage class:* Very poorly drained
*Seasonal high water table:* 1 foot above to 1 foot below the surface from October through May
*Surface runoff:* Very slow or ponded
*Flooding:* Occasional
*Organic matter content:* High
*Hazard of water erosion:* Slight
*Hazard of soil blowing:* Slight

### Composition

Borosaprists: 90 to 100 percent
Contrasting inclusions: 0 to 10 percent

### Inclusions

*Contrasting inclusions:*
- Dysic Borosaprists in landscape positions similar to those of the major soils
- The somewhat poorly drained Au Gres soils on low knolls and ridges

*Similar inclusions:*
- Soils that have sandy material below a depth of 16 inches
- Soils that have loamy or clayey material below a depth of 16 inches
- Soils that have a higher fiber content in the subsoil

### Use and Management

**Land use:** Woodland

*Major management concerns:* Equipment limitation
*Management considerations:*
- Because of wetness and low strength, woodland management is not recommended.

### Interpretive Groups

*Land capability classification:* None assigned
*Woodland ordination symbol:* None assigned
*Michigan soil management group:* None assigned
*Primary plant association:* Northern whitecedar-Eastern hemlock-Canada violet
*Secondary plant association:* Mixed ash-Basswood-Downy yellow violet

## Prime Farmland

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

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

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

About 68,500 acres in the survey area, or about 16 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern part, mainly in associations 3, 4, 5, and 6, which are described under the heading "General Soil Map Units."

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, are droughty, and are 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. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have a seasonal high water table qualify

as prime farmland only in areas where these limitations have been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not 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 to prevent soil-related failures in land uses.

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

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

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

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where 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.

The soils in the survey area are assigned to various interpretive groups. These groups are listed at the end of each map unit description and in the "Interpretive Groups" section.

## Crops and Pasture

This section was prepared by George Byelich, Alcona County Cooperative Extension Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils are identified, the estimated yields of the main crops and hay and pasture plants are listed for each soil, and the system of land capability classification used by the Natural Resources Conservation Service is explained.

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

In 1992, 29,000 acres in Alcona County was used as cropland or for pasture and hay (Michigan Department of Agriculture, 1992). In addition, 305,000 acres was used as woodland, both publicly owned and privately owned.

The potential for increased crop production is fair. Production can be increased by applying the latest technology on all of the cropland in the county. If fertility is enhanced, the production of alfalfa has the most potential for improvement.

Soil wetness is the major problem on much of the better cropland in Alcona County. In some areas the somewhat poorly drained Algonquin soils have been drained for use as cropland. Most of the poorly drained and very poorly drained soils cannot be economically drained. Such soils are in low-lying areas on plains and in depressions where ponding is frequent and suitable drainage outlets are not readily available. These soils are also subject to low soil temperatures, which hinder seed germination, and extended periods of frost. In areas of somewhat poorly drained soils, such as Richter, Kawkawlin, and

Killmaster soils, artificial drainage is needed. Unless the excess water is removed from these soils, tillage, seed germination, and growth are adversely affected.

Subsurface tile drainage systems generally are used to remove excess water. The proper spacing of tile drains compensates for differences in permeability of the soils. In some areas, open ditches are needed as outlets for the drains. More deep open ditches are needed to provide outlets for surface and subsurface drainage. Hoist and Negwegon soils are well drained and moderately well drained. Zimmerman, Mancelona, and Klacking soils are also well drained, but droughtiness during long dry periods is a problem. Small areas of wet soils along drainageways and swales commonly are used in combination with larger areas of well drained soils. Artificial drainage may be needed in some of the wet areas to prevent delays in fieldwork.

Care must be exercised to prevent the drainage of designated wetlands. Drainage of these areas could violate existing wetland laws and regulations and may jeopardize receipt of USDA benefits. Information about the design of drainage systems for each kind of soil is available in local offices of the Natural Resources Conservation Service.

Water erosion is a major hazard on some of the soils used for crops and pasture in Alcona County. Erosion reduces the productive capacity of the soil by removing the surface layer, which contains most of the available plant nutrients and organic matter. For example, the surface layer of the eroded Negwegon soils has a higher clay content and a lower organic matter content than the original surface layer. Because of the clay content, the plow layer stays wet longer after a rain and fieldwork can be delayed. The surface layer also tends to be cloddy and makes a poor seedbed. Surface crusting is common, and plant emergence can be difficult. More energy is required to till eroded soils than noneroded soils. Erosion on farmland also can result in the pollution of lakes and streams by sediment, nutrients, and pesticides.

Erosion-control practices provide a protective surface cover, reduce the runoff rate, and increase the rate of water infiltration. Conservation tillage, which leaves crop residue on the surface, increases the rate of water infiltration and helps to control runoff and erosion. No-till cropping of corn also reduces the hazard of erosion. No-till farming requires high levels of management and relies on herbicides and insecticides for weed and pest control. No-till is especially effective in minimizing erosion on the less clayey, sloping soils in the county. Contour farming or contour stripcropping can control erosion on long slopes, but these practices generally cannot be readily applied on the short, steep slopes that are common in Alcona County.

Grassed waterways are used on undulating and nearly level soils and are used on sloping soils to minimize gully erosion. They can be used to stabilize previously eroded areas that have been reshaped and seeded. Grassed waterways are installed on nearly level soils if a large watershed drains across the land. Subsurface drains generally are installed below the waterway to remove excess water. Drainage benefits vegetative growth and results in drier soil conditions, which facilitate the use of machinery.

Grade-stabilization structures help to control erosion where surface water drains into channels. These structures generally are used in conjunction with grassed waterways both at the outlet end and the inlet end. Grade-stabilization structures conduct the water to a lower elevation and at the same time prevent erosion at the sides and bottom of a channel.

Soil blowing is a hazard in Alcona County on soils that have a surface layer of sand, loamy sand, or sandy loam. Using surface mulch to maintain the plant cover, planting small grain buffer strips, leaving crop residue on the surface, and maintaining a rough surface through tillage help to control soil blowing on these soils. Vegetative barriers also are effective in reducing the hazard of soil blowing. Field windbreaks of adapted trees and shrubs planted at right angles to the prevailing wind provide long-term protection from erosion.

Soil fertility is naturally low in the sandy soils in the county. It is medium in most of the loamy soils. The soils that formed on till plains or moraines, such as Hoist and Killmaster soils, are moderately high in natural fertility. Soil fertility is quite variable because of differences in past land use and management. Most of the soils in the county are medium acid to neutral in the surface layer. Additions of lime, bio ash, and fertilizer to the soil should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help to determine the kind and amount of all nutrients to be applied (Michigan State University, 1992).

Soil tilth is an important factor in the germination of seeds and in the workability of the soil. Soils that have good tilth require a minimum of working for seed germination and plant growth. Many of the agricultural soils that are used for crops in Alcona County have a surface layer of clay loam, loam, or sandy loam. Soils that have good tilth have granular structure and contain a moderate to high amount of organic matter. Using machinery when the soils are wet results in

soil compaction and surface crusting. Soil compaction and surface crusting reduce the rate of water infiltration and increase the runoff rate. Soil compaction and the loss of granular soil structure cause small individual soil particles to form. These small particles are carried away by wind and water. Preparing a good seedbed on severely eroded soils is difficult, mainly because of their susceptibility to excessive erosion. Using adequate surface and subsurface drainage, carefully timing fieldwork, and maintaining the content of organic matter through forage production improve soil structure and tilth and minimize soil compaction and erosion.

Oats, barley, and wheat are the main field crops suited to the climate and soils in Alcona County. Alfalfa is a commonly grown legume. Grasses grown for hay and pasture are mainly bromegrass, orchardgrass, and timothy. The county has a number of Christmas tree plantations.

Specialty crops, such as strawberries and raspberries, are grown only on a limited acreage in the county. The well drained loamy sands, sandy loams, and loams are suited to these crops. The latest information about growing specialty crops can be obtained at local offices of the Cooperative Extension Service.

Much of the permanent pasture in the county is in areas where erosion can be a hazard. Other areas of pasture are on wet soils. Control of erosion is particularly important during seeding operations. The need for lime and fertilizer should be determined by soil tests, and adequate amounts should be applied as required.

Grazing when the soils are wet can cause surface compaction, which hinders the growth of pasture plants. Proper harvesting methods, such as those used for hay or silage, increase plant growth and minimize soil compaction.

The productivity of a pasture and its ability to protect the soil surface are influenced by the number of livestock the pasture supports, the length of time the livestock graze, and the rainfall distribution. Good pasture management includes maintaining key forage plants by applying proper stocking rates, applying a system of pasture rotation, deferring grazing, grazing at the proper season, applying fertilizer as appropriate, and supplying water at strategic locations for livestock.

## Yields per Acre

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

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

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

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

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

## Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass,

and unit (USDA, 1961). Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

At the end of each map unit description, the Michigan soil management group is listed. The soils in each map unit are assigned to a group according to the dominant texture, the drainage class, and the major management concerns (Mokma and others, 1982). More detailed information about these groups is available from the local office of the Michigan State University Cooperative Extension Service.

## Woodland Management and Productivity

Originally, a dense forest covered all of the survey area, except for a few bogs and marshes. Most of the area was logged, and the slash was burned. Many areas were cleared. Many of the cleared areas have either reverted to natural forest or have been planted to pines.

Currently, Alcona County has about 305,000 acres of woodland. This acreage represents about 70 percent of the total land area. Approximately 110,000 acres is in the Huron National Forest. Private forest tracts and hunting clubs have holdings of more than 180,000 acres.

There are five major kinds of natural forest cover within the county (Society of American Foresters, 1954). Each kind is distinctly different from the others. Each has different value and potential for forest use and for producing woodland products. The soils in the areas of the different kinds of forest cover generally are quite different.

The Jack Pine forest cover type makes up about 29,000 acres. Jack pine and northern pin oak are the dominant species. Other common associated trees include eastern white pine, red pine, and aspen. This cover type is mainly in areas of the Grayling and Graycalm soils. These are deep, sandy soils that have weak profile development. The more droughty and less fertile soils support only northern pin oak and jack pine. Growth is slow, and reestablishing tree cover in cutover areas is difficult.

The Oak forest cover type makes up about 60,000 acres. Northern red oak is the dominant species. Other common associated trees include bigtooth aspen, red pine, eastern white pine, and paper birch. This cover type is mainly in areas of the McGinn and Glennie soils. These are deep, sandy and loamy soils. Growth is good on these soils. Plantations of red pine and eastern white pine are common in areas of this cover type.

The Northern Hardwoods forest cover type makes up about 14,000 acres. Sugar maple is the most common species, but American beech and red maple are also common. Other common associated trees include black cherry, northern red oak, aspen,

American basswood, eastern hemlock, eastern white pine, red pine, and white ash. This cover type is mainly in areas of the Nester, Alcona, Negwegon, Hoist, and Bamfield soils. These are well drained and moderately well drained, loamy and clayey soils. The soils of this cover type are the most productive in the survey area. Growth is good or excellent, and the potential for wood products is high.

The Aspen-Birch forest cover type makes up about 45,000 acres. Most stands are a mixture of aspen, paper birch, red maple, and conifers and include a wide range of tree species (fig. 13). Paper birch and aspen are dominant. Other common associated trees include eastern white pine, northern pin oak, eastern hemlock, white spruce, and balsam poplar. Also included are sugar maple, northern red oak, and American elm. Most of the American elm trees have died from Dutch elm disease. This cover type is mainly in areas of the Au Gres, Croswell, Eastport, and Allendale soils. These are sandy and sandy over clayey soils. Tree growth is fair or good on these soils.

The Northern Whitecedar forest cover type makes up about 24,000 acres. Northern whitecedar is the dominant species. Other common associated trees include black spruce, black ash, red maple, eastern hemlock, balsam poplar, and tamarack. This cover type is mainly in areas of the Lupton, Tawas, Leafriver, and Waucedah soils. These are very poorly drained organic soils or very poorly drained, sandy mineral soils. The water table is at or near the surface most of the time. Tree growth is slow. Reestablishing stands of desirable trees in cutover areas is difficult. Windthrow is a serious hazard in areas that are opened up by cutting.

Management for wood crops on the different kinds of soil in the survey area varies but is usually governed by the species present. One management alternative would favor northern hardwood species with an uneven-aged approach. Another management alternative would favor aspen and white birch using an even-aged approach. Management should include considering erosion-control strategies, planting trees where natural regeneration is undesirable or insufficient, controlling vegetation that competes with natural or planted regeneration, improving seedling survival, minimizing windthrow on the wetter sites, harvesting in a timely manner, controlling damage by insects and diseases, removing cull trees and undesirable species, and maintaining the optimum basal area.

Erosion may occur as a result of site preparation for planting or as a result of cutting operations where the soil is exposed along logging roads, stream crossings, and fire lanes and in landing areas. Forests abused by fire may also be subject to erosion. Erosion is generally a hazard on forest land if slopes are 18 percent or more. Establishing logging roads and skid roads on the contour helps to minimize erosion.

Soil wetness is the result of a high water table, flooding, or ponding. Excessive wetness increases the seedling mortality rate, limits the use of equipment, increases the invasion or growth of undesirable plants following harvest, and increases the likelihood of windthrow by restricting the rooting depth of some trees. Ruts form easily on some soils when wheeled skidders are used during wet periods. Deep ruts tend to restrict lateral drainage, damage tree roots, and alter soil structure and can result in a species change and reduced yields. Wetness can be overcome by timing woodland management activities during seasons of the year when the soils are dry or frozen or have adequate snow cover.

Soil droughtiness may also cause seedling mortality. Steep, south- and west-facing slopes may be especially droughty. Planting during periods when soil conditions are moist can minimize seedling losses. Seedling survival during dry seasons can be improved by planting large, vigorous nursery stock or containerized seedlings if natural regeneration is undesirable or insufficient. Special site preparation, such as furrowing to conserve moisture, may also be needed. It may be necessary to use containerized planting stock on very dry sites.

The slope may limit the use of forestry equipment. Slopes of 18 percent or more generally limit the use of equipment in logging areas, on skid trails, and on logging roads. Establishing the logging roads and skid trails on the contour helps to overcome the slope. The slope can also influence the location of landings and log handling areas. Nearly level and undulating areas provide the best locations for such sites.

Table 8 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

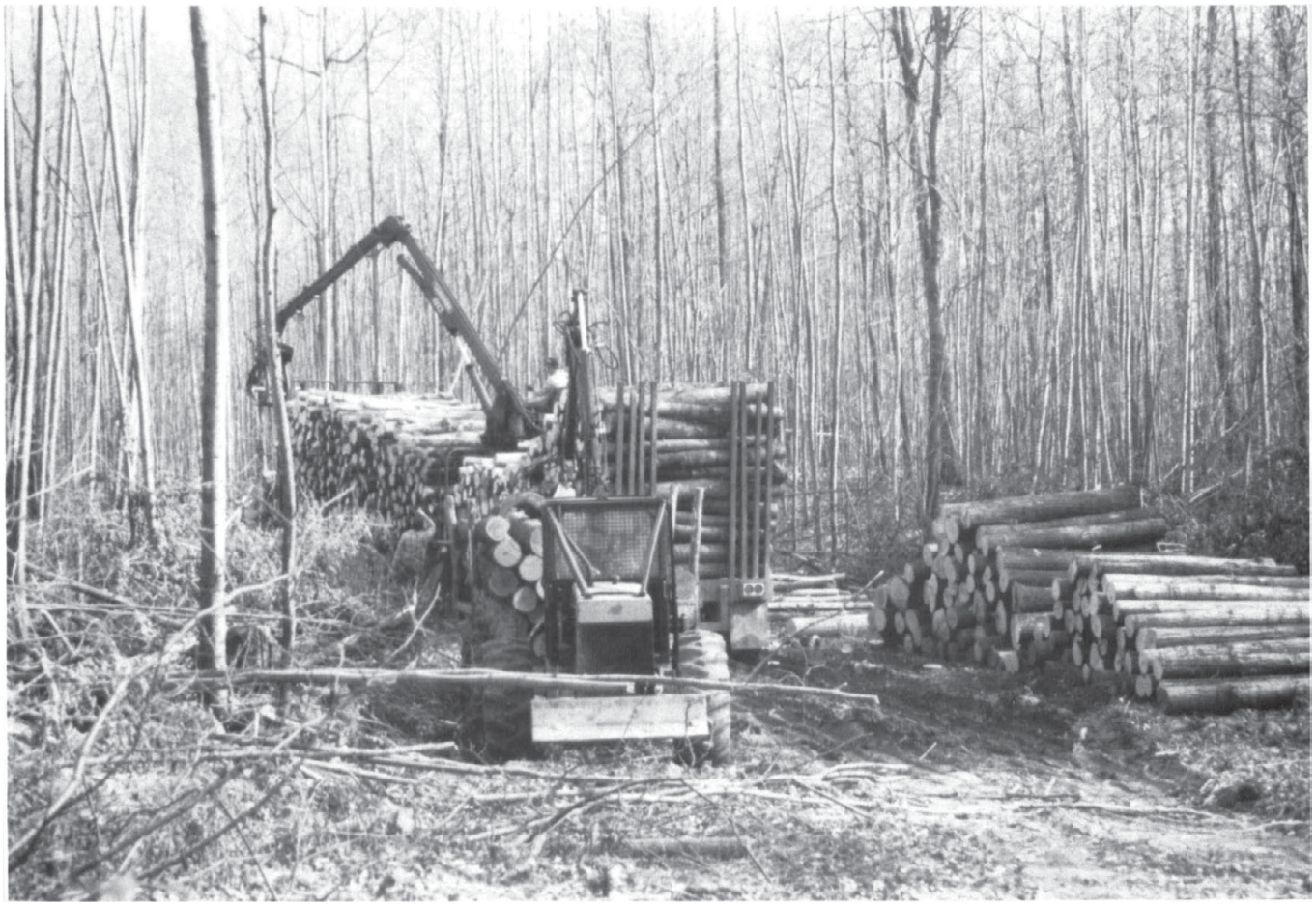

**Figure 13.—Aspen for pulp is harvested from an area of Bamfield fine sandy loam, moderately wet, 0 to 6 percent slopes.**

11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength in the spring thaw period and during periods of high rainfall. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

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

*Equipment limitation* reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely

restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

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

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

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. The volume was determined through the use of standard yield tables (USDA, National Forestry Manual).

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

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

Logging and harvesting of wood resources is an important part of the economy of Alcona County. Table 9 provides expanded information concerning the operability of harvesting equipment. The table gives information about operating harvesting or thinning equipment in logging areas and on skid roads, log landings, and haul roads. Limitations are given for the most limiting season and for the preferred operating season. The most limiting season in this survey area generally is spring or late fall. In some areas, however, it is during dry periods in summer, when loose sand can limit trafficability on deep, excessively drained, sandy soils.

The preferred operating season is the period when harvesting or thinning causes the least amount of soil damage. This period generally is when the soil is not too wet or when the ground is frozen or partly frozen or has an adequate snow cover.

In table 9, a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high flotation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

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

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

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

## Plant Associations

The Ecological Classification System (ECS) for the Huron-Manistee National Forests (Driscoll and others, 1984) was developed for National Forest System information needs. These include delineating land units for planning analyses, predicting vegetative structure and the distribution of wildlife habitat, planning desired future conditions within and across geologic regions for conservation of biological diversity, and evaluating ecological processes, such as forest succession or soil productivity. The overall purpose of the ECS is to provide an ecological framework for integrated resource planning and management.

The ECS is an ecological approach to defining biological potential of the National Forest land base. Multiple ecological factors were used to define the classification and map units. Climate, landform, soil, and vegetation information was integrated before map units were described and delineated. Information regarding vegetation and soils was predominantly used to delineate map units in the field.

Plant associations are used in the mapping process to help identify local map units. Plant associations are combinations of late successional overstories and groups of associated understory and ground flora species. Species groups are associated with the map unit. However, species composition may vary within the map units, and any given species within a species group may not occur at a particular place. In some cases, the plant association does not reflect soil characteristics and potential. In landscapes that do not support diagnostic plant communities because of natural variability or disturbance, soil and landform variables serve alone as differentiating map unit criteria.

Plant associations have been determined for the map units in the survey area. The primary plant association and secondary plant association are specified at the end of some map unit descriptions under the heading "Detailed Soil Map Units" and are listed in the section "Interpretive Groups." These associations represent the plants that are the most diagnostic for the landforms and soils of the map unit. The following paragraphs describe the plant associations in the survey area. They provide information about the landform and soil type on which the plants occur, the potential late successional overstory and the diagnostic understory, and the ground flora species characteristic of the association.

### Plant Association 1—Black oak (Quercus velutina)-White oak (Quercus alba)-Blueberry (Angustifolium)

This association is characteristic of dry, nutrient-poor landscapes in areas of sandy textured soils. Potential late successional natural vegetation includes species that have adapted to harsh conditions and frequent fire disturbance. It is represented by overstory species of black oak (Quercus velutina), white oak (Quercus alba), and northern pin oak (Quercus ellipsoidalis). Distinguishing ground flora and understory species include blueberry (Vaccinium angustifolium), cowwheat (Melampyrum lineare), trailing arbutus (Epigaea repens), huckleberry (Gaylussacia baccata), brackenfern (Pteridium aquilinum), red maple (Acer rubrum) seedlings, and oak (Quercus spp.) seedlings.

### Plant Association 2—Mixed oak (Quercus spp.)-Red maple (Acer rubrum)-Starflower (Trientalis borealis)

This association is primarily in areas of sandy soils that exhibit weak spodic development. Potential late successional overstory species include black oak (Quercus velutina), white oak (Quercus alba), northern red oak (Quercus rubra), red maple (Acer rubrum), red pine (Pinus resinosa), and eastern white pine (Pinus strobus). Distinguishing ground flora and understory species include mapleleaf viburnum (Viburnum acerifolium), brackenfern (Pteridium aquilinum), wintergreen (Gaultheria procumbens), starflower (Trientalis borealis), blueberry (Vaccinium angustifolium), red maple (Acer rubrum) seedlings and saplings, and juneberry species (Amelanchier spp.).

### Plant association 3—Northern red oak (Quercus rubra)-Red maple (Acer rubrum)-Mapleleaf viburnum (Viburnum acerifolium)

This association is primarily on sandy morainal landscapes and in areas of well developed soils on lake plains. Potential late successional overstory species include northern red oak (Quercus rubra), red maple (Acer rubrum), and eastern white pine (Pinus strobus). Distinguishing ground flora and understory species include mapleleaf viburnum (Viburnum acerifolium), sarsaparilla (Aralia nudicalis), lily-of-the-valley (Maianthemum canadense), largeleaf aster (Aster macrophyllum), squaw root (Conopholis americana), red maple (Acer

rubrum) seedlings and saplings, and witchhazel (Hamamelis virginiana).

**Plant Association 4—Northern red oak (Quercus rubra)-Red maple (Acer rubrum)-Trefoil (Desmodium spp.)**

This association is primarily on moraines and lake beds that have deposits of sand overlying fine-loamy materials. Potential late successional overstory species include northern red oak (Quercus rubra), red maple (Acer rubrum), sugar maple (Acer saccharum), black cherry (Prunus serotina), and white ash (Fraxinus americana). Distinguishing ground flora and understory species include trefoils (Desmodium spp.), downy yellow violet (Viola pubescens), flowering dogwood (Cornus florida), black cherry (Prunus serotina) seedlings, sugar maple (Acer saccharum) seedlings, mapleleaf viburnum (Viburnum acerifolium), and red maple (Acer rubrum) seedlings.

**Plant Association 5—Sugar maple (Acer saccharum)-American beech (Fagus grandifolia)-Clubmoss (Lycopodium obscurum, L. lucidulum)**

This association is on sandy moraines and sandy lake plains in areas of soils that have dark horizons in the subsoil. Potential late successional overstory species include sugar maple (Acer saccharum), American beech (Fagus grandifolia), northern red oak (Quercus rubra), and red maple (Acer rubrum). The association is characterized by low diversity and coverage of ground flora along the forest floor. Distinguishing understory and ground flora species include lily-of-the-valley (Maianthemum canadense), clubmosses (Lycopodium obscurum and L. lucidulum), true Solomons seal (Polygonatum biflorum), longstalk sedge (Carex pedunculata), and sugar maple (Acer saccharum) seedlings.

**Plant Association 6—Sugar maple (Acer saccharum)-White ash (Fraxinus americana)-Sweet cicely (Osmorhiza claytonii)**

This association is in areas of coarse over fine textured soils on moraines, till plains, and lake beds. Potential late successional overstory species include sugar maple (Acer saccharum), white ash (Fraxinus americana), American basswood (Tilia americana), eastern hemlock (Tsuga canadensis), black cherry (Prunus serotina), and northern red oak (Quercus rubra). It is characterized by diverse and abundant ground flora on the forest floor. Distinguishing understory and ground flora species include sweet cicely (Osmorhiza claytonii), wild leek (Allium tricoccum), false miterwort (Tiarella cordifolia), true miterwort (Mitella diphylla), Canada white violet (Viola canadensis), bellwort (Uvularia perfoliata), grapefern (Botrychium virginianum), blue cohosh (Caulophyllum thalictroides), sugar maple (Acer saccharum) seedlings, and white ash (Fraxinus americana) seedlings.

**Plant Association 7—Northern red oak (Quercus rubra)-Red maple (Acer rubrum)-Leatherleaf (Chamaedaphne calyculata)-Blueberry (Vaccinium angustifolium)**

This association is in areas of poorly drained, acidic sand deposits on outwash plains and lake plains. Potential late successional overstory species include northern red oak (Quercus rubra), black oak (Quercus velutina), white oak (Quercus alba), red maple (Acer rubrum), and eastern white pine (Pinus strobus). It is characterized by species adapted to acidic and frequent anaerobic soil conditions. Distinguishing understory and ground flora species include leatherleaf (Chamaedaphne calyculata), blueberry (Vaccinium angustifolium), Labrador tea (Ledum groenlandicum), wintergreen (Gaultheria procumbens), dewberry (Rubus spp.), brackenfern (Pteridium aquilinum), and speckled alder (Alnus rugosa).

**Plant Association 8—Red maple (Acer rubrum)-Balsam fir (Abies balsamea)-Bunchberry (Cornus canadensis)**

This association is on outwash plains, flood plains, and lake plains in areas of sandy deposits that are slightly acid to alkaline. Potential late successional overstory species include red maple (Acer rubrum), black ash (Fraxinus nigra), green ash (Fraxinus pennsylvanica), balsam fir (Abies balsamea), and eastern white pine (Pinus strobus). Distinguishing understory and ground flora species include lily-of-the-valley (Maianthemum canadense), bunchberry (Cornus canadensis), goldthread (Coptis groenlandica), wintergreen (Gaultheria procumbens), and shield fern (Dryopteris spinulosa).

**Plant Association 9—Mixed ash (Fraxinus spp.)-Basswood (Tilia americana)-Downy yellow violet (Viola pubescens)**

This association is in areas of poorly drained, nutrient-rich, loamy soils on lake beds, till plains, and flood plains. Organic deposits are shallow. Potential late successional overstory species include American basswood (Tilia americana), eastern hemlock (Tsuga canadensis), black ash (Fraxinus nigra), green ash (Fraxinus pennsylvanica), and white cedar (Thuja occidentalis). Distinguishing

understory and ground flora species include downy yellow violet (Viola pubescens), maidenhair fern (Adiantum pedatum), cinnamon fern (Osmunda cinnamomea), jack in the pulpit (Arisaema triphyllum), and bellwort (Uvularia perfoliata).

**Plant Association 10—Black spruce (Picea mariana)-Tamarack (Larix laricina)-Labrador tea (Ledum groenlandicum)**

This association is in areas of poorly drained, dysic organic deposits on outwash plains and lake plains. The organic deposits are deep. The association is characterized by acid bog conditions. Overstory is sparse with black spruce (Picea mariana) and tamarack (Larix laricina) as the predominant species. Distinguishing understory and ground flora species include Labrador tea (Ledum groenlandicum), leatherleaf (Chamaedaphne calyculata), sphagnum (Sphagnum spp.), and speckled alder (Alnus rugosa).

**Plant Association 11—Northern whitecedar (Thuja occidentalis)-Eastern hemlock (Tsuga canadensis)-Canada violet (Viola canadense)**

This association is in areas of poorly drained, euic organic deposits on flood plains, till plains, and lake beds. The organic deposits are deep. Potential late successional overstory species include northern whitecedar (Thuja occidentalis), eastern hemlock (Tsuga canadensis), white spruce (Picea glauca), and black ash (Fraxinus nigra). Distinguishing understory and ground flora species include Canada violet (Viola canadense), maidenhair fern (Adiantum pedatum), bedstraws (Galium spp.), and lily-of-the-valley (Maianthemum canadense).

## 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 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

## Recreation

Recreation is a major land use in Alcona County. Much of the county is used for second home development and for extensive recreational activities, such as fishing, hunting, sightseeing, and wildlife and plant observation. Winter recreation activities include cross-country skiing and snowmobiling. Some areas are dedicated to intensive recreational use. These include campgrounds, a Great Lakes harbor, picnic areas, playgrounds, hiking trails, cross-country skiing areas, and golf courses. Because of increasing population and land prices, land use will likely undergo changes in the future. These changes may include the diversion of more land to various types of recreational uses. The appeal of waterfront property is putting great pressure on the riparian lands of Lake Huron and other water bodies.

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season

when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 11, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

*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 gentle 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.

## Wildlife Habitat

This section was prepared by Lynn Sampson, biologist, Natural Resources Conservation Service.

Wildlife is a product of the land and depends upon the complex relationship of soil, water, and vegetation for its needs. Wildlife populations are in balance with essential habitat containing food, cover, and water.

Habitat for wildlife in Alcona County is diverse and ranges from heavily wooded areas to open farmland. Alcona County has many streams, inland lakes, and diverse wetlands, all of which support many populations of fish and wildlife.

Before permanent settlement, such wildlife species as black bear, mountain lion, bobcat, and timber wolf roamed the survey area. The passenger pigeon and eastern wild turkey were abundant in the forests of the county.

After logging and agricultural development occurred in the late 1800's, species adapted to second-growth forest, brushy edges, and agricultural areas became abundant. The population of white-tailed deer, red fox, cottontail rabbit, and raccoons increased.

The wooded areas in the county provide important habitat for white-tailed deer (fig. 14), ruffed grouse, and eastern wild turkey. These areas also provide food and cover for black bear, raccoons, skunks, tree squirrels, cardinals, wrens, woodpeckers, and mice. Young stands of jack pine provide important nesting and brooding habitat for the Kirtland's warbler.

The farmed areas and associated idle areas of grass and brush are inhabited by cottontail rabbits, woodchucks, red fox, gray fox, opossum, hawks, owls, and numerous songbirds.

The wooded streams and diverse wetlands provide habitat for blue herons, green herons, bald eagles, belted kingfishers, woodcock, marsh hawks, muskrats, and mink. The streams and lakes support good populations of sunfish, perch, largemouth bass, smallmouth bass, walleye, and northern pike. The rivers and streams are popular among fishermen for trout, salmon, smelt, and steelhead.

The plant and animal communities of Alcona County include many species recognized as rare, threatened, or endangered by the State of Michigan. Included are the common loon, bald eagle, Caspian tern, Kirtland's warbler, channel darter, black sedge, fairy-slipper, pine-drops, and western moonwort.

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

**Figure 14.—White-tailed deer find food and cover in areas of Chinwhisker sand, 0 to 4 percent slopes.**

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

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

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

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are buckwheat, corn, wheat, oats, rye, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and

legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are orchardgrass, timothy, bromegrass, red clover, and alfalfa.

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

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, apple, hawthorn, and dogwood. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

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

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

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

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

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include coyote, 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 wild turkey, ruffed grouse, woodcock, warblers, woodpeckers, squirrels, gray fox, raccoon, deer, and black 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, wading birds, muskrat, mink, and beaver.

## Engineering

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

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of

the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

## Building Site Development

Table 13 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, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

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

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, 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 or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

## Sanitary Facilities

Table 14 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 14 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan 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 14 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 or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is

used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

## Construction Materials

Table 15 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand* and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 15, 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 (fig. 15) 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,

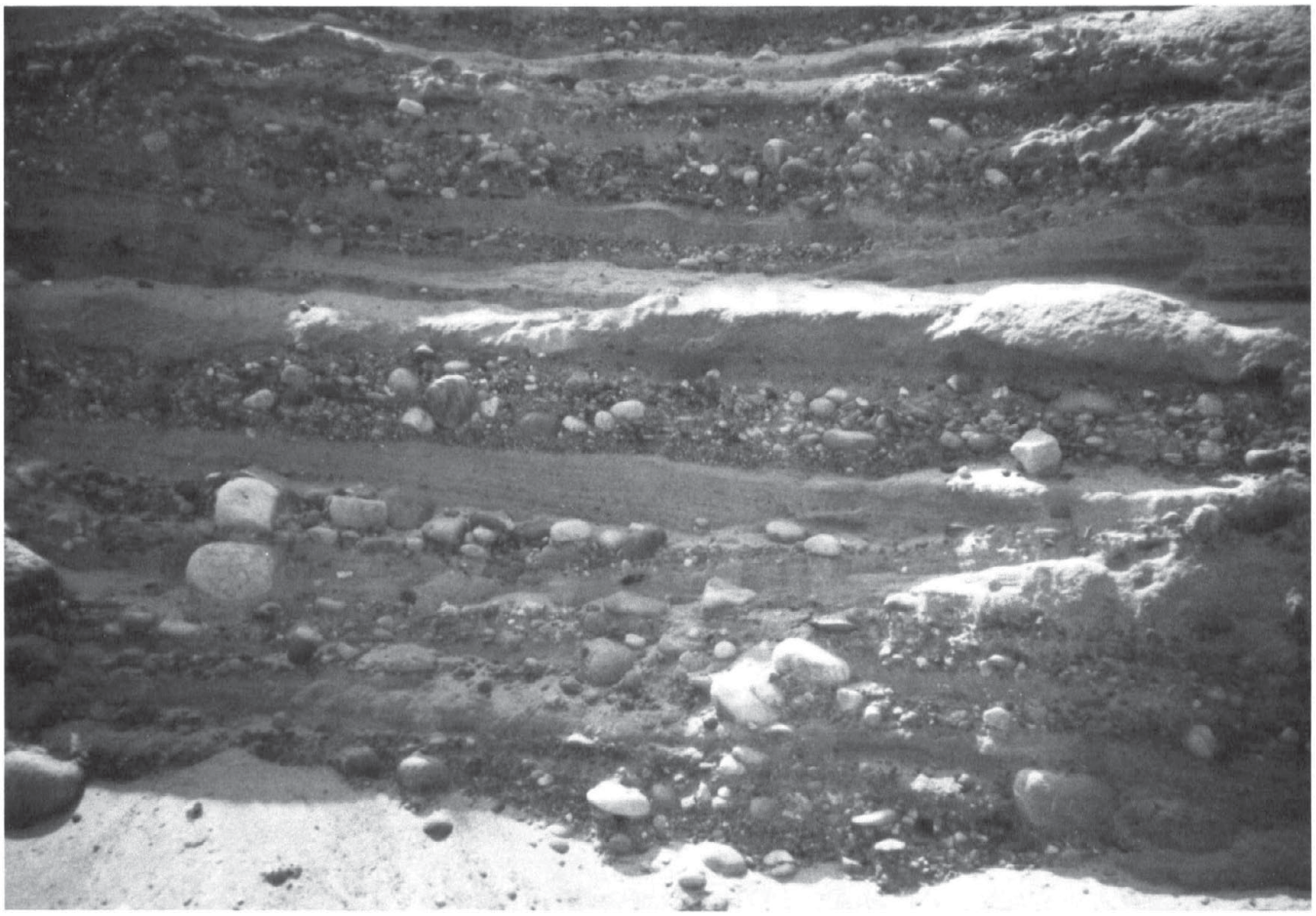

**Figure 15.—The stratified substratum in Mancelona soils provides a source of gravel.**

slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

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

## Water Management

Table 16 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; embankments, dikes, and levees; and aquifer-fed excavated ponds. 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, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

*Aquifer-fed excavated ponds* are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table and permeability of the aquifer. The content of large stones affects the ease of excavation.

*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 a cemented pan or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to a cemented pan, 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 sulfur. 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 a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

*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 a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

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

## Engineering Index Properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 16). "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.

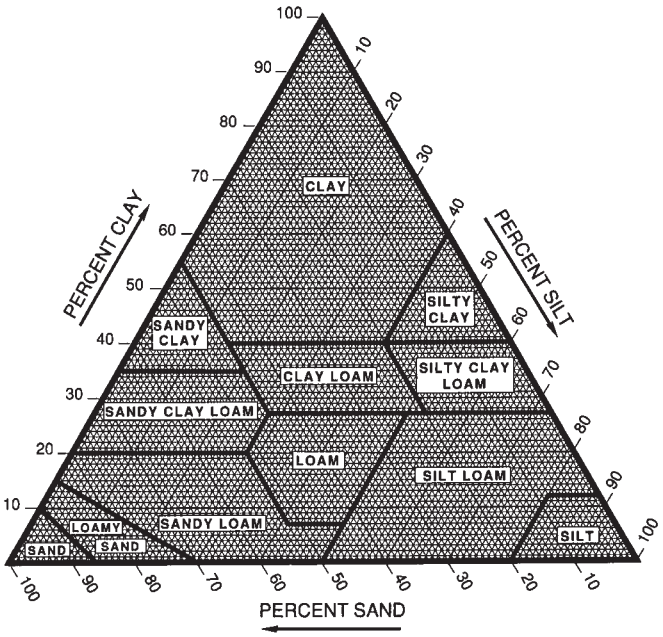


**Figure 16.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.**

*Classification* of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils

exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit* and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## Physical and Chemical Properties

Table 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 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 and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an

estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In table 18, 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.

## Soil and Water Features

Table 19 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 19, 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, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 19.

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.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not

artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

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

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

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