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In cooperation with
Michigan Department of
Agriculture, Michigan
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Extension, and Michigan
Technological University

Soil Survey of Crawford County, Michigan



How To Use This Soil Survey

General Soil Map

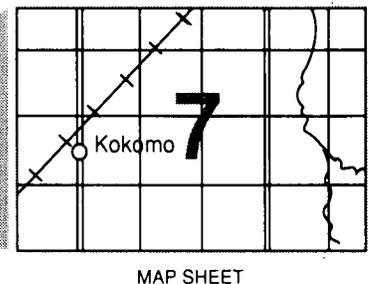
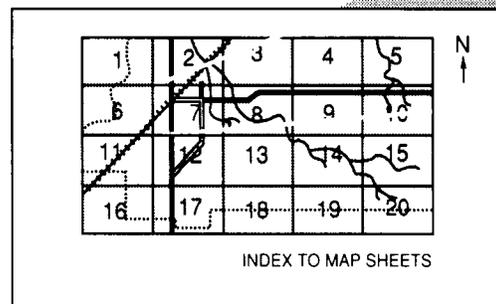
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

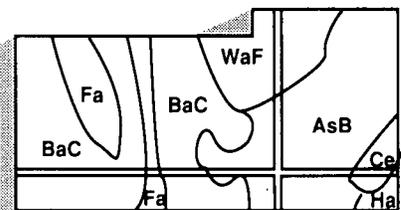
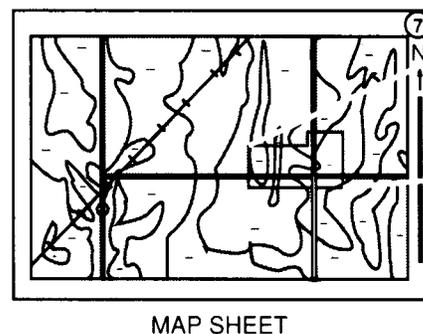
Detailed Soil Maps

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



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

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

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

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 1993. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Forest Service, the Michigan Department of Agriculture, Michigan State University Extension, and Michigan Technological University. The survey is part of the technical assistance furnished to the Crawford-Roscommon Soil 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: The Au Sable River drains approximately 85 percent of the survey area. It is popular for trout fishing and canoeing.

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Foreword

This soil survey contains information that affects land use planning in this survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, 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.

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

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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Soil Survey of Crawford County, Michigan

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

CRAWFORD COUNTY is in the north-central part of the Lower Peninsula of Michigan (fig. 1). The county is bordered on the north by Otsego County, on the east by Oscoda County, on the south by Roscommon County, and on the west by Kalkaska County. It has a total area of 360,602 acres, or about 563 square miles. The population was 12,260 in 1990. Grayling, the county seat, is approximately 140 miles north of Lansing.

About 76 percent of the county is forested, about 23 percent is used as urban land or other land, about 1 percent is water, and less than 1 percent is used for agricultural purposes (Michigan Department of Agriculture, 1988). Forestry, the National Guard, and gas and oil production are the main economic enterprises in the county. Recreation and tourism are also important to the economy, along with several small industries. The largest single employer in the county is the community hospital.

This survey updates the soil survey of Crawford County published in 1927 (Veatch and others, 1927). It also updates information included in the Crawford County portion of the Camp Grayling soil survey (Werlein and Kroell, 1990). The present survey provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the County

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

Climate

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

In winter, the average temperature is 19.5 degrees F and the average daily minimum temperature is 10.7 degrees. The lowest temperature on record, which occurred on February 17, 1979, is -42 degrees. In summer, the average temperature is 65.5 degrees and the average daily maximum temperature is 78.8 degrees. The highest recorded temperature, which occurred on June 28, 1887, 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



Figure 1.—Location of Crawford County in Michigan.

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 31.95 inches. Of this, 19.8 inches, or 62 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 15.79 inches. The heaviest 1-day rainfall during the period of record was 5.02 inches on August 8-9, 1965. Thunderstorms occur on about 30 days each year, and most occur in June, July, and August.

The average seasonal snowfall is about 93.8 inches. The greatest snow depth at any one time during the period of record was 51 inches. On the average, 127 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 63 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 67 percent of the time possible in summer and 37 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 10.1 miles per hour, in January.

History and Development

The original inhabitants of the survey area were scattered bands of Ottawa and Chippewa Indians. The vast forests of mature pine that covered most of the area provided little food for game animals. Consequently, game was relatively scarce and most of the Indian tribes passed through the area to seek out more productive food gathering areas along the shores of Lake Michigan and Lake Huron. The Au Sable and Manistee Rivers were used as early transportation routes between these two lakes.

In the 1860's, lumbermen discovered the vast white pine forests in the survey area and the lumbering boom began. In 1872, the first railroad was extended northward to "Crawford Station", which is now the city of Grayling (fig. 2). The local citizens decided the name Crawford was too common and voted to change it to Grayling, after the fish that was so abundant in the Au Sable River. Grayling was then established in 1874.

Crawford County was organized by the State Legislature in 1879. Rail transportation became well established, and by 1890 the county population was 2,962 (Grayling Uptown District Association, 1992). The lumber towns of Pere Cheney, Grayling, and Frederic developed along the rail lines. As the forests became depleted in these areas, lumbering expanded to the north and east. One of the largest sawmills was constructed in Deward in 1901. It lasted only 11 years before closing in 1912. The supply of timber was rapidly dwindling as Grayling reached its peak industrial height in 1917. Lumber products from the mills were shipped all over the world to markets in Europe, South America, and Asia. The logging era came to a halt when the last mill in Grayling closed in 1927.

Early settlers were encouraged to buy land cleared by the lumbermen. By 1900, the county had 228 farms (Grayling Uptown District Association, 1992). Most of the farms supplied food for the horses and lumberjacks, but one large orchard in Frederic Township shipped crates of apples to downstate markets. The farms gradually failed because of the predominance of sandy soils and the short growing season.

Recreation and tourism became important parts of the economy after the logging boom. Lovells began as a logging town in 1896 and later developed into a well known fishing area after trout were planted in the Au Sable River. As word spread about the exceptional trout fishing, many lodges and resorts developed along the banks of the Au Sable and Manistee Rivers to accommodate the enthusiasts. Today, recreation and tourism continue to be a mainstay of the economy.

Regrowth of the forests has enabled the forest products industry to once again become an important

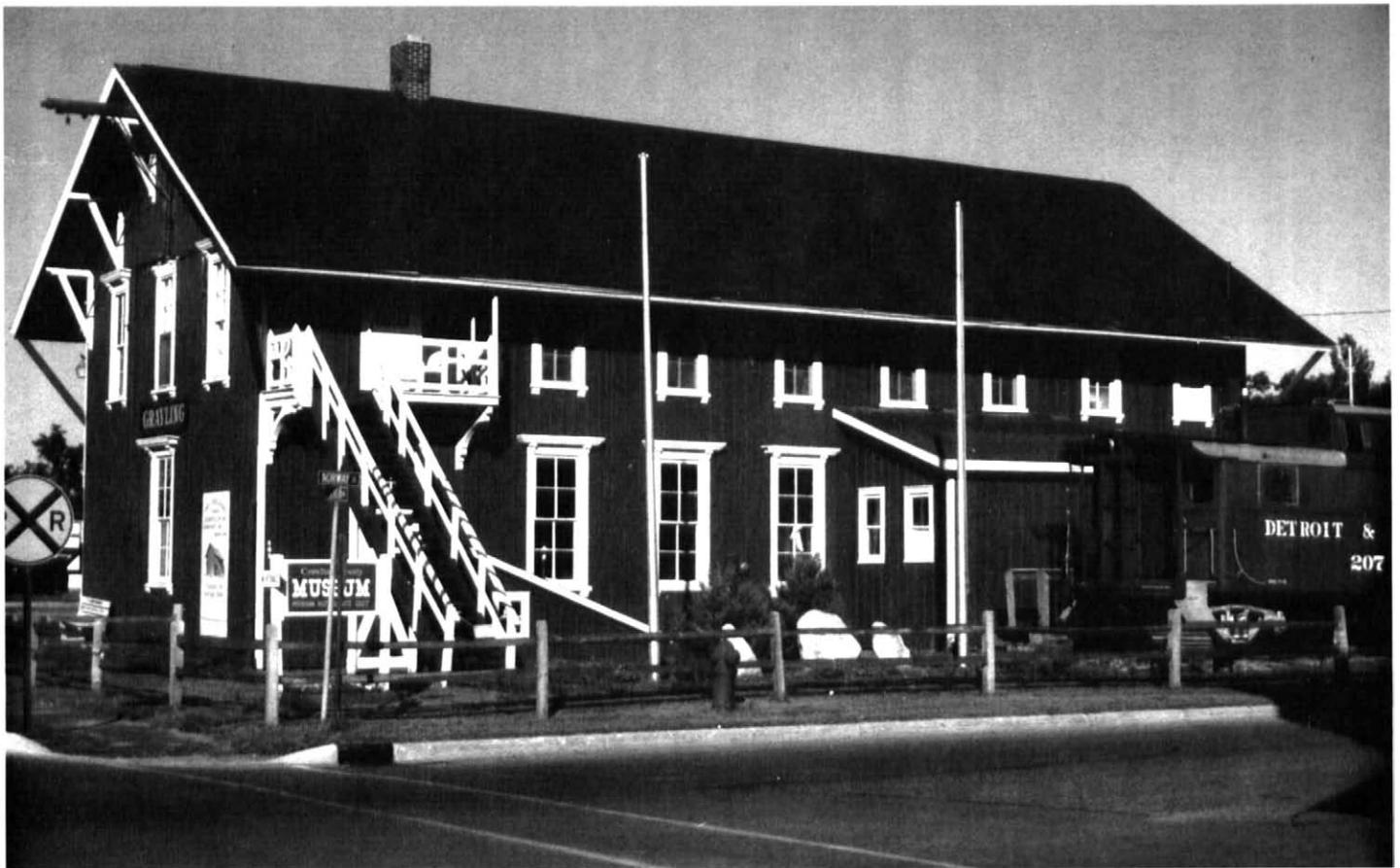


Figure 2.—Railroads played an important part in the history and development of Crawford County. The old depot in Grayling is now a museum.

part of the economy. Crawford County now ranks as one of the largest producers of pulpwood in the northern Lower Peninsula.

Oil and gas production became important to the area economy when oil was discovered in Beaver Creek Township in 1947. The Beaver Creek field, producing from the Richfield Formation, ranks among Michigan's best. Through the end of 1982, oil production from this field was more than 14.5 million barrels and natural gas production was more than 20.5 billion cubic feet (Michigan Oil and Gas News, 1987). In the early 1970's, further exploration revealed oil and gas in the Niagaran Formation underlying Frederic and Maple Forest Townships. By the end of 1985, Crawford County ranked 10th in all-time natural gas production and 13th in oil production in Michigan (Michigan Oil and Gas News, 1987).

The largest National Guard training facility east of the Mississippi River is in Crawford County. Camp Grayling was first established in 1913. Rasmus Hanson, a

Grayling lumberman, donated more than 14,000 acres to the State of Michigan for a training ground for the State Militia and for a wildlife preserve. This area was originally known as Camp Ferris, named after a former governor of Michigan, Woodbridge M. Ferris. Through years of modernization and expansion, Camp Grayling grew to encompass portions of Crawford, Kalkaska, and Otsego Counties. More than 100,000 acres of the camp is in Crawford County.

Physiography

Two main bedrock formations underlie Crawford County. The northern part of the county is underlain by bedrock of the Napoleon Formation. This formation is composed of 50 to 100 feet of white and light gray sandstone of late Mississippian age. The southern part of the county is underlain by the slightly younger Michigan Formation, also of late Mississippian age. This formation is composed of interbedded layers of shale,

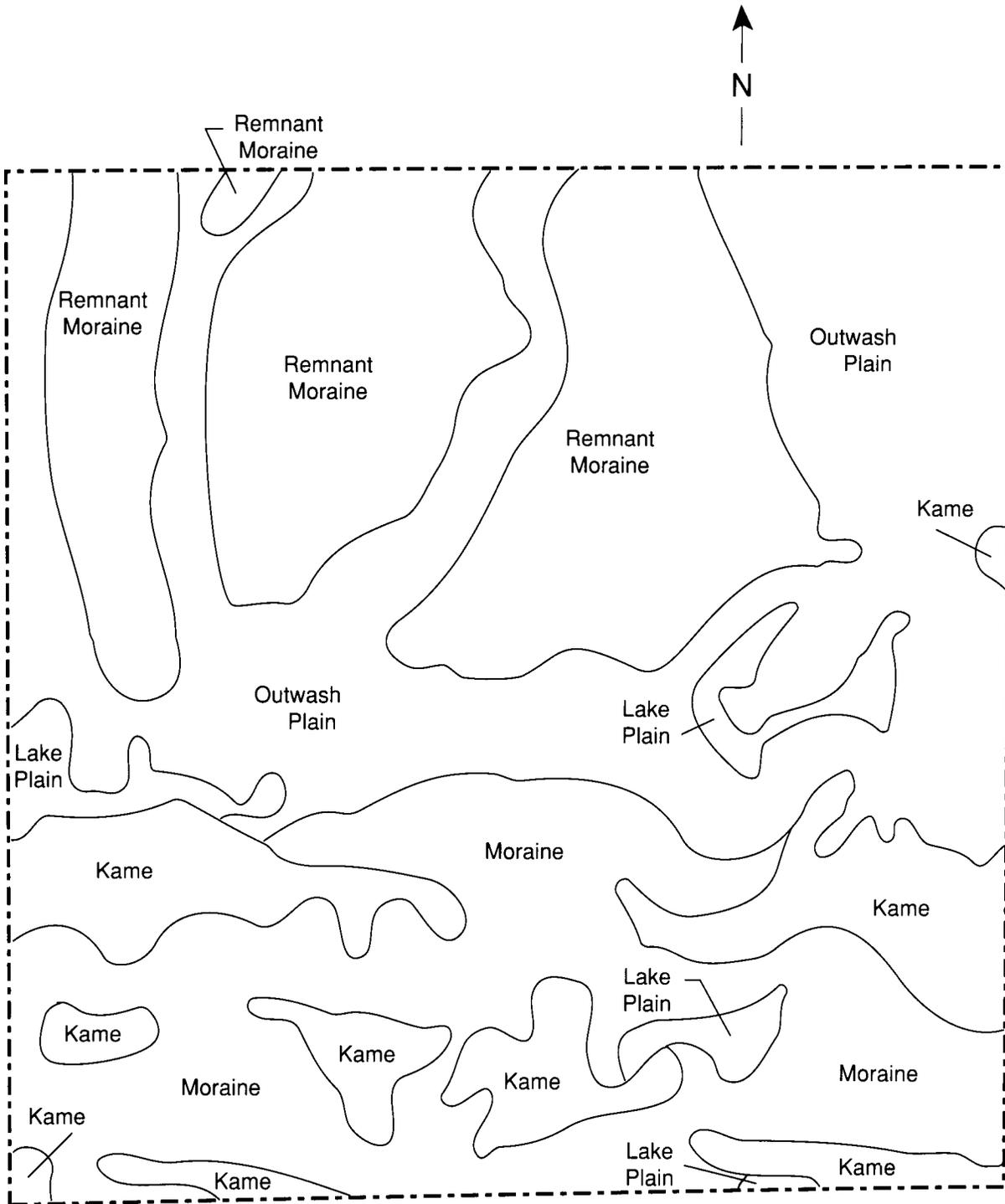


Figure 3.—Dominant glacial landforms of Crawford County. Modified after Burgis and Eschman, 1981.

sandstone, and limestone and is as much as 500 feet thick. These two formations are covered by glacial drift ranging from more than 600 feet thick in the northern part of the county to less than 200 feet thick in the

southern part (Western Michigan University, Department of Geology, 1981).

The landforms in Crawford County are a result of late Wisconsin glacial ice (fig. 3). The retreat of glacial ice

in this area occurred between 12,500 and 14,500 years ago (Burgis and Eschman, 1981). The dominant landforms are outwash plains, kames, moraines, and lake plains.

The county has three main physiographic regions. The first is in the northwestern and north-central parts of the county. It is characterized by a series of four high plateaulike remnant moraines that have been dissected by glacial meltwater. The remnant moraines occur as fingerlike projections and are separated by broad outwash channels. These landforms have a north-south orientation with a general gradient to the south. They are primarily composed of sandy outwash, but a thin veneer of loamy ablation till occurs on a few isolated nearly level plateaus. Ice stagnation and subsequent meltwater flow have left portions of the area pitted. Slopes range from nearly level to very steep.

The second physiographic region is in the central and northeastern parts of the county. It is characterized by nearly level to gently sloping outwash plains. Some areas of outwash are extensively pitted. The mainstream of the Au Sable River and the North Branch of the Au Sable River are in this region. These streams have cut shallow trenches in the outwash material. The soils range from excessively drained sand in the higher areas to very poorly drained muck in drainageways and depressions. The lowest elevation in the county, 1,006 feet above sea level, is in the Au Sable River basin near the eastern edge of the county.

The third physiographic region is in the southern part of the county. It consists of a nearly level to gently sloping plain that is interrupted by a series of high kame moraines. Much of the gently sloping plain is overwashed with sand. The kame moraines have a general east-west orientation. The highest elevation in the county, 1,524 feet above sea level, is on one of these moraines. A few small postglacial lake plains also occur in this region. The soils are predominantly sandy and loamy, and slopes range from nearly level to steep.

Streams and Lakes

Crawford County is drained by two major rivers, the Au Sable and Manistee Rivers. The Au Sable River watershed drains more than 85 percent of the county. It can be subdivided into four minor watersheds—the mainstream, the East Branch, the North Branch, and the South Branch. The mainstream and the East Branch of the Au Sable River drain the northwestern and north-central parts of the county. They flow southward toward the city of Grayling, where they converge. The Au Sable River then flows east from Grayling and eventually drains into Lake Huron. The North Branch and its tributaries drain the northeastern part of the county near

the town of Lovells. The North Branch flows southward before entering the mainstream near the east-central edge of the county. The South Branch and its tributaries drain the southern part of the county. The South Branch flows to the northeast and enters the mainstream of the Au Sable River about 12 miles east of Grayling.

The Manistee River Watershed drains the western edge of the county. It flows southward and then southwest and exits the county about 6 miles west of Grayling. This watershed drains into Lake Michigan.

A small portion of the Muskegon River Watershed is in the southwest corner of the county, but no streams or rivers from this watershed are in the county. This watershed also drains into Lake Michigan.

Approximately 40 natural lakes are scattered throughout the county. The largest include Barnes Lake, Hardgrove Lake, K.P. Lake, Jones Lake, Lonesome Lake, Section One Lake, and Shupac Lake in the northern part of the county and Lake Margrethe, Shellenbarger Lake, Wakeley Lake, and West Lake in the southern part. Lake Margrethe has 1,840 acres of water (fig. 4). It is a kettle lake, which formed in the depression left by a large block of glacial ice. The ice broke free from the retreating glacier and gradually melted, leaving a water-filled depression. Many of the lakes in the county were formed in this manner.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; and the kinds of crops and native plants. 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 and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they



Figure 4.—Lake Margrethe, which is west of Grayling, is the largest lake in the survey area.

were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area 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-vegetation-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 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. Soil taxonomy, 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 and 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 woodland productivity are assembled from Michigan Department of Natural Resources 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 predict 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.

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 210 to 282 identify map units within the Huron National Forest.

Procedures for Map Units 13 to 146 and Map Units 347 to 349

Prior to soil mapping, soil scientists gathered information on climate, glacial geology, vegetation, and land use in the survey area. Soil survey maps made for

conservation planning and the 1927 soil survey of Crawford County were among the references used (Veatch and others, 1927). Before the actual fieldwork began, the scientists studied and compared each map sheet to the USGS topographic map for the area and stereoscopically plotted preliminary boundaries of slopes and landforms on 1:15,840 leaf-off aerial photographs.

A reconnaissance was made by pickup truck on the existing network of roads and trails 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 steep side slope.

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, push probe, or spade to a depth of about 5.0 to 6.5 feet. The pedons described as typical were observed and studied in pits where possible.

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 National Soil Survey Laboratory, Lincoln, Nebraska, and the Soil Research Laboratory, Michigan Technological University, Houghton, Michigan. The results of the analyses are stored in a computerized data file at the laboratories. The results of the studies and the laboratory procedures 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 210 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. An important result of the reconnaissance activities was 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. The 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 (Driscoll and others, 1984; 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 broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Rubicon-Grayling-Croswell Association

Nearly level and undulating, excessively drained and moderately well drained, sandy soils on outwash plains and stream terraces

This association is on broad upland flats and low knolls. Slope ranges from 0 to 6 percent.

This association makes up about 4 percent of the county. It is about 40 percent Rubicon soils, 23 percent Grayling soils, 20 percent Croswell soils, and 17 percent soils of minor extent.

Rubicon soils are nearly level and undulating and are excessively drained. Typically, the surface layer is black sand about 1 inch thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is about 29 inches thick. It is dark brown, dark yellowish brown, and yellowish brown sand. The substratum to a depth of about 80 inches is light yellowish brown sand.

Grayling soils are nearly level and undulating and are excessively drained. Typically, the surface layer is black sand about 3 inches thick. The subsoil is about 20

inches thick. It is strong brown, dark yellowish brown, and brownish yellow sand. The substratum to a depth of about 80 inches is light yellowish brown sand.

Croswell soils are nearly level and are moderately well drained. Typically, the surface layer is black sand about 1 inch thick. The subsurface layer is brown sand about 3 inches thick. The subsoil is about 25 inches thick. The upper part is dark brown and strong brown sand. The lower part is yellowish brown and brownish yellow, mottled sand. The substratum to a depth of about 80 inches is pale brown, mottled sand.

Of minor extent in this association are the somewhat poorly drained Au Gres soils and the very poorly drained Ausable, Bowstring, Leafriver, and Lupton soils. Au Gres soils are on the lower flats and in depressions, Ausable and Bowstring soils are on flood plains, and Leafriver and Lupton soils are in depressions and drainageways.

This association is used mainly as woodland. The major management concerns are the equipment limitation and seedling mortality. The windthrow hazard and plant competition are additional concerns in areas of the Croswell soils.

The Rubicon and Grayling soils are well suited to building site development. Wetness is a limitation in areas of the Croswell soils. A poor filtering capacity is a major limitation if the soils in this association are used as sites for septic tank absorption fields. The wetness is an additional concern in areas of the Croswell soils.

2. Tawas-Leafriver-Lupton Association

Nearly level, very poorly drained, mucky soils on outwash plains and lake plains

This association is on low flats and in depressions and drainageways. Slope ranges from 0 to 2 percent.

This association makes up about 7 percent of the county. It is about 35 percent Tawas soils, 30 percent Leafriver soils, 15 percent Lupton soils, and 20 percent soils of minor extent (fig. 5).

Typically, the surface layer of the Tawas soils is very dark brown muck about 10 inches thick. The next layer is dark reddish brown and black muck about 14 inches



Figure 5.—A typical area of the Tawas-Leafriver-Lupton association. Areas of these soils are used as woodland or for wildlife habitat.

thick. The substratum to a depth of about 60 inches is dark gray and brown sand.

Typically, the surface layer of the Leafriver soils is black muck about 9 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 3 inches thick. The upper part of the substratum is grayish brown, mottled sand. The lower part to a depth of about 60 inches is olive gray and gray sand.

Typically, the surface layer of the Lupton soils is black muck about 9 inches thick. The substratum to a depth of about 60 inches also is black muck.

Of minor extent in this association are the very poorly drained Dawson and Loxley soils, the somewhat poorly drained Au Gres soils, the moderately well drained Croswell soils, and the excessively drained Grayling and Rubicon soils. Dawson and Loxley soils are in landscape positions similar to those of the major soils. Au Gres, Croswell, Grayling, and Rubicon soils are in the higher landscape positions.

This association is used mainly as woodland. The

major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition.

The major soils in this association are generally unsuited to building site development and septic tank absorption fields because of ponding and low strength.

3. Blue Lake-Kalkaska-Feldhauser Association

Nearly level to rolling, somewhat excessively drained to moderately well drained, sandy and loamy soils on remnant moraines

This association is on broad upland flats, hills, and knolls. Slope ranges from 0 to 18 percent.

This association makes up about 5 percent of the county. It is about 40 percent Blue Lake soils, 34 percent Kalkaska soils, 14 percent Feldhauser soils, and 12 percent soils of minor extent.

Blue Lake soils are nearly level and undulating and are well drained. Typically, the surface layer is very

dark grayish brown loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 4 inches thick. The subsoil is about 66 inches thick. The upper part is dark reddish brown and dark yellowish brown loamy sand. The lower part is light yellowish brown sand that has bands of brown and strong brown loamy sand and sandy loam. The substratum to a depth of about 80 inches is brown sand.

Kalkaska soils are nearly level to rolling and are somewhat excessively drained. Typically, the surface layer is very dark gray sand about 4 inches thick. The subsurface layer is grayish brown sand about 5 inches thick. The subsoil is sand about 33 inches thick. The upper part is dark brown and brown, and the lower part is dark yellowish brown and yellowish brown. The substratum to a depth of about 80 inches is yellowish brown sand.

Feldhauser soils are nearly level and undulating and are moderately well drained. Typically, the surface layer is dark brown fine sandy loam about 10 inches thick. The subsoil is about 44 inches thick. The upper part is dark yellowish brown and yellowish brown fine sandy loam; the next part is dark yellowish brown sandy loam and dark yellowish brown, mottled sandy loam; and the lower part is light yellowish brown sand that has bands of strong brown loamy sand. The substratum to a depth of about 80 inches is yellowish brown sand.

Of minor extent in this association are the excessively drained Rubicon soils, the somewhat excessively drained Graycalm soils, and the well drained Montcalm soils. All of these soils are in landscape positions similar to those of the major soils.

Most areas of this association are used as woodland. The major management concerns on the Kalkaska soils are the equipment limitation and seedling mortality. Plant competition is the major concern on the Blue Lake soils, and plant competition and the equipment limitation are concerns on the Feldhauser soils.

About 7 percent of this association is used as cropland. Most of the cropland is in areas of the Feldhauser soils. If cultivated crops are grown, the major management concerns are controlling water erosion and soil blowing and maintaining tilth and the content of organic matter.

The major soils in this association are well suited to building site development in the nearly level and undulating areas. The slope is a concern in the rolling areas. The Blue Lake soils are well suited to septic tank absorption fields in the nearly level and undulating areas. A poor filtering capacity is a limitation if the Kalkaska soils are used as sites for septic tank absorption fields. The main concern in areas of the Feldhauser soils is the restricted permeability.

4. Kinross-Croswell-Au Gres Association

Nearly level and undulating, poorly drained to moderately well drained, mucky and sandy soils on outwash plains, lake plains, and stream terraces

This association is on low flats, in depressions, and on low knolls adjacent to drainageways, lakes, and swamps. Slope ranges from 0 to 6 percent.

This association makes up about 4 percent of the county. It is about 27 percent Kinross soils, 25 percent Croswell soils, 20 percent Au Gres soils, and 28 percent soils of minor extent.

Kinross soils are nearly level and are poorly drained. Typically, the surface layer is black muck about 3 inches thick. The subsurface layer is grayish brown, mottled sand about 7 inches thick. The subsoil is sand about 12 inches thick. The upper part is dark reddish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled sand.

Croswell soils are nearly level and undulating and are moderately well drained. Typically, the surface layer is black sand about 1 inch thick. The subsurface layer is brown sand about 3 inches thick. The subsoil is sand about 25 inches thick. The upper part is dark brown and strong brown, and the lower part is yellowish brown and brownish yellow and is mottled. The substratum to a depth of about 80 inches is pale brown, mottled sand.

Au Gres soils are nearly level and are somewhat poorly drained. Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is light brownish gray sand about 4 inches thick. The subsoil is sand about 16 inches thick. The upper part is dark reddish brown, and the lower part is dark yellowish brown and yellowish brown and is mottled. The substratum to a depth of about 60 inches is light yellowish brown, mottled sand.

Of minor extent in this association are the very poorly drained Leafriver and Tawas soils and the excessively drained Grayling soils. Leafriver and Tawas soils are in depressions and drainageways. Grayling soils are on the higher flats and on low knolls.

This association is used mainly as woodland. The major management concerns are the equipment limitation, the windthrow hazard, and plant competition.

The Kinross soils are generally unsuited to building site development and septic tank absorption fields, mainly because of ponding. Seasonal wetness is a limitation affecting these uses in areas of the Au Gres and Croswell soils. A poor filtering capacity is an additional limitation if the Au Gres and Croswell soils are used as sites for septic tank absorption fields.

5. Rubicon-Kalkaska-Blue Lake Association

Nearly level to very steep, excessively drained to well drained, sandy soils on outwash plains, stream terraces, and remnant moraines

This association is on broad upland flats, knolls, hills, dissected ridges, and side slopes of ridges. Slope ranges from 0 to 50 percent.

This association makes up about 9 percent of the county. It is about 50 percent Rubicon soils, 30 percent Kalkaska soils, 6 percent Blue Lake soils, and 14 percent soils of minor extent.

Rubicon soils are nearly level to very steep and are excessively drained. Typically, the surface layer is black sand about 1 inch thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is about 29 inches thick. It is dark brown, dark yellowish brown, and yellowish brown sand. The substratum to a depth of about 80 inches is light yellowish brown sand.

Kalkaska soils are nearly level to very steep and are somewhat excessively drained. Typically, the surface layer is very dark gray sand about 4 inches thick. The subsurface layer is grayish brown sand about 5 inches thick. The subsoil is sand about 33 inches thick. The upper part is dark brown and brown, and the lower part is dark yellowish brown and yellowish brown. The substratum to a depth of about 80 inches is yellowish brown sand.

Blue Lake soils are nearly level to rolling and are well drained. Typically, the surface layer is very dark grayish brown loamy sand about 1 inch thick. The subsurface layer is brown loamy sand about 4 inches thick. The subsoil is about 66 inches thick. The upper part is dark reddish brown and dark yellowish brown loamy sand. The lower part is light yellowish brown sand that has bands of brown and strong brown loamy sand and sandy loam. The substratum to a depth of about 80 inches is brown sand.

Of minor extent in this association are the excessively drained Grayling and somewhat excessively drained Graycalm soils. These soils are in landscape positions similar to those of the major soils.

This association is used mainly as woodland. The major management concerns in areas of the Rubicon and Kalkaska soils are the equipment limitation and seedling mortality. The hazard of erosion is also a concern in steep areas of these soils. Plant competition is the major concern on the Blue Lake soils.

The major soils are well suited to building site development in nearly level and undulating areas. The slope is a major concern in rolling to very steep areas. A poor filtering capacity is a limitation if the Rubicon and Kalkaska soils are used as sites for septic tank absorption fields. The slope is an additional concern in

rolling to very steep areas of this association. Nearly level and undulating areas of Blue Lake soils are well suited to septic tank absorption fields.

6. Graycalm-Grayling Association

Nearly level to steep, excessively drained and somewhat excessively drained, sandy soils on outwash plains, kames, and moraines

This association is on broad upland flats, knolls, hills, ridges, and side slopes of ridges. Slope ranges from 0 to 45 percent.

This association makes up about 38 percent of the county. It is about 45 percent Graycalm soils, 35 percent Grayling soils, and 20 percent soils of minor extent.

Graycalm soils are somewhat excessively drained. Typically, the surface layer is dark brown sand about 3 inches thick. The subsoil is about 75 inches thick. The upper part is dark yellowish brown and yellowish brown sand. The lower part is light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam.

Grayling soils are excessively drained. Typically, the surface layer is black sand about 3 inches thick. The subsoil is about 20 inches thick. It is strong brown, dark yellowish brown, and brownish yellow sand. The substratum to a depth of about 80 inches is light yellowish brown sand.

Of minor extent in this association are Typic Udipsamments, Haplorthods, Eutroboralfs, the moderately well drained Croswell soils, and the very poorly drained Leafriver and Tawas soils. Typic Udipsamments, Haplorthods, and Eutroboralfs are in landscape positions similar to those of the major soils. Croswell soils are on low flats or low knolls. Leafriver and Tawas soils are in depressions or drainageways.

This association is used mainly as woodland. The major management concerns are the equipment limitation, seedling mortality, and the hazard of erosion in steep areas.

The major soils in this association are well suited to building site development in nearly level and undulating areas. The slope is the main concern affecting this use in rolling to steep areas. The main concern affecting septic tank absorption fields is a poor filtering capacity. The slope is also a concern in rolling to steep areas.

7. Graycalm-Klacking Association

Nearly level to steep, somewhat excessively drained and well drained, sandy soils on outwash plains, kames, and moraines

This association is on broad upland flats; on knolls, hills, ridges; and on the side slopes of ridges.



Figure 6.—A typical area of the Grayling association on an outwash plain. Jack pine is the dominant tree species in areas of these soils.

Slope ranges from 0 to 45 percent.

This association makes up about 9 percent of the county. It is about 40 percent Graycalm soils, 29 percent Klacking soils, and 31 percent soils of minor extent.

Graycalm soils are somewhat excessively drained. Typically, the surface layer is dark brown sand about 3 inches thick. The subsoil is about 75 inches thick. The upper part is dark yellowish brown and yellowish brown sand. The lower part is light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam.

Klacking soils are well drained. Typically, the surface layer is very dark grayish brown loamy sand about 2 inches thick. The subsoil is about 77 inches thick. In sequence downward, it is dark yellowish brown and yellowish brown sand; light yellowish brown sand that has bands of brown loamy sand; brown sandy loam and

light yellowish brown sand; and light yellowish brown sand that has bands of dark brown loamy sand and sandy loam.

Of minor extent in this association are the excessively drained Grayling soils, the well drained Montcalm soils, and the moderately well drained Perecheney soils. These soils are in landscape positions similar to those of the major soils.

This association is used mainly as woodland. The major management concerns are the equipment limitation, seedling mortality, and the hazard of erosion in steep areas. Plant competition is an additional concern in areas of the Klacking soils.

The major soils in this association are well suited to building site development in nearly level and undulating areas. The slope is a limitation in rolling to steep areas. A poor filtering capacity is a limitation if the Graycalm soils are used as sites for septic tank absorption fields.

The slope is an additional limitation in rolling to steep areas. The Klacking soils are well suited to septic tank absorption fields in nearly level and undulating areas.

8. Grayling Association

Nearly level to steep, excessively drained, sandy soils on outwash plains, kames, and moraines

This association is on broad upland flats, knolls, hills, ridges, and side slopes of ridges. Slope ranges from 0 to 45 percent.

This association makes up about 22 percent of the county. It is about 85 percent Grayling soils and 15 percent soils of minor extent.

The Grayling soils are nearly level to steep and are excessively drained. Typically, the surface layer is black sand about 3 inches thick. The subsoil is about 20 inches thick. It is strong brown, dark yellowish brown, and brownish yellow sand. The substratum to a depth of about 80 inches is light yellowish brown sand.

Of minor extent in this association are Typic Udipsamments, the moderately well drained Croswell soils, the somewhat excessively drained Graycalm soils, and the very poorly drained Leafriver and Tawas soils. Typic Udipsamments and Graycalm soils are in landscape positions similar to those of the Grayling soils. Croswell soils are on low flats or low knolls. Leafriver and Tawas soils are in depressions or drainage ways.

This association is used mainly as woodland (fig. 6). The major management concerns are the equipment limitation and seedling mortality.

The major soils in this association are well suited to building site development in nearly level and undulating areas. The slope is the main concern in rolling to steep areas. A poor filtering capacity is a limitation if these soils are used as sites for septic tank absorption fields. The slope is an additional concern in the steeper areas.

9. Kellogg-Tawas-Wakeley Association

Nearly level and undulating, moderately well drained and very poorly drained, sandy and mucky soils on outwash plains and lake plains

This association is on low knolls, on low flats, and in depressions. Slope ranges from 0 to 6 percent.

This association makes up about 2 percent of the county. It is about 29 percent Kellogg soils, 22 percent Tawas soils, 15 percent Wakeley soils, and 34 percent soils of minor extent.

Kellogg soils are nearly level and undulating and are moderately well drained. Typically, the surface layer is pinkish gray sand about 4 inches thick. The subsoil is about 34 inches thick. It is dark brown and strong brown sand in the upper part and dark brown, mottled silty clay in the lower part. The substratum to a depth of about 80 inches is brown, mottled silty clay.

Tawas soils are nearly level and are very poorly drained. Typically, the surface layer is very dark brown muck about 10 inches thick. The next layer is dark reddish brown and black muck about 14 inches thick. The substratum to a depth of about 60 inches is dark gray and brown sand.

Wakeley soils are nearly level and are very poorly drained. Typically, the surface layer is black muck about 4 inches thick. The substratum extends to a depth of about 80 inches. It is brown and grayish brown, mottled loamy sand in the upper part and brown and dark brown, mottled clay in the lower part.

Of minor extent in this association are the very poorly drained Leafriver soils, the somewhat poorly drained Allendale and Au Gres soils, the excessively drained Grayling soils, and the somewhat excessively drained Graycalm soils. Allendale and Au Gres soils are on flats in slightly higher landscape positions than the Tawas and Wakeley soils. Grayling and Graycalm soils are on the higher flats or on knolls.

This association is used mainly as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition.

The Kellogg soils are well suited to use as sites for buildings without basements. The main concerns are seasonal wetness and the shrink-swell potential. The Kellogg soils are poorly suited to septic tank absorption fields, mainly because of the seasonal wetness and restricted permeability. The Tawas and Wakeley soils are generally unsuited to building site development and septic tank absorption fields, mainly because of ponding.

Detailed Soil Map Units

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

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. 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 other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties 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, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have

been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit 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, 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, slope, stoniness, salinity, 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, 0 to 6 percent slopes, is a phase of the Graycalm series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Graycalm-Klacking complex, 0 to 6 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas 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 or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Histosols and Aquents, ponded, is an undifferentiated group in this survey area.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, borrow, is an example.

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

Soil Descriptions

13—Tawas-Lupton mucks

Setting

Landform: Low flats, depressions, and drainageways on outwash plains and lake plains

Slope: 0 to 2 percent

Shape of areas: Irregular or oval

Size of areas: 3 to 1,180 acres

Typical Profile

Tawas

Surface layer:

0 to 10 inches—very dark brown muck

Subsoil:

10 to 24 inches—dark reddish brown and black muck

Substratum:

24 to 60 inches—dark gray and brown sand

Lupton

Surface layer:

0 to 9 inches—black muck

Substratum:

9 to 60 inches—black muck

Soil Properties and Qualities

Permeability: Tawas—moderately slow to moderately rapid in the organic material and rapid in the underlying sand; Lupton—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 at some time 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

Composition

Tawas soil and similar soils: 35 to 70 percent

Lupton soil and similar soils: 25 to 50 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils in the slightly higher landscape positions
- The poorly drained Kinross soils in landscape positions similar to those of the major soils
- Small areas of open water

Similar inclusions:

- Soils that have thin layers of loamy material in the substratum
- Soils that have muck layers less than 16 inches thick
- Soils that are very strongly acid in part of the profile

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- 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.
- Log landings should be established in areas of drier, more suitable soils.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on these soils.
- After cutting, competition from brush can delay or prevent natural regeneration of desired species.
- Selective cutting or cutting in strips and leaving desirable seed trees along the edge of the openings are beneficial for natural regeneration.

Buildings

Major management concerns: Ponding

Suitability:

- Because of ponding and low strength, these soils are

generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding

Suitability:

- Because of ponding and low strength, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIw

Woodland ordination symbol: Tawas—5W; Lupton—2W

Michigan soil management group: Tawas—M/4c;

Lupton—Mc

14—Dawson-Loxley peats

Setting

Landform: Low flats and closed depressions on outwash plains and lake plains

Slope: 0 to 2 percent

Shape of areas: Irregular or oval

Size of areas: 3 to 80 acres

Typical Profile

Dawson

Surface layer:

0 to 4 inches—dark yellowish brown peat

Subsoil:

4 to 43 inches—very dark brown and black muck

Substratum:

43 to 60 inches—very dark grayish brown and dark brown sand

Loxley

Surface layer:

0 to 6 inches—yellowish brown peat

Substratum:

6 to 60 inches—black, dark reddish brown, and very dark brown muck

Soil Properties and Qualities

Permeability: Dawson—moderately slow to moderately rapid in the organic material and rapid in the underlying sand; Loxley—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 at some time 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

Dawson soil and similar soils: 35 to 70 percent

Loxley soil and similar soils: 25 to 60 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils in the slightly higher landscape positions
- The poorly drained Kinross soils in landscape positions similar to those of the major soils
- Small areas of open water

Similar inclusions:

- Soils that have thin layers of loamy material in the substratum
- Soils that have organic layers less than 16 inches thick
- Soils that are less acid in part of the profile

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Suitability:

- These soils are generally unsuited to woodland because of extreme acidity, the low strength of the organic material, and the wetness. Overcoming these limitations is not practical.
- Tree cover is sparse. Some spruce and tamarack are around the edges of the unit. Shrubs are the most common vegetation.

Buildings

Major management concerns: Ponding

Suitability:

- Because of ponding and low strength, these soils are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding

Suitability:

- Because of ponding and low strength, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIw

Woodland ordination symbol: 2W

Michigan soil management group: Dawson—M/4c-a;

Loxley—Mc-a

15A—Croswell-Au Gres sands, 0 to 3 percent slopes

Setting

Landform: Flats, shallow depressions, or low knolls adjacent to drainageways and swamps on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 3 to 60 acres

Typical Profile

Croswell

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 5 inches—brown sand

Subsoil:

5 to 16 inches—dark brown and strong brown sand

16 to 30 inches—yellowish brown and brownish yellow, mottled sand

Substratum:

30 to 80 inches—pale brown, mottled sand

Au Gres

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 4 inches—black sand

Subsurface layer:

4 to 8 inches—light brownish gray sand

Subsoil:

8 to 9 inches—dark reddish brown, mottled sand

9 to 24 inches—dark yellowish brown and yellowish brown, mottled sand

Substratum:

24 to 60 inches—light yellowish brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Croswell—moderately well drained; Au Gres—somewhat poorly drained

Seasonal high water table: Croswell—at a depth of 2.0 to 3.5 feet at some time from October through May; Au Gres—at a depth of 0.5 foot to 1.5 feet at some time 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 soil and similar soils: 60 to 70 percent

Au Gres soil and similar soils: 20 to 40 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The poorly drained Kinross and very poorly drained Leafriver soils in depressions
- The excessively drained Grayling and Rubicon soils on low knolls or on the higher flats

Similar inclusions:

- Soils that have a seasonal high water table between depths of 4 and 5 feet
- Soils that have a lighter colored subsoil
- Soils in which the subsoil is partially cemented

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Using heavy equipment only when the Au Gres soil is relatively dry, is frozen, or has adequate snow cover helps to prevent the formation of deep ruts.
- Year-round logging roads require roadfill and gravel.
- Year-round logging roads should be stabilized on the Croswell soil because loose sand can interfere with the traction of wheeled equipment, especially during dry periods.
- Log landings are generally available in areas of these soils during the preferred operating season.
- Trees that can withstand seasonal wetness should be selected for planting on the Au Gres soil.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate on the Croswell soil. Replanting may be needed in some areas.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- If trees are planted, site preparation by mechanical or chemical means 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 measures:

- Because cutbanks are unstable and are subject to

caving, trench walls should be reinforced.

- Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.

Septic tank absorption fields

Major management concerns: Seasonal wetness, rapid permeability

Management measures:

- Filling or mounding with suitable fill material helps to raise the absorption field above the water table.
- The poor filtering capacity of these soils can result in the pollution of ground water.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: Croswell—5S; Au Gres—6W

Michigan soil management group: Croswell—5a; Au Gres—5b

16B—Graycalm sand, 0 to 6 percent slopes

Setting

Landform: Flats or low knolls on outwash plains, kames, and moraines

Shape of areas: Irregular

Size of areas: 3 to more than 1,000 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Graycalm soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling and well drained Klacking soils in landscape positions similar to those of the Graycalm soil

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil
- Soils that have calcareous sand and gravel in the substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- 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: IVs

Woodland ordination symbol: 6S

Michigan soil management group: 5a

17A—Croswell sand, 0 to 3 percent slopes

Setting

Landform: Flats or low knolls adjacent to drainageways and swamps on outwash plains and stream terraces

Shape of areas: Irregular or linear

Size of areas: 3 to more than 400 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 5 inches—brown sand

Subsoil:

5 to 16 inches—dark brown and strong brown sand

16 to 30 inches—yellowish brown and brownish yellow, mottled sand

Substratum:

30 to 80 inches—pale brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: At a depth of 2.0 to 3.5 feet at some time 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 soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling and Rubicon soils in landscape positions similar to or slightly higher than those of the Croswell soil
- The somewhat poorly drained Au Gres soils in the slightly lower landscape positions

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils that have a seasonal high water table between depths of 4 and 5 feet

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting

special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave, seasonal wetness

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
- Constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.

Septic tank absorption fields

Major management concerns: Seasonal wetness, rapid permeability

Management measures:

- Filling or mounding with suitable fill material helps to raise the absorption field above the water table.
- The poor filtering capacity of this soil can result in 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: Flats or shallow depressions adjacent to drainageways and swamps on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 3 to 100 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 4 inches—black sand

Subsurface layer:

4 to 8 inches—light brownish gray sand

Subsoil:

8 to 9 inches—dark reddish brown, mottled sand

9 to 24 inches—dark yellowish brown and yellowish brown, mottled sand

Substratum:

24 to 60 inches—light yellowish brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat poorly drained

Seasonal high water table: At a depth of 0.5 foot to 1.5 feet at some time 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

Au Gres soil and similar soils: 90 to 100 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils in the slightly higher landscape positions
- The poorly drained Kinross soils in depressions

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils in which the subsoil is partially cemented

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Year-round logging roads require roadfill and gravel.
- Log landing sites are generally available on this soil during the preferred operating season.
- 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.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave, seasonal wetness

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
- Constructing buildings on well compacted fill material raises the site to a level above the water table.

Septic tank absorption fields

Major management concerns: Seasonal wetness, rapid permeability

Management measures:

- Filling or mounding with suitable fill material helps to raise the absorption field above the water table.
- The poor filtering capacity of this soil can result in 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: Low flats and shallow depressions on outwash plains and lake plains

Slope: 0 to 1 percent

Shape of areas: Irregular or oval

Size of areas: 3 to 330 acres

Typical Profile

Surface layer:

0 to 9 inches—black muck

Subsurface layer:

9 to 12 inches—very dark grayish brown fine sandy loam

Substratum:

12 to 28 inches—grayish brown, mottled sand

28 to 60 inches—olive gray and gray 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 at some time 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

Composition

Leafriver soil and similar soils: 90 to 100 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils in the slightly higher landscape positions
- The poorly drained Kinross soils in landscape

positions similar to those of the Leafriver soil

Similar inclusions:

- Soils that have a surface layer of muck less than 8 inches thick
- Soils that have thin bands of gravelly sand in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Log landings should be established in areas of drier, more suitable soils.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees are generally not planted on this soil because of wetness, severe seedling mortality, and plant competition.

Buildings

Major management concerns: Ponding

Suitability:

- Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding

Suitability:

- 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

20B—Graycalm-Grayling sands, 0 to 6 percent slopes

Setting

Landform: Flats and low knolls on outwash plains, kames, and moraines

Shape of areas: Irregular

Size of areas: 3 to more than 3,200 acres

Typical Profile

Graycalm

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Grayling

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Graycalm—somewhat excessively drained; Grayling—excessively drained

Seasonal high water table: Below a depth of 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Graycalm soil and similar soils: 45 to 70 percent

Grayling soil and similar soils: 30 to 50 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Klacking and Montcalm soils and the moderately well drained Perecheney soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have bands of fine sand or gravelly sand in the subsoil or substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- The poor filtering capacity of these soils 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: Graycalm—6S; Grayling—4S

Michigan soil management group: Graycalm—5a; Grayling—5.7a

20D—Graycalm-Grayling sands, 6 to 18 percent slopes**Setting**

Landform: Knolls and low ridges on outwash plains, kames, and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 310 acres

Typical Profile**Graycalm**

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Grayling

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Graycalm—somewhat excessively drained; Grayling—excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight or moderate

Hazard of soil blowing: Severe

Composition

Graycalm soil and similar soils: 40 to 60 percent

Grayling soil and similar soils: 35 to 55 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Klackung soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have bands of fine sand or gravelly sand in the subsoil or substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Log landings should be established in more suitable, nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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: Rapid permeability, slope

Management measures:

- The poor filtering capacity of these soils 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: Graycalm—6S; Grayling—4S

Michigan soil management group: Graycalm—5a; Grayling—5.7a

20F—Graycalm-Grayling sands, 18 to 45 percent slopes**Setting**

Landform: Hills and ridges on outwash plains, kames, and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 250 acres

Typical Profile**Graycalm**

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Grayling

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Graycalm—somewhat excessively drained; Grayling—excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow or medium

Flooding: None

Organic matter content: Low

Hazard of water erosion: Moderate or severe

Hazard of soil blowing: Severe

Composition

Graycalm soil and similar soils: 40 to 60 percent

Grayling soil and similar soils: 30 to 60 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The well drained Klacking soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil or substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Erosion results from the concentration of runoff on logging roads and in the tracks of wheeled equipment. Logging roads and skid trails should be established on the contour and water removed by water bars or by out-sloping or in-sloping road surfaces.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.
- Because the slope and loose sand can interfere with the traction of wheeled equipment, year-round logging roads should be stabilized and should be constructed on the contour or on the gentler slopes.
- Log landings should be established in more suitable, nearly level areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, these soils are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- Because of the slope, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: Graycalm—6R; Grayling—4R

Michigan soil management group: Graycalm—5a; Grayling—5.7a

21B—Graycalm-Klacking complex, 0 to 6 percent slopes**Setting**

Landform: Flats and low knolls on outwash plains, kames, and moraines

Shape of areas: Irregular

Size of areas: 3 to more than 800 acres

Typical Profile**Graycalm**

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Klacking

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 3 inches—very dark grayish brown loamy sand

Subsoil:

3 to 21 inches—dark yellowish brown and yellowish brown sand

21 to 39 inches—light yellowish brown sand that has bands of brown loamy sand

39 to 46 inches—brown sandy loam and light yellowish brown sand

46 to 80 inches—light yellowish brown sand that has bands of dark brown loamy sand and sandy loam

Soil Properties and Qualities

Permeability: Graycalm—rapid; Klacking—moderately rapid

Available water capacity: Low

Drainage class: Graycalm—somewhat excessively drained; Klacking—well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Graycalm—severe; Klacking—moderate

Composition

Graycalm soil and similar soils: 45 to 70 percent

Klacking soil and similar soils: 25 to 50 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling soils and the moderately well drained Feldhauser, Perecheney, and Kellogg soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils in which part of the subsoil contains 15 to 30 percent gravel
- Soils in which the subsoil has loamy fine sand
- Soils that have bands of sandy clay loam in the subsoil

Use and Management

Land use: Dominant use—woodland (fig. 7); other uses—building sites

Woodland

Major management concerns: Equipment limitation, seedling mortality, plant competition

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads on the Graycalm soil should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- After trees are harvested on the Klacking soil, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.



Figure 7.—A mature red pine plantation in an area of Graycalm-Klacking complex, 0 to 6 percent slopes.

Septic tank absorption fields

Major management concerns: Graycalm—rapid permeability

Management measures:

- The poor filtering capacity of the Graycalm 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: IVs

Woodland ordination symbol: 6S

Michigan soil management group: Graycalm—5a;

Klacking—4a

21D—Graycalm-Klacking complex, 6 to 18 percent slopes

Setting

Landform: Knolls and low ridges on outwash plains, kames, and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 70 acres

Typical Profile

Graycalm

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Klacking

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 3 inches—very dark grayish brown loamy sand

Subsoil:

3 to 21 inches—dark yellowish brown and yellowish brown sand

21 to 39 inches—light yellowish brown sand that has bands of brown loamy sand

39 to 46 inches—brown sandy loam and light yellowish brown sand

46 to 80 inches—light yellowish brown sand that has bands of dark brown loamy sand and sandy loam

Soil Properties and Qualities

Permeability: Graycalm—rapid; Klacking—moderately rapid

Available water capacity: Low

Drainage class: Graycalm—somewhat excessively drained; Klacking—well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight or moderate

Hazard of soil blowing: Graycalm—severe; Klacking—moderate

Composition

Graycalm soil and similar soils: 40 to 75 percent

Klacking soil and similar soils: 25 to 50 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils in which part of the subsoil contains 15 to 30 percent gravel
- Soils that have sandy clay loam bands in the subsoil

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, plant competition

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads on the Graycalm soil should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- Log landings should be established in more suitable, nearly level areas.
- After trees are harvested on the Klacking soil, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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: Graycalm—rapid permeability, slope; Klacking—slope

Management measures:

- The poor filtering capacity of the Graycalm 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.
- 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: 6S

Michigan soil management group: Grayling—5a; Klacking—4a

21F—Graycalm-Klacking complex, 18 to 45 percent slopes

Setting

Landform: Hills and ridges on kames and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 70 acres

Typical Profile

Graycalm

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Klacking

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 3 inches—very dark grayish brown loamy sand

Subsoil:

3 to 21 inches—dark yellowish brown and yellowish brown sand

21 to 39 inches—light yellowish brown sand that has bands of brown loamy sand

39 to 46 inches—brown sandy loam and light yellowish brown sand

46 to 80 inches—light yellowish brown sand that has bands of dark brown loamy sand and sandy loam

Soil Properties and Qualities

Permeability: Graycalm—rapid; Klacking—moderately rapid

Available water capacity: Low

Drainage class: Graycalm—somewhat excessively drained; Klacking—well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow or medium

Flooding: None

Organic matter content: Low

Hazard of water erosion: Moderate

Hazard of soil blowing: Graycalm—severe; Klacking—moderate

Composition

Graycalm soil and similar soils: 45 to 80 percent

Klacking soil and similar soils: 15 to 45 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils in which part of the subsoil contains 15 to 30 percent gravel
- Soils that have sandy clay loam bands in the subsoil

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality, plant competition

Management measures:

- Erosion results from the concentration of runoff on logging roads and in the tracks of wheeled equipment. Logging roads and skid trails should be established on the contour and water removed by water bars or by out-sloping or in-sloping road surfaces.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.
- The slope and loose sand on the Graycalm soil can interfere with the traction of wheeled equipment. Year-round logging roads should be stabilized and should be built on the contour or on the gentler slopes.
- Log landings should be established in more suitable, nearly level areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- After trees are harvested on the Klacking soil, plant

competition may delay the establishment of desired species.

- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, these soils are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- Because of the slope, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 6R

Michigan soil management group: Graycalm—5a; Klacking—4a

22B—Montcalm loamy sand, 0 to 6 percent slopes

Setting

Landform: Flats and shallow depressions on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 3 to 160 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 4 inches—brown loamy sand

Subsoil:

4 to 19 inches—dark brown and light yellowish brown loamy sand

19 to 35 inches—strong brown sandy loam

35 to 63 inches—yellowish brown sand that has bands of strong brown loamy sand

Substratum:

63 to 70 inches—light brown sand

Soil Properties and Qualities

Permeability: Moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low
Hazard of water erosion: Slight
Hazard of soil blowing: Moderate

Composition

Montcalm soil and similar soils: 85 to 100 percent
 Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Graycalm soils and the moderately well drained Feldhauser and Perechney soils in landscape positions similar to those of the Montcalm soil

Similar inclusions:

- Soils that have a surface layer of loamy fine sand
- Soils in which part of the subsoil contains 15 to 20 percent gravel
- Soils that have a darker subsoil

Use and Management

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

Woodland

Major management concerns: Plant competition

Management measures:

- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.

Cropland

Major management concerns: Droughtiness, soil blowing, organic matter content

Management measures:

- Drought-tolerant crops should be selected for planting, or the crops should be irrigated.
- Crop residue management, green manure crops, application of manure, and conservation tillage increase the available water capacity and the content of organic matter.
- Windbreaks, cover crops, conservation tillage, and vegetative barriers help to control soil blowing.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- 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: 3A
Michigan soil management group: 4a

23—Ausable-Bowstring mucks, frequently flooded

Setting

Landform: Low flats and depressions along perennial rivers and creeks on flood plains

Slope: 0 to 2 percent

Shape of areas: Irregular or linear

Size of areas: 3 to 150 acres

Typical Profile

Ausable

Surface layer:

0 to 10 inches—black muck

Substratum:

10 to 20 inches—brown, mottled sand that has thin layers of very dark brown muck

20 to 37 inches—gray gravelly sand that has thin layers of very dark grayish brown muck

37 to 60 inches—dark grayish brown sand

Bowstring

Surface layer:

0 to 19 inches—black muck that has thin bands of gray sand

Next layer:

19 to 34 inches—dark reddish brown muck

34 to 38 inches—gray sand that has thin bands of very dark brown muck

38 to 60 inches—very dark brown muck that has thin bands of gray sand

Soil Properties and Qualities

Permeability: Ausable—moderate or moderately rapid in the organic material and rapid in the underlying sand; Bowstring—moderately slow to moderately rapid

Available water capacity: Ausable—moderate; Bowstring—high

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time from October through May

Surface runoff: Very slow or ponded

Flooding: Frequent from November through May

Organic matter content: High

Hazard of water erosion: Slight

Hazard of soil blowing: Moderate

Composition

Ausable soil and similar soils: 40 to 90 percent

Bowstring soil and similar soils: 10 to 50 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and moderately well drained Croswell soils in the higher landscape positions

Similar inclusions:

- Soils that have 16 to 50 inches of muck overlying sand
- Soils that average more than 35 percent gravel in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- These soils are usually wet most of the year and are subject to flooding. Access is easiest during periods in winter when the soils or access roads are frozen.
- The Bowstring soil is generally not suited to the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment is needed.
- Log landings should be established in areas of drier, more suitable soils.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Because of wetness, severe seedling mortality, and plant competition, trees are generally not planted on these soils.

Buildings

Major management concerns: Seasonal flooding, wetness

Suitability:

- Because of flooding and wetness, these soils are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Seasonal flooding, wetness

Suitability:

- Because of flooding and wetness, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIw

Woodland ordination symbol: Ausable—2W; Bowstring—3W

Michigan soil management group: Ausable—L-4c; Bowstring—L-Mc

24A—Kinross-Au Gres complex, 0 to 3 percent slopes

Setting

Landform: Low flats and shallow depressions on outwash plains and lake plains

Shape of areas: Irregular

Size of areas: 3 to 210 acres

Typical Profile

Kinross

Surface layer:

0 to 3 inches—black muck

Subsurface layer:

3 to 10 inches—grayish brown, mottled sand

Subsoil:

10 to 14 inches—dark reddish brown, partially cemented sand

14 to 22 inches—yellowish brown, mottled sand

Substratum:

22 to 60 inches—yellowish brown, mottled sand

Au Gres

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 4 inches—black sand

Subsurface layer:

4 to 8 inches—light brownish gray sand

Subsoil:

8 to 9 inches—dark reddish brown, mottled sand

9 to 24 inches—dark yellowish brown and yellowish brown, mottled sand

Substratum:

24 to 60 inches—light yellowish brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Kinross—poorly drained; Au Gres—somewhat poorly drained

Seasonal high water table: Kinross—1 foot above to 1 foot below the surface at some time from October through May; Au Gres—at a depth of 0.5 foot to 1.5 feet at some time from October through May

Surface runoff: Kinross—very slow or ponded; Au Gres—very slow

Flooding: None

Organic matter content: Kinross—high; Au Gres—low

Hazard of water erosion: Slight

Hazard of soil blowing: Kinross—moderate; Au Gres—severe

Composition

Kinross soil and similar soils: 50 to 70 percent
 Au Gres soil and similar soils: 30 to 50 percent
 Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils in the higher landscape positions
- The very poorly drained Leafriver and Tawas soils in landscape positions similar to those of the Kinross soil

Similar inclusions:

- Soils that have a lighter colored subsoil

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Year-round logging roads require roadfill and gravel. Culverts are needed on the Kinross soil to maintain the natural drainage system.
- Log landing sites are generally available on the Au Gres soil during the preferred operating season.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees are generally not planted on the Kinross soil because of wetness, severe seedling mortality, and plant competition.
- Trees that can withstand seasonal wetness should be selected for planting on the Au Gres soil.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Kinross—ponding; Au Gres—seasonal wetness

Management measures:

- Because of ponding, the Kinross soil is generally unsuited to building site development.
- In areas of the Au Gres soil, constructing buildings on well compacted fill material raises the site a sufficient distance above the water table.

Septic tank absorption fields

Major management concerns: Kinross—ponding; Au Gres—seasonal wetness, rapid permeability

Management measures:

- Because of ponding, the Kinross soil is generally unsuited to septic tank absorption fields.
- In areas of the Au Gres soil, filling or mounding with suitable fill material helps to raise the absorption field above the water table.
- The poor filtering capacity of the Au Gres soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: Vlw

Woodland ordination symbol: Kinross—2W; Au Gres—6W

Michigan soil management group: Kinross—5c-a; Au Gres—5b

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

Setting

Landform: Flats and low knolls on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 3 to more than 900 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 3 inches—very dark grayish brown loamy sand

Subsoil:

3 to 21 inches—dark yellowish brown and yellowish brown sand

21 to 39 inches—light yellowish brown sand that has bands of brown loamy sand

39 to 46 inches—brown sandy loam and light yellowish brown sand

46 to 80 inches—light yellowish brown sand that has bands of dark brown loamy sand and sandy loam

Soil Properties and Qualities

Permeability: Moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Moderate

Composition

Klacking soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Graycalm and moderately well drained Kellogg soils in landscape positions similar to those of the Klacking soil

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil
- Soils that have more clay in the subsoil

Use and Management

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

Woodland

Major management concerns: Plant competition

Management measures:

- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- 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

32B—Kellogg sand, 0 to 6 percent slopes

Setting

Landform: Flats and low knolls on outwash plains and lake plains

Shape of areas: Irregular

Size of areas: 3 to more than 100 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 6 inches—pinkish gray sand

Subsoil:

6 to 26 inches—dark brown and strong brown sand

26 to 29 inches—dark brown, mottled silty clay that has coatings of pinkish gray loamy sand

29 to 40 inches—dark brown, mottled silty clay

Substratum:

40 to 80 inches—brown, mottled silty clay

Soil Properties and Qualities

Permeability: Rapid in the sandy material and very slow in the clayey material

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 2.0 to 3.5 feet at some time 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

Kellogg soil and similar soils: 85 to 100 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Allendale soils in landscape positions similar to or slightly lower than those of the Kellogg soil
- The well drained Klacking and somewhat excessively drained Graycalm soils in landscape positions similar to those of the Kellogg soil

Similar inclusions:

- Soils that have mottles below a depth of 48 inches
- Soils that have a lighter colored subsoil
- Soils in which the subsoil and substratum have less clay

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, plant competition

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave, seasonal wetness, the shrink-swell potential

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
- Wetness can be overcome 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, very slow permeability

Management measures:

- Filling or mounding with suitable fill material helps to raise the absorption field above the water table and increases the thickness of the filtering material.
- Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

Interpretive Groups

Land capability classification: IIIs

Woodland ordination symbol: 3S

Michigan soil management group: 4/1a

34B—Kneff very fine sandy loam, 0 to 6 percent slopes**Setting**

Landform: Flats and low knolls on lake plains

Shape of areas: Irregular

Size of areas: 3 to 50 acres

Typical Profile

Surface layer:

0 to 8 inches—dark grayish brown very fine sandy loam

Subsoil:

8 to 14 inches—dark brown silty clay loam that has coatings of brown very fine sandy loam

14 to 23 inches—dark brown silty clay loam

23 to 29 inches—dark brown, mottled silty clay loam

Substratum:

29 to 61 inches—stratified dark brown, mottled silty clay loam, silt loam, and silty clay and dark yellowish brown very fine sandy loam

61 to 80 inches—stratified, mottled pale brown sand, brown silty clay loam, and pale brown silt loam

Soil Properties and Qualities

Permeability: Moderately slow

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: Perched at a depth of 2.0 to

3.5 feet at some time from October through May

Surface runoff: Slow

Flooding: None

Organic matter content: Moderate

Hazard of water erosion: Slight or moderate

Hazard of soil blowing: Moderate

Composition

Kneff soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The well drained Klacking and somewhat excessively drained Graycalm soils in landscape positions similar to those of the Kneff soil
- The moderately well drained Kellogg soils in landscape positions similar to those of the Kneff soil
- The somewhat poorly drained Bowers soils in the lower landscape positions

Similar inclusions:

- Soils that have more clay in the subsoil
- Soils that are sand in the lower part of the substratum

Use and Management

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

Cropland

Major management concerns: Erosion, soil blowing, tilth, compaction

Management measures:

- A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses, legumes, and small grain help to control runoff, erosion, and soil blowing.
- Minimizing tillage and tilling at the proper moisture content help to prevent cloddiness and compaction.

Woodland

Major management concerns: Equipment limitation, plant competition

Management measures:

- Skidders should not be used during wet periods when ruts form easily. Year-round roads and landings require a gravel base.
- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by using such harvest methods as selective cutting or by mechanical or chemical means.

Buildings

Major management concerns: Seasonal wetness

Management measures:

- Wetness can be overcome by installing a drainage

system around structures that have basements and crawl spaces.

Septic tank absorption fields

Major management concerns: Seasonal wetness, moderately slow permeability

Management measures:

- Filling or mounding with 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.

Interpretive Groups

Land capability classification: 1Ie

Woodland ordination symbol: 3L

Michigan soil management group: 1.5a

35—Kinross muck

Setting

Landform: Low flats and shallow depressions on outwash plains and lake plains

Slope: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 3 to 310 acres

Typical Profile

Surface layer:

0 to 3 inches—black muck

Subsurface layer:

3 to 10 inches—grayish brown, mottled sand

Subsoil:

10 to 14 inches—dark reddish brown, partially cemented sand

14 to 22 inches—yellowish brown, mottled sand

Substratum:

22 to 60 inches—yellowish brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time 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

Composition

Kinross soil and similar soils: 85 to 100 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils in the slightly higher landscape positions
- The moderately well drained Crowell soils on low knolls or on the higher flats
- The very poorly drained Leafriver and Tawas soils in landscape positions similar to those of the Kinross soil

Similar inclusions:

- Soils that have a lighter colored subsoil

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Year-round logging roads require roadfill and gravel. Culverts are needed to maintain the natural drainage system.
- Log landings should be established in areas of drier, more suitable soils.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees are generally not planted on this soil because of wetness, severe seedling mortality, and plant competition.

Buildings

Major management concerns: Ponding

Suitability:

- Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding

Suitability:

- 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

47D—Graycalm sand, 6 to 18 percent slopes

Setting

Landform: Knolls and low ridges on outwash plains, kames, and moraines

Shape of areas: Irregular
Size of areas: 3 to 100 acres

Typical Profile

Organic mat:
 0 to 2 inches—partially decomposed leaf litter
Surface layer:
 2 to 5 inches—dark brown sand
Subsoil:
 5 to 27 inches—dark yellowish brown and yellowish brown sand
 27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Soil Properties and Qualities

Permeability: Rapid
Available water capacity: Low
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow
Flooding: None
Organic matter content: Low
Hazard of water erosion: Slight
Hazard of soil blowing: Severe

Composition

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

Inclusions

Contrasting inclusions:

- The excessively drained Grayling and well drained Klacking soils in landscape positions similar to those of the Graycalm soil

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil
- Soils that have calcareous sand and gravel in the substratum

Use and Management

Land use: Dominant use—woodland (fig. 8); other uses—building sites

Woodland

Major management concerns: Equipment limitation, seedling mortality
Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, slope
Management measures:

- 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: Rapid permeability, slope
Management measures:

- 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.
- Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

Interpretive Groups

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

47F—Graycalm sand, 18 to 45 percent slopes

Setting

Landform: Hills and ridges on kames and moraines
Shape of areas: Irregular
Size of areas: 3 to 60 acres

Typical Profile

Organic mat:
 0 to 2 inches—partially decomposed leaf litter
Surface layer:
 2 to 5 inches—dark brown sand
Subsoil:
 5 to 27 inches—dark yellowish brown and yellowish brown sand
 27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Soil Properties and Qualities

Permeability: Rapid
Available water capacity: Low
Drainage class: Somewhat excessively drained
Seasonal high water table: At a depth of more than 6 feet
Surface runoff: Slow or medium
Flooding: None



Figure 8.—Harvest of a mixed stand of red oak and red maple in an area of Graycalm sand, 6 to 18 percent slopes. These trees are used for lumber and as fuel for power plants.

Organic matter content: Low

Hazard of water erosion: Moderate or severe

Hazard of soil blowing: Severe

Composition

Graycalm soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling and well drained Klacking soils in landscape positions similar to those of the Graycalm soil

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil
- Soils that have calcareous sand and gravel in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Erosion results from the concentration of runoff on logging roads and in the tracks of wheeled equipment. Logging roads and skid trails should be established on the contour and water removed by water bars or by out-sloping or in-sloping road surfaces.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.
- Because the slope and loose sand can interfere with the traction of wheeled equipment, year-round logging

roads should be stabilized and should be built on the contour or on the gentler slopes.

- The best sites for log landings are in adjacent nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- 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

48B—Rubicon-Graycalm sands, 0 to 6 percent slopes

Setting

Landform: Flats or low knolls on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 3 to 280 acres

Typical Profile

Rubicon

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 6 inches—brown sand

Subsoil:

6 to 35 inches—dark brown, dark yellowish brown, and yellowish brown sand

Substratum:

35 to 80 inches—light yellowish brown sand

Graycalm

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Rubicon—excessively drained;
Graycalm—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Rubicon soil and similar soils: 45 to 70 percent

Graycalm soil and similar soils: 25 to 50 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling soils, the somewhat excessively drained Kalkaska soils, and the well drained Blue Lake and Montcalm soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil or substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- The poor filtering capacity of these soils 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: Rubicon—4S; Graycalm—6S

Michigan soil management group: Rubicon—5.3a; Graycalm—5a

48D—Rubicon-Graycalm sands, 6 to 18 percent slopes**Setting**

Landform: Knolls and low ridges on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 3 to 220 acres

Typical Profile**Rubicon**

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 6 inches—brown sand

Subsoil:

6 to 35 inches—dark brown, dark yellowish brown, and yellowish brown sand

Substratum:

35 to 80 inches—light yellowish brown sand

Graycalm

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Rubicon—excessively drained;

Graycalm—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Rubicon soil and similar soils: 45 to 70 percent

Graycalm soil and similar soils: 25 to 50 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling soils, the somewhat excessively drained Kalkaska soils, and the well drained Blue Lake and Klacking soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil or substratum

Use and Management

Land use: Dominant use—woodland (fig. 9); other uses—building sites

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Log landings should be established in more suitable, nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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: Rapid permeability, slope

Management measures:

- The poor filtering capacity of this soil can result in



Figure 9.—Clearcutting to regenerate aspen is a common practice in areas of Rubicon-Graycalm sands, 6 to 18 percent slopes.

the contamination 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 contamination 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: VIIIs

Woodland ordination symbol: Rubicon—4S; Graycalm—6S

Michigan soil management group: Rubicon—5.3a;
Graycalm—5a

49B—Kalkaska sand, 0 to 6 percent slopes

Setting

Landform: Flats and low knolls on outwash plains and moraines

Shape of areas: Irregular

Size of areas: 3 to 1,600 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 6 inches—very dark gray sand

Subsurface layer:

6 to 11 inches—grayish brown sand

Subsoil:

11 to 14 inches—dark brown sand
 14 to 44 inches—brown, dark yellowish brown, and yellowish brown sand

Substratum:

44 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Kalkaska soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The moderately well drained Croswell soils in the slightly lower landscape positions
- The well drained Blue Lake, moderately well drained Feldhauser, and excessively drained Rubicon soils in landscape positions similar to those of the Kalkaska soil

Similar inclusions:

- Soils that have thin bands of loamy sand in the subsoil or substratum
- Soils that have bands of gravelly sand in the substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- 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: IVs

Woodland ordination symbol: 3S

Michigan soil management group: 5a

50B—Au Gres-Kinross-Croswell complex, 0 to 6 percent slopes**Setting**

Landform: Flats, shallow depressions, and low knolls adjacent to drainageways and swamps on outwash plains and lake plains

Shape of areas: Irregular

Size of areas: 3 to 60 acres

Typical Profile**Au Gres***Organic mat:*

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 4 inches—black sand

Subsurface layer:

4 to 8 inches—light brownish gray sand

Subsoil:

8 to 9 inches—dark reddish brown, mottled sand

9 to 24 inches—dark yellowish brown and yellowish brown, mottled sand

Substratum:

24 to 60 inches—light yellowish brown, mottled sand

Kinross*Surface layer:*

0 to 3 inches—black muck

Subsurface layer:

3 to 10 inches—grayish brown, mottled sand

Subsoil:

10 to 14 inches—dark reddish brown, partially cemented sand

14 to 22 inches—yellowish brown, mottled sand

Substratum:

22 to 60 inches—yellowish brown, mottled sand

Croswell*Organic mat:*

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 5 inches—brown sand

Subsoil:

5 to 16 inches—dark brown and strong brown sand

16 to 30 inches—yellowish brown and brownish yellow, mottled sand

Substratum:

30 to 80 inches—pale brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Au Gres—somewhat poorly drained;
Kinross—poorly drained; Croswell—moderately well drained

Seasonal high water table: Au Gres—at a depth of 0.5 foot to 1.5 feet at some time from October through May; Kinross—1.0 foot above to 1.0 foot below the surface at some time from October through May; Croswell—at a depth of 2.0 to 3.5 feet at some time from October through May

Surface runoff: Au Gres and Croswell—very slow;
Kinross—very slow or ponded

Flooding: None

Organic matter content: Au Gres and Croswell—low;
Kinross—high

Hazard of water erosion: Slight

Hazard of soil blowing: Au Gres and Croswell—severe;
Kinross—moderate

Composition

Au Gres soil and similar soils: 30 to 50 percent

Kinross soil and similar soils: 25 to 35 percent

Croswell soil and similar soils: 15 to 30 percent

Contrasting inclusions: 0 to 10 percent

Inclusions*Contrasting inclusions:*

- The very poorly drained Leafriver and Tawas soils in landscape positions similar to those of the Kinross soil
- The excessively drained Grayling and Rubicon soils in the higher landscape positions

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils that have a seasonal high water table between depths of 4 and 5 feet

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- In areas of the Au Gres and Kinross soils, using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Year-round logging roads require roadfill and gravel. Culverts are needed in areas of the Kinross soil to maintain the natural drainage system.
- Loose sand, especially on the Croswell soil, can interfere with the traction of wheeled equipment, especially during dry periods. Year-round logging roads should be stabilized.
- Log landing sites are generally available on the Au Gres and Croswell soils during the preferred operating season.
- Trees that can withstand seasonal wetness should be selected for planting on the Au Gres soil. On the Croswell soil, planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Trees are generally not planted on the Kinross soil because of wetness, severe seedling mortality, and plant competition.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Au Gres and Croswell—cutbanks cave, seasonal wetness; Kinross—ponding

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced in areas of the Au Gres and Croswell soils.
- In areas of the Au Gres and Croswell soils, constructing the buildings on well compacted fill material raises the site a sufficient distance above the water table.
- Because of ponding, the Kinross soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Au Gres and Croswell—seasonal wetness, rapid permeability; Kinross—ponding

Management measures:

- In areas of the Au Gres and Croswell soils, filling or mounding with suitable fill material helps to raise the absorption field above the water table.
- The poor filtering capacity of these soils can result in the pollution of ground water.
- Because of ponding, the Kinross soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: IVw

Woodland ordination symbol: Au Gres—6W; Kinross—2W; Croswell—5S

Michigan soil management group: Au Gres—5b; Kinross—5c-a; Croswell—5a

51—Tawas-Leafriver mucks**Setting**

Landform: Low flats, depressions, and drainageways on outwash plains and lake plains

Slope: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 3 to more than 330 acres

Typical Profile**Tawas**

Surface layer:

0 to 10 inches—very dark brown muck

Subsoil:

10 to 24 inches—dark reddish brown and black muck

Substratum:

24 to 60 inches—dark gray and brown sand

Leafriver

Surface layer:

0 to 9 inches—black muck

Subsurface layer:

9 to 12 inches—very dark grayish brown fine sandy loam

Substratum:

12 to 28 inches—grayish brown, mottled sand

28 to 60 inches—olive gray and gray sand

Soil Properties and Qualities

Permeability: Moderately slow to moderately rapid in the organic material and rapid in the underlying sandy material

Available water capacity: Tawas—high; Leafriver—moderate

Drainage class: Very poorly drained

Seasonal high water table: 1 foot above to 1 foot below the surface at some time 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

Composition

Tawas soil and similar soils: 35 to 60 percent

Leafriver soil and similar soils: 25 to 50 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres and poorly drained Kinross soils in the slightly higher landscape positions

Similar inclusions:

- Small areas of soils that have less than 8 inches or more than 50 inches of organic material
- Soils that have thin layers of very gravelly sand in the substratum
- Soils that contain 10 to 35 percent gravel in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- These soils are usually wet most of the year and are generally not suitable for the use of ordinary crawler tractors or rubber-tired skidders. Special harvesting equipment is needed.
- Access is easiest during periods in winter when the soils or access roads are frozen.
- Year-round logging roads require roadfill and gravel.
- Culverts are needed to maintain the natural drainage system.
- Log landings should be established in areas of drier, more suitable soils.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees are generally not planted on these soils because of wetness, seedling mortality, and plant competition.

Buildings

Major management concerns: Ponding

Suitability:

- Because of ponding, these soils are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding

Suitability:

- Because of ponding, these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vlw

Woodland ordination symbol: Tawas—5W; Leafriver—2W

Michigan soil management group: Tawas—M/4c; Leafriver—5c

52B—Blue Lake loamy sand, 0 to 6 percent slopes**Setting**

Landform: Flats on moraines

Shape of areas: Irregular

Size of areas: 3 to more than 1,000 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—very dark grayish brown loamy sand

Subsurface layer:

2 to 6 inches—brown loamy sand

Subsoil:

6 to 21 inches—dark reddish brown and dark yellowish brown loamy sand

21 to 71 inches—light yellowish brown sand that has bands of brown and strong brown loamy sand and sandy loam

Substratum:

71 to 80 inches—brown sand

Soil Properties and Qualities

Permeability: Moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Moderate

Composition

Blue Lake soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Feldhauser, somewhat

excessively drained Kalkaska, and excessively drained Rubicon soils in landscape positions similar to those of the Blue Lake soil

Similar inclusions:

- Soils that have less than 6 inches of loamy sand or sandy loam bands in the lower part of the subsoil
- Soils that are lighter colored in the upper part of the subsoil

Use and Management

Land use: Dominant use—woodland (fig. 10); other uses—building sites

Woodland

Major management concerns: Plant competition

Management measures:

- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- 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: 3A

Michigan soil management group: 4a

52D—Blue Lake loamy sand, 6 to 18 percent slopes**Setting**

Landform: Knolls and low ridges on moraines

Shape of areas: Irregular

Size of areas: 3 to 90 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—very dark grayish brown loamy sand

Subsurface layer:

2 to 6 inches—brown loamy sand

Subsoil:

6 to 21 inches—dark reddish brown and dark yellowish brown loamy sand

21 to 71 inches—light yellowish brown sand that has



Figure 10.—A second-growth stand of sugar maple and beech in an area of Blue Lake loamy sand, 0 to 6 percent slopes. The lush ground cover indicates that this is one of the most productive woodland soils in the county.

bands of brown and strong brown loamy sand and sandy loam

Substratum:

71 to 80 inches—brown sand

Soil Properties and Qualities

Permeability: Moderately rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight or moderate

Hazard of soil blowing: Moderate

Composition

Blue Lake soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Graycalm and Kalkaska soils and the excessively drained Rubicon

soils in landscape positions similar to those of the Blue Lake soil

Similar inclusions:

- Soils that have less than 6 inches of loamy sand or sandy loam bands in the lower part of the subsoil
- Soils that are lighter colored in the upper part of the subsoil

Use and Management

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

Woodland

Major management concerns: Plant competition

Management measures:

- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by mechanical or chemical means.
- Log landings should be established in more suitable, nearly level areas.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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 measures:

- Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

Interpretive Groups

Land capability classification: IVe

Woodland ordination symbol: 3A

Michigan soil management group: 4a

58A—Wakeley-Allendale complex, 0 to 3 percent slopes

Setting

Landform: Low flats and depressions on outwash plains and lake plains

Shape of areas: Irregular

Size of areas: 5 to 100 acres

Typical Profile

Wakeley

Surface layer:

0 to 4 inches—black muck

Substratum:

4 to 28 inches—brown and grayish brown, mottled loamy sand

28 to 80 inches—brown and dark brown, mottled clay

Allendale

Organic mat:

0 to 3 inches—partially decomposed leaf litter

Surface layer:

3 to 7 inches—pinkish gray sand

Subsoil:

7 to 21 inches—dark brown and yellowish brown, mottled sand

21 to 24 inches—light brownish gray, mottled fine sand

24 to 63 inches—dark brown and brown, mottled clay

Substratum:

63 to 80 inches—brown, mottled clay

Soil Properties and Qualities

Permeability: Rapid in the sand and slow or very slow in the underlying clay

Available water capacity: Moderate

Drainage class: Wakeley—very poorly drained;

Allendale—somewhat poorly drained

Seasonal high water table: Wakeley—perched 1.0 foot

above to 1.0 foot below the surface at some time

from October through May; Allendale—perched at a depth of 0.5 foot to 1.5 feet at some time from

October through May

Surface runoff: Wakeley—very slow or ponded;

Allendale—very slow

Flooding: None

Organic matter content: Wakeley—high; Allendale—low

Hazard of water erosion: Slight

Hazard of soil blowing: Wakeley—moderate; Allendale—severe

Composition

Wakeley soil and similar soils: 60 to 80 percent

Allendale soil and similar soils: 20 to 40 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The very poorly drained Tawas soils in depressions
- The moderately well drained Croswell and Kellogg soils in the higher landscape positions

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils that have a layer of gravelly sand above the clay
- Soils that have less clay in the lower part of the subsoil or in the substratum
- Soils that have less than 18 inches of sand overlying clay

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- In areas of the Allendale soil, using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Access on the Wakeley soil is easiest during periods in winter when the soil or the access roads are frozen.
- Year-round logging roads require roadfill and gravel.
- Culverts are needed on the Wakeley soil to maintain the natural drainage system.
- Log landing sites are generally available on the Allendale soil during the preferred operating season.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees that can withstand seasonal wetness should be selected for planting on the Allendale soil.
- Trees are generally not planted on the Wakeley soil because of wetness, severe seedling mortality, and plant competition.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Wakeley—ponding; Allendale—seasonal wetness

Management measures:

- Because of ponding, the Wakeley soil is generally unsuited to building site development.
- In areas of the Allendale soil, constructing the buildings on well compacted fill material raises the site a sufficient distance above the water table.

Septic tank absorption fields

Major management concerns: Wakeley—ponding; Allendale—seasonal wetness, rapid permeability in the sandy material

Management measures:

- Because of ponding, the Wakeley soil is generally unsuited to septic tank absorption fields.
- In areas of the Allendale soil, filling or mounding with suitable fill material helps to raise the absorption field above the water table.
- The poor filtering capacity of the sandy material in the Allendale soil can result in the pollution of ground water.

Interpretive Groups

Land capability classification: Vw

Woodland ordination symbol: Wakeley—3W; Allendale—4W

Michigan soil management group: Wakeley—4/1c; Allendale—4/1b

64B—Feldhauser fine sandy loam, 0 to 6 percent slopes

Setting

Landform: Flats and slight depressions on moraines and outwash plains

Shape of areas: Irregular

Size of areas: 3 to 340 acres

Typical Profile

Surface layer:

0 to 10 inches—dark brown fine sandy loam

Subsoil:

10 to 21 inches—dark yellowish brown and yellowish brown fine sandy loam

21 to 30 inches—dark yellowish brown sandy loam

30 to 39 inches—dark yellowish brown, mottled sandy loam

39 to 54 inches—light yellowish brown sand that has bands of strong brown loamy sand

Substratum:

54 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Permeability: Moderate in the loamy material and rapid in the underlying sand

Available water capacity: Moderate

Drainage class: Moderately well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Moderate

Hazard of water erosion: Slight

Hazard of soil blowing: Moderate

Composition

Feldhauser soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The well drained Blue Lake and somewhat excessively drained Graycalm soils in landscape positions similar to those of the Feldhauser soil

Similar inclusions:

- Soils that have less than 20 inches of loamy material overlying sand
- Soils that have a redder subsoil

Use and Management

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

Cropland

Major management concerns: Erosion, soil blowing, tilth, compaction

Management measures:

- A system of conservation tillage that leaves crop residue on the surface and crop rotations that include grasses, legumes, and small grain help to control runoff, erosion, and soil blowing.
- Minimizing tillage and tilling at the proper soil moisture content help to prevent cloddiness and compaction.

Woodland

Major management concerns: Equipment limitation, plant competition

Management measures:

- Skidders should not be used during wet periods when ruts form easily. Year-round logging roads and landings require a gravel base.
- After trees are harvested, plant competition may delay the establishment of desired species.
- Competing vegetation can be controlled by using such harvest methods as selective cutting or by mechanical or chemical means.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Moderate permeability

Management measures:

- Increasing the size of the absorption area helps to compensate for the restricted permeability.

Interpretive Groups

Land capability classification: IIe

Woodland ordination symbol: 3L

Michigan soil management group: 3/5a

65F—Rubicon sand, 8 to 50 percent slopes, dissected

Setting

Landform: Hills and ridges on stream terraces and moraines

Distinctive landscape features: Dissected landscape

Shape of areas: Irregular

Size of areas: 3 to 200 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 6 inches—brown sand

Subsoil:

6 to 35 inches—dark brown, dark yellowish brown, and yellowish brown sand

Substratum:

35 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow or medium

Flooding: None

Organic matter content: Low

Hazard of water erosion: Moderate or severe

Hazard of soil blowing: Severe

Composition

Rubicon soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Graycalm and Kalkaska soils in landscape positions similar to those of the Rubicon soil

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils that have bands of gravelly sand in the substratum
- Soils that have thin bands of loamy sand in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Establishing logging roads and skid roads in the less sloping areas in the ravines or diagonally across the side slopes helps to control erosion.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.

- Because the slope and loose sand can interfere with the traction of wheeled equipment, year-round logging roads should be stabilized.
- The best sites for log landings are the less sloping areas in the ravines or adjacent nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, most areas of this soil are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- Because of the slope, most areas of this soil are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4R

Michigan soil management group: 5.3a

67A—Bowers-Deerheart complex, 0 to 3 percent slopes

Setting

Landform: Low flats and depressions on lake plains

Shape of areas: Irregular

Size of areas: 50 to 120 acres

Typical Profile

Bowers

Surface layer:

0 to 8 inches—very dark grayish brown loam

Subsoil:

8 to 11 inches—dark brown, mottled silty clay loam and grayish brown, mottled sandy loam

11 to 25 inches—dark brown, mottled silty clay loam

25 to 45 inches—brown, mottled silty clay loam

Substratum:

45 to 80 inches—light yellowish brown, mottled, stratified silty clay loam and silt loam

Deerheart

Surface layer:

0 to 6 inches—very dark grayish brown, mottled silt loam

Subsoil:

6 to 27 inches—gray, mottled silty clay loam

27 to 43 inches—light olive brown, mottled silty clay loam that has thin layers of silt loam and silt

Substratum:

43 to 80 inches—brown, mottled silty clay loam

stratified with light olive brown very fine sandy loam, silt, and silt loam

Soil Properties and Qualities

Permeability: Slow

Available water capacity: High

Drainage class: Bowers—somewhat poorly drained; Deerheart—poorly drained

Seasonal high water table: Bowers—at a depth of 1 to 2 feet at some time from October through May;

Deerheart—1 foot above to 1 foot below the surface at some time from October through May

Surface runoff: Bowers—slow; Deerheart—very slow or ponded

Flooding: None

Organic matter content: Moderate

Hazard of water erosion: Slight

Hazard of soil blowing: Slight

Composition

Bowers soil and similar soils: 40 to 65 percent

Deerheart soil and similar soils: 40 to 60 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Allendale soils and the poorly drained and very poorly drained Wakeley soils, which have sand in the upper part of the profile
- The very poorly drained Leafriver soils in depressions
- The moderately well drained Kneff soils in the higher landscape positions

Similar inclusions:

- Soils that have layers of fine sand, very fine sand, or loamy very fine sand in the subsoil or substratum
- Soils that have more silt in the profile

Use and Management

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

Cropland

Major management concerns: Wetness, compaction, tilth
Management measures:

- A combination of surface and subsurface drains can reduce the wetness.
- Shallow surface ditches are effective in removing surface water if adequate drainage outlets are available.
- Minimizing tillage and tilling at the proper moisture

content help to prevent cloddiness and compaction.

Woodland

Major management concerns: Equipment limitation, plant competition

Management measures:

- In areas of the Bowers soil, using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Access on the Deerheart soil is easiest during periods in winter when the soil or the access roads are frozen.
- Year-round logging roads require roadfill and gravel.
- Culverts are needed on the Deerheart soil to maintain the natural drainage system.
- Log landing sites are generally available on the Bowers soil during the preferred operating season.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees that can withstand seasonal wetness should be selected for planting on the Bowers soil.
- Trees are generally not planted on the Deerheart soil because of wetness and plant competition.
- Competing vegetation can be controlled by mechanical or chemical means.

Buildings

Major management concerns: Bowers—seasonal wetness; Deerheart—ponding

Management measures:

- In areas of the Bowers soil, constructing the buildings on well compacted fill material raises the site a sufficient distance above the water table.
- Because of ponding, the Deerheart soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Bowers—seasonal wetness, slow permeability; Deerheart—ponding

Management measures:

- In areas of the Bowers soil, filling or mounding with 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.
- Because of ponding, the Deerheart soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: 1lw

Woodland ordination symbol: 7W

Michigan soil management group: Bowers—1.5b;
Deerheart—1.5c

75B—Rubicon sand, 0 to 6 percent slopes

Setting

Landform: Flats or low knolls on outwash plains and stream terraces

Shape of areas: Irregular

Size of areas: 3 to more than 1,000 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 6 inches—brown sand

Subsoil:

6 to 35 inches—dark brown, dark yellowish brown, and yellowish brown sand

Substratum:

35 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Rubicon soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils in landscape positions similar to or slightly lower than those of the Rubicon soil
- The somewhat excessively drained Graycalm and Kalkaska soils in landscape positions similar to those of the Rubicon soil

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils that have bands of gravelly sand in the substratum
- Soils that have thin bands of loamy sand in the substratum

Use and Management

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



Figure 11.—Rubicon sand, 0 to 6 percent slopes, is suitable for logging roads and log landings during the preferred operating season.

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized (fig. 11).
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to

caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- 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: 4S

Michigan soil management group: 5.3a

75D—Rubicon sand, 6 to 18 percent slopes**Setting**

Landform: Knolls and low ridges on stream terraces and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 70 acres

Typical Profile

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 6 inches—brown sand

Subsoil:

6 to 35 inches—dark brown, dark yellowish brown, and yellowish brown sand

Substratum:

35 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight or moderate

Hazard of soil blowing: Severe

Composition

Rubicon soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The somewhat excessively drained Graycalm and Kalkaska soils in landscape positions similar to those of the Rubicon soil

Similar inclusions:

- Soils that have a lighter colored subsoil
- Soils that have bands of gravelly sand in the substratum
- Soils that have thin bands of loamy sand in the substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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: Rapid permeability, slope

Management measures:

- 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.
- Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4S

Michigan soil management group: 5.3a

78—Pits, borrow**Setting**

Landform: Flats and knolls on outwash plains, lake plains, stream terraces, and moraines

Shape of areas: Irregular or rectangular

Size of areas: 3 to 70 acres

Description

- This map unit consists of open excavations from which the surface layer and underlying soil material have been removed. Colors and textures of the soil material are variable. The pits range from 4 to more than 50 feet in depth. The outer edges have steep or vertical sides. Active pit sites support few plants, but abandoned areas may have a sparse cover of grasses and forbs.

Composition

Pits: 100 percent

Use and Management

Land use: Source of fill material for roads, building sites, and sanitary landfills

Management measures:

- 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

81B—Grayling sand, 0 to 6 percent slopes

Setting

Landform: Flats and low knolls on outwash plains

Shape of areas: Irregular

Size of areas: 3 to more than 5,000 acres

Typical Profile

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Grayling soil and similar soils: 90 to 100 percent

Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils in the slightly lower landscape positions
- The somewhat excessively drained Graycalm soils in landscape positions similar to those of the Grayling soil

- The excessively drained Rubicon and Hartwick soils, which have a darker subsoil than the Grayling soil; in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Soils that have bands of fine sand or gravelly sand in the subsoil or substratum
- Soils that have free carbonates in the substratum

Use and Management

Land use: Dominant use—woodland and habitat for the Kirtland's warbler; other uses—building sites

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- 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: 4S

Michigan soil management group: 5.7a

81D—Grayling sand, 6 to 18 percent slopes

Setting

Landform: Knolls and low ridges on outwash plains, kames, and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 640 acres

Typical Profile

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Grayling soil and similar soils: 90 to 100 percent

Contrasting inclusions: 0 to 10 percent

Inclusions*Contrasting inclusions:*

- The somewhat excessively drained Graycalm soils in landscape positions similar to those of the Grayling soil
- The excessively drained Rubicon and Hartwick soils, which have a darker subsoil than the Grayling soil; in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Soils that have bands of fine sand or gravelly sand in the subsoil or substratum
- Soils that have free carbonates in the substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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: Rapid permeability, slope

Management measures:

- 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.
- Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4S

Michigan soil management group: 5.7a

81F—Grayling sand, 18 to 45 percent slopes**Setting**

Landform: Hills and ridges on outwash plains, kames, and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 200 acres

Typical Profile*Surface layer:*

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 80 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow or medium

Flooding: None

Organic matter content: Low

Hazard of water erosion: Moderate or severe

Hazard of soil blowing: Severe

Composition

Grayling soil and similar soils: 90 to 100 percent

Contrasting inclusions: 0 to 10 percent

Inclusions*Contrasting inclusions:*

- The somewhat excessively drained Graycalm soils in

landscape positions similar to those of the Grayling soil

- The excessively drained Rubicon soils, which have a darker subsoil than the Grayling soil; in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Soils that have bands of gravelly sand in the substratum
- Soils that have free carbonates in the substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Erosion results from the concentration of runoff on logging roads and in the tracks of wheeled equipment. Logging roads and skid trails should be established on the contour and water removed by water bars or by out-sloping or in-sloping road surfaces.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.
- Because the slope and loose sand can interfere with the traction of wheeled equipment, year-round logging roads should be stabilized and should be established on the contour or on the gentler slopes.
- The best sites for log landings are adjacent nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- Because of the slope, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIIs

Woodland ordination symbol: 4R

Michigan soil management group: 5.7a

82B—Udorthents, loamy, nearly level and undulating

Setting

Landform: Flats or low knolls on moraines

Slope: 0 to 6 percent

Shape of areas: Irregular or rectangular

Size of areas: 5 to 35 acres

Typical Profile

Surface layer:

0 to 8 inches—dark yellowish brown fine sandy loam

Substratum:

8 to 15 inches—yellowish brown and dark yellowish brown fine sandy loam

15 to 80 inches—variable

Soil Properties and Qualities

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Moderate

Composition

Udorthents and similar soils: 95 to 100 percent

Contrasting inclusions: 0 to 5 percent

Inclusions

Contrasting inclusions:

- Soils that have a surface layer of loamy sand or sand
- Small areas where the soil is undisturbed

Similar inclusions:

- Soils that have a surface layer of sandy loam

Use and Management

Land use: Former use—cropland; current use—excavated for topsoil

Management measures:

- Onsite investigation is needed to determine the suitability for specific uses.
- This map unit consists of areas where topsoil has been removed and the subsoil or substratum is exposed. The exposed areas support little or no vegetation. Some inactive areas have a sparse cover of grass. Reclamation can help to control erosion in these areas when they become inactive.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

83B—Udipsamments, nearly level and undulating

Setting

Landform: Flats and low knolls on outwash plains, lake plains, stream terraces, and moraines
Slope: 0 to 6 percent
Shape of areas: Irregular or rectangular
Size of areas: 3 to 300 acres

Typical Profile

0 to 60 inches—sand or loamy sand

Soil Properties and Qualities

Permeability: Rapid
Available water capacity: Low
Drainage class: Excessively drained or somewhat excessively drained
Seasonal high water table: At a depth of 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

Composition

Udipsamments and similar soils: 90 to 100 percent
 Contrasting inclusions: 0 to 10 percent

Inclusions

Contrasting inclusions:

- Small areas of undisturbed soils
- Soils that have a surface layer of sandy loam

Similar inclusions:

- Soils that have a surface layer of loamy sand
- Soils that have thin bands of loamy sand, sandy loam, or gravelly sand below the surface

Use and Management

Land use: Oil and gas well drilling sites, military training areas, or abandoned land
Management measures:

- Onsite investigation is needed to determine the suitability for specific uses.
- This map unit consists of sandy areas where the surface layer and part of the subsoil have been removed or disturbed. In some areas the original soil has been covered with sandy fill material. Most areas

are barren or sparsely vegetated.

Interpretive Groups

Land capability classification: None assigned
Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

86—Histosols and Aquepts, ponded

Setting

Landform: Low flats or depressions along drainageways, lakes, and swamps on outwash plains, lake plains, and flood plains
Slope: 0 percent
Shape of areas: Irregular or linear
Size of areas: 5 to 65 acres

Soil Properties and Qualities

Texture: Histosols—muck; Aquepts—variable
Permeability: Moderately slow to moderately rapid
Available water capacity: Low to high
Drainage class: Very poorly drained
Seasonal high water table: 1 foot above to 1 foot below the surface year-round
Surface runoff: Ponded
Flooding: None
Organic matter content: High
Hazard of water erosion: Slight
Hazard of soil blowing: Slight

Composition

Histosols and Aquepts: 90 to 100 percent
 Contrasting inclusions: 0 to 10 percent

Contrasting Inclusions

- The somewhat poorly drained Au Gres soils in the slightly higher landscape positions
- The poorly drained Kinross soils in landscape positions similar to those of the Histosols and Aquepts

Use and Management

Land use: Wildlife habitat
Management measures:

- Onsite investigation is needed to determine the suitability for specific uses.
- This map unit consists of areas of standing water along lakes, creeks, rivers, or drainageways. Many areas are behind beaver dams and typically support vegetation, such as cattails, willows, alders, sedges, and grasses. These areas provide habitat for wetland wildlife, such as beaver, mink, muskrat, and various species of waterfowl.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned
Michigan soil management group: None assigned

115D—Kalkaska sand, 6 to 18 percent slopes

Setting

Landform: Knolls and low ridges on outwash plains and moraines

Shape of areas: Irregular or linear

Size of areas: 3 to 120 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 6 inches—very dark gray sand

Subsurface layer:

6 to 11 inches—grayish brown sand

Subsoil:

11 to 14 inches—dark brown sand

14 to 44 inches—brown, dark yellowish brown, and yellowish brown sand

Substratum:

44 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Kalkaska soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The well drained Blue Lake and excessively drained Rubicon soils in landscape positions similar to those of the Kalkaska soil
- The somewhat excessively drained Graycalm soils, which have a lighter colored subsoil that contains more clay than that of the Kalkaska soil

Similar inclusions:

- Soils that have thin bands of loamy sand in the subsoil or substratum

- Soils that have bands of gravelly sand in the substratum

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, slope

Management measures:

- 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: Rapid permeability, slope

Management measures:

- 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.
- 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: 3S

Michigan soil management group: 5a

126F—Udipsamments-Haplorthods-Eutroboralfs complex, nearly level to steep

Setting

Landform: Variable

Slope: 0 to 45 percent

Shape of areas: Irregular

Size of areas: Range 13—1,050 acres; Range 40—7,010 acres

Typical Profile

Udipsamments

0 to 60 inches—sand, loamy sand

Haplorthods

0 to 60 inches—sand

Eutroboralfs

0 to 60 inches—variable

Soil Properties and Qualities*Permeability:* Udipsamments—rapid; Haplorthods and Eutroboralfs—variable*Available water capacity:* Udipsamments—low; Haplorthods and Eutroboralfs—variable*Drainage class:* Udipsamments—excessively drained or somewhat excessively drained; Haplorthods and Eutroboralfs—excessively drained to well drained*Seasonal high water table:* Below a depth of 6 feet*Surface runoff:* Udipsamments—very slow to medium; Haplorthods and Eutroboralfs—variable*Flooding:* None*Organic matter content:* Udipsamments—low; Haplorthods and Eutroboralfs—variable*Hazard of water erosion:* Variable*Hazard of soil blowing:* Udipsamments—severe; Haplorthods and Eutroboralfs—variable**Composition**

Dominantly Udipsamments, Haplorthods, and Eutroboralfs

Contrasting inclusions: Histosols and Aquents

Use and Management

Land use: This map unit is used as an artillery, small arms, and bombing range by the National Guard. It consists of pits or craters formed by exploding bombs, artillery shells, rockets, or mortar shells and includes the surrounding undisturbed soils. Because of repetitive explosions and fire, many areas are sparsely vegetated with grasses and forbs. Areas outside of the concentrated target points still maintain a forest cover.

Management considerations:

- This prohibited access area is generally too dangerous for other uses because unexploded ammunition may be throughout the area.

Interpretive Groups*Land capability classification:* None assigned*Woodland ordination symbol:* None assigned*Michigan soil management group:* None assigned**144B—Perecheney sand, 0 to 6 percent slopes****Setting***Landform:* Flats on outwash plains, lake plains, and moraines*Shape of areas:* Irregular*Size of areas:* 3 to more than 200 acres**Typical Profile***Organic mat:*

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 3 inches—black sand

Subsoil:

3 to 27 inches—strong brown and yellowish brown sand

27 to 36 inches—brownish yellow, mottled sand

36 to 38 inches—pale brown, mottled sand that has small pockets of dark yellowish brown sandy clay loam

38 to 52 inches—dark yellowish brown, mottled sandy clay loam

Substratum:

52 to 80 inches—light yellowish brown sand and dark brown loamy sand that has thin bands of dark brown silt loam

Soil Properties and Qualities*Permeability:* Rapid in the sandy material and moderately slow in the loamy material*Available water capacity:* Moderate*Drainage class:* Moderately well drained*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet at some time 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**

Perecheney soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The moderately well drained Croswell soils, which are sandy throughout; in landscape positions similar to or slightly lower than those of the Perecheney soil
- The well drained Klacking and somewhat excessively drained Graycalm soils in landscape positions similar to those of the Perecheney soil

Similar inclusions:

- Soils that have mottles at a depth of more than 48 inches
- Soils that have less clay in the subsoil

Use and Management**Land use:** Dominant use—woodland (fig. 12); other uses—building sites



Figure 12.—A mixed stand of red oak and red maple in an area of Perecheney sand, 0 to 6 percent slopes.

Woodland

Major management concerns: Equipment limitation and seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave, seasonal wetness

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.
- Wetness can be overcome by installing a drainage system around structures that have basements and crawl spaces.

Septic tank absorption fields

Major management concerns: Seasonal wetness, moderately slow permeability in the loamy material

Management measures:

- Filling or mounding with 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.

Interpretive Groups

Land capability classification: IVs

Woodland ordination symbol: 6S

Michigan soil management group: 4/2a

146F—Rubicon-Graycalm sands, 8 to 50 percent slopes, dissected**Setting**

Landform: Hills and ridges on moraines

Distinctive landscape features: Dissected landscape

Shape of areas: Irregular

Size of areas: 3 to 200 acres

Typical Profile**Rubicon**

Organic mat:

0 to 1 inch—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 6 inches—brown sand

Subsoil:

6 to 35 inches—dark brown, dark yellowish brown, and yellowish brown sand

Substratum:

35 to 80 inches—light yellowish brown sand

Graycalm

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Rubicon—excessively drained;

Graycalm—somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow or medium

Flooding: None

Organic matter content: Low

Hazard of water erosion: Moderate or severe

Hazard of soil blowing: Severe

Composition

Rubicon soil and similar soils: 60 to 80 percent

Graycalm soil and similar soils: 20 to 40 percent

Contrasting inclusions: 0 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling and somewhat excessively drained Kalkaska soils in landscape positions similar to those of the major soils

Similar inclusions:

- Soils that have bands of gravelly sand in the subsoil or substratum

Use and Management

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

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Establishing logging roads and skid roads in the less sloping areas in ravines or diagonally across the side slopes helps to control erosion.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.
- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- The best sites for log landings are the less sloping areas in the ravines or adjacent nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, most areas of these soils are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- Because of the slope, most areas of these soils are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIIs

Woodland ordination symbol: Rubicon—4R; Graycalm—6R

Michigan soil management group: Rubicon—5.3a; Graycalm—5a

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 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 80 to 90 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions

Similar inclusions:

- Sandy soils that have bands of loamy sand below a depth of 60 inches
- 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 measures:

- 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: VIIs

Woodland ordination symbol: 4S

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, 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 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 80 to 90 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The more fertile Entic Haplorthods, sandy, loamy substratum, in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Sandy soils that have bands of loamy sand below a depth of 60 inches
- 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 measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4S

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, 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 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 80 to 90 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The more fertile Entic Haplorthods, sandy, loamy substratum, in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Sandy soils that have bands of loamy sand below a depth of 60 inches
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained
- Sandy soils that have gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitations, seedling mortality

Management measures:

- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Sandy, steep slopes are susceptible to erosion. Using logging equipment and constructing roads on these slopes should be avoided if possible.
- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4R

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, Mixed oak-Red maple-Starflower

210E—Grayling sand, steep**Setting**

Landform: Overwashed sandy moraines

Slope: 30 to 50 percent

Shape of areas: Irregular

Size of areas: 20 to 400 acres

Reference Profile

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 15 feet

Surface runoff: Rapid

Flooding: None

Organic matter content: Low

Hazard of water erosion: Severe

Hazard of soil blowing: Severe

Composition

Grayling soil and similar soils: 80 to 90 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The more fertile Entic Haplorthods, sandy, loamy substratum, in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Sandy soils that have bands of loamy sand below a depth of 60 inches
- Sandy soils that have a gray subsurface layer
- Sandy soils that have gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitations, seedling mortality

Management measures:

- Dry, loose sand can be easily displaced by disturbance of the surface soil.
- Avoiding management practices that disturb the soil helps to prevent erosion in the steeper areas.
- Planting when the soil is moist can reduce the seedling mortality rate.

- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4R

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, 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

Seasonal high water table: At a depth of 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 soil and similar soils: 70 to 90 percent

Contrasting inclusions: 10 to 30 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic

Endoaquods 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 do not have bands in the substratum
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained
- Sandy soils that have gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, Mixed oak-Red maple-Starflower

211C—Grayling sand, banded substratum, rolling

Setting

Landform: 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

Seasonal high water table: At a depth of 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 soil and similar soils: 70 to 90 percent

Contrasting inclusions: 10 to 30 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods 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 do not have bands in the substratum
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained
- Sandy soils that have gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: 4S

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, Mixed oak-Red maple-Starflower

211D—Grayling sand, banded substratum, hilly

Setting

Landform: Overwashed moraines and ice-contact moraines

Slope: 18 to 30 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

Seasonal high water table: At a depth of 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 soil and similar soils: 70 to 90 percent

Contrasting inclusions: 10 to 30 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods 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 do not have bands in the substratum
- Sandy soils that have a gray subsurface layer
- Sandy soils that are moderately well drained
- Sandy soils that have gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Sandy, steep slopes are susceptible to erosion. Using logging equipment and constructing roads on these slopes should be avoided if possible.
- Planting when the soil is moist can reduce the seedling mortality rate.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4R

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, Mixed oak-Red maple-Starflower

211E—Grayling sand, banded substratum, steep

Setting

Landform: Overwashed moraines and ice-contact moraines

Slope: 30 to 50 percent

Shape of areas: Irregular

Size of areas: 10 to 200 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

Seasonal high water table: At a depth of more than 15 feet

Surface runoff: Rapid

Flooding: None

Organic matter content: Low
Hazard of water erosion: Severe
Hazard of soil blowing: Severe

Composition

Grayling soil and similar soils: 70 to 90 percent
 Contrasting inclusions: 10 to 30 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods in depressions
- Entic Haplorthods, sandy, loamy substratum, in landscape positions similar to those of the Grayling soil
- Psammentic Eutroboralfs, sandy, in landscape positions similar to those of the Grayling soil

Similar inclusions:

- Dry, sandy soils that do not have bands in the substratum
- Dry, sandy soils that have a gray subsurface layer
- Sandy soils that have gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Dry, loose sand can be easily displaced by disturbance of the surface soil.
- Avoiding management practices that disturb the soil helps to prevent erosion in the steeper areas.
- Planting when the soil is moist can reduce the seedling mortality rate.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 4R

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, 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

Seasonal high water table: At a depth of 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 soil and similar soils: 80 to 90 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions

Similar inclusions:

- Sandy soils that have bands of loamy sand in the substratum
- 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 sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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: VI s

Woodland ordination symbol: 4S

Michigan soil management group: 5.7a

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, 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

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Substratum:

80 to 180 inches—coarse sand and sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 70 to 90 percent

Contrasting inclusions: 10 to 30 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods 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 are darker brown in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, Mixed oak-Red maple-Starflower

215B—Typic Udipsamments, loamy substratum, nearly level and undulating

Setting

Landform: Outwash plains and overwashed moraines

Slope: 0 to 6 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

Seasonal high water table: At a depth of 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 Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- Entic Haplorthods, sandy, loamy substratum, and Psammentic Eutroboralfs, sandy, 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 measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 1, Black oak-White oak-Blueberry

Secondary plant association: 2, 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

Seasonal high water table: At a depth of 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, Argic Endoaquods, and Typic Endoaquods, sandy, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- The well drained Psammentic Eutroboralfs, 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 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 measures:

- 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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

Seasonal high water table: At a depth of 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 Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- The well drained Glossic Eutroboralfs and Psammentic Eutroboralfs, sandy, 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

- Sandy soils that are darker brown in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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

Seasonal high water table: At a depth of 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:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- The well drained Glossic Eutroboralfs and Psammentic Eutroboralfs, sandy, 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
- Sandy soils that are darker brown in the upper part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, slope

Management measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- Glossic Eutroboralfs and Psammentic Eutroboralfs, sandy, in landscape positions similar to those of the Typic Udipsamments

Similar inclusions:

- Sandy soils that are moderately well drained
- Sandy soils that have a surface layer of loamy sand or fine sand
- Sandy soils that have gravelly sand in the substratum
- Sandy soils that have bands in the lower part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- Glossic Eutroboralfs and Psammentic Eutroboralfs, sandy, in landscape positions similar to those of the Typic Udipsamments

Similar inclusions:

- Sandy soils that are moderately well drained
- Sandy soils that have a surface layer of loamy sand or fine sand
- Sandy soils that have gravelly sand in the substratum
- Sandy soils that have bands in the lower part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- Glossic Eutroboralfs and Psammentic Eutroboralfs, sandy, in landscape positions similar to those of the Typic Udipsamments

Similar inclusions:

- Sandy soils that are moderately well drained
- Sandy soils that have a surface layer of loamy sand or fine sand
- Sandy soils that have gravelly sand in the substratum
- Sandy soils that have bands in the lower part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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.

- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, Black oak-White oak-Blueberry

221E—Typic Udipsamments, banded substratum, steep

Setting

Landform: Sandy moraines

Slope: 30 to 50 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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 15 feet

Surface runoff: Medium

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:

- The somewhat poorly drained Au Gres soils and Argic

Endoaquods and the very poorly drained, dysic Borosaprists; in depressions and drainageways

- Glossic Eutroboralfs and Psammentic Eutroboralfs, sandy, in landscape positions similar to those of the Typic Udipsamments

Similar inclusions:

- Sandy soils that are moderately well drained
- Sandy soils that have a surface layer of loamy sand or fine sand
- Sandy soils that have gravelly sand in the substratum
- Sandy soils that have bands in the lower part of the subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Dry, loose sand can be easily displaced by disturbance of the surface soil.
- Avoiding management practices that disturb the soil helps to prevent erosion in the steeper areas.
- Planting when the soil is moist can reduce the seedling mortality rate.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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

Seasonal high water table: At a depth of 5 to 15 feet at some time from January through December

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 Argic Endoaquods 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 gravelly sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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**

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Substratum:

80 to 180 inches—coarse sand and sand

Grayling

Surface layer:

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 40 to 70 percent

Grayling soil and similar soils: 30 to 60 percent

Contrasting inclusions: 0 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods, the poorly drained Leafriver 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 sand in the substratum

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Planting when the soils are 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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**

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Substratum:

80 to 180 inches—coarse sand and sand

Grayling*Surface layer:*

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 40 to 70 percent

Grayling soil and similar soils: 30 to 60 percent

Contrasting inclusions: 0 to 20 percent

Inclusions*Contrasting inclusions:*

- The somewhat poorly drained Au Gres soils and Argic Endoaquods, the poorly drained Leafriver soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways
- The well drained Entic Haplorthods, sandy, loamy substratum, and Glossic Eutroboralfs; in landscape positions similar to those of the major soils

Similar inclusions:

- Sandy soils that are moderately well drained
- Sandy soils that have gravelly sand in the 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 measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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***Organic mat:*

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 5 inches—dark brown sand

Subsoil:

5 to 27 inches—dark yellowish brown and yellowish brown sand

27 to 80 inches—light yellowish brown sand that has thin bands of yellowish brown loamy sand and strong brown sandy loam

Substratum:

80 to 180 inches—coarse sand and sand

Grayling*Surface layer:*

0 to 3 inches—black and grayish brown sand

Subsoil:

3 to 23 inches—strong brown, dark yellowish brown, and brownish yellow sand

Substratum:

23 to 180 inches—light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of 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 soil and similar soils: 40 to 70 percent

Grayling soil and similar soils: 30 to 60 percent

Contrasting inclusions: 0 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Au Gres soils and Argic Endoaquods, the poorly drained Leafriver soils, and the very poorly drained, dysic Borosaprists; in depressions and drainageways

- The well drained Entic Haplorthods, sandy, loamy substratum, and Glossic Eutroboralfs; in landscape positions similar to those of the major soils

Similar inclusions:

- Sandy soils that are moderately well drained
- Sandy soils that have gravelly sand in the 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 measures:

- 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.
- Southern exposures may have a higher seedling mortality rate.

Interpretive Groups

Land capability classification: VIs

Woodland ordination symbol: Graycalm—6R; Grayling—4R

Michigan soil management group: Graycalm—5a; Grayling—5.7a

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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—partially decomposed leaf litter

Surface layer:

1 to 2 inches—black sand

Subsurface layer:

2 to 5 inches—brown sand

Subsoil:

5 to 16 inches—strong brown sand

16 to 30 inches—yellowish brown and brownish yellow, mottled sand

Substratum:

30 to 80 inches—pale brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Moderately well drained

Seasonal high water table: At a depth of 2.0 to 3.5 feet at some time 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 soil 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 Argic Endoaquods, 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

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 1, 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 3 inches—very dark gray sand

Subsurface layer:

3 to 7 inches—grayish brown sand

Subsoil:

7 to 11 inches—dark brown sand

11 to 35 inches—strong brown sand

Substratum:

35 to 60 inches—yellowish brown sand

60 to 90 inches—reddish brown sandy clay loam

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of 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 Argic Endoaquods, the poorly drained Leafriver 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 measures:

- 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 3, Northern red oak-Red maple-Mapleleaf viburnum

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

0 to 99 inches—variable

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Well drained

Seasonal high water table: At a depth of more than 15 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 Argic Endoaquods and Allendale soils and the very poorly drained, euc Borosapristis; 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 measures:

- 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: 3, Northern red oak-Red maple-Mapleleaf viburnum

Secondary plant association: 4, 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

0 to 99 inches—variable

Soil Properties and Qualities

Permeability: Moderate

Available water capacity: Moderate

Drainage class: Well drained

Seasonal high water table: At a depth of 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 Typic Udipsamments in landscape positions similar to those of the Glossic Eutroboralfs
- The somewhat poorly drained Allendale soils and the very poorly drained, euc Borosapristis; 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: Surface compaction

Management measures:

- Using heavy equipment in areas of soils that have a loamy surface layer can result in surface compaction. Using the equipment during dry periods or during the 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: 4, Northern red oak-Red maple-Trefoil

Secondary plant association: 3, Northern red oak-Red maple-Mapleleaf viburnum

239B—Psammentic Eutroboralfs, sandy-Typic Udipsamments, banded substratum complex, 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

Psammentic Eutroboralfs

Surface layer:

0 to 2 inches—dark grayish brown sand

Subsoil:

2 to 10 inches—dark yellowish brown sand

10 to 32 inches—yellowish brown sand

32 to 54 inches—strong brown loamy sand and light yellowish brown sand

54 to 75 inches—yellowish brown sand that has bands of strong brown loamy sand

Substratum:

75 to 180 inches—light yellowish brown sand

Typic Udipsamments

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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Psammentic Eutroboralfs—well drained;
Typic Udipsamments—excessively drained

Seasonal high water table: At a depth of 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

Psammentic Eutroboralfs and similar soils: 40 to 60 percent

Typic Udipsamments and similar soils: 40 to 50 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Argic Endoaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

Similar inclusions:

- Sandy soils that are moderately well drained

- Soils that have a surface layer of loamy sand or fine sand

Use and Management

Land use: Woodland

Major management concerns: Seasonal droughtiness; loose, sandy soils

Management measures:

- 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: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 3, Northern red oak-Red maple-Mapleleaf viburnum

239C—Psammentic Eutroboralfs, sandy-Typic Udipsamments, banded substratum complex, 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

Psammentic Eutroboralfs

Surface layer:

0 to 2 inches—dark grayish brown sand

Subsoil:

2 to 10 inches—dark yellowish brown sand

10 to 32 inches—yellowish brown sand

32 to 54 inches—strong brown loamy sand and light yellowish brown sand

54 to 75 inches—yellowish brown sand that has bands of strong brown loamy sand

Substratum:

75 to 180 inches—light yellowish brown sand

Typic Udipsamments

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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Psammentic Eutroboralfs—well drained;
Typic Udipsamments—excessively drained

Seasonal high water table: At a depth of more than 15
feet

Surface runoff: Slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Psammentic Eutroboralfs and similar soils: 40 to 60
percent

Typic Udipsamments and similar soils: 40 to 50 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Argic Endoaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

Similar inclusions:

- Sandy soils that are moderately well drained
- Soils that have a surface layer of loamy sand or fine sand

Use and Management

Land use: Woodland

Major management concerns: Seasonal droughtiness;
loose, sandy soils

Management measures:

- 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: 2, Mixed oak-Red maple-
Starflower

Secondary plant association: 3, Northern red oak-Red
maple-Mapleleaf viburnum

**239E—Psammentic Eutroboralfs, sandy-
Typic Udipsamments, banded substratum
complex, steep**

Setting

Landform: Overwashed end moraines and ground
moraines

Slope: 30 to 60 percent

Shape of areas: Irregular

Size of areas: 10 to 200 acres

Reference Profile

Psammentic Eutroboralfs

Surface layer:

0 to 2 inches—dark grayish brown sand

Subsoil:

2 to 10 inches—dark yellowish brown sand

10 to 32 inches—yellowish brown sand

32 to 54 inches—strong brown loamy sand and light
yellowish brown sand

54 to 75 inches—yellowish brown sand that has bands
of strong brown loamy sand

Substratum:

75 to 180 inches—light yellowish brown sand

Typic Udipsamments

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 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

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Psammentic Eutroboralfs—well drained;
Typic Udipsamments—excessively drained

Seasonal high water table: At a depth of more than 15
feet

Surface runoff: Rapid

Flooding: None

Organic matter content: Low

Hazard of water erosion: Severe

Hazard of soil blowing: Severe

Composition

Psammentic Eutroboralfs and similar soils: 40 to 60 percent

Typic Udipsamments and similar soils: 40 to 50 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Argic Endoaquods and Allendale soils and the very poorly drained, euic Borosaprists; in depressions and drainageways

Similar inclusions:

- Sandy soils that are moderately well drained
- Soils that have a surface layer of loamy sand or fine sand

Use and Management

Land use: Woodland

Major management concerns: Seasonal droughtiness; loose, sandy soils; slope

Management measures:

- Planting when the soil is moist can reduce the seedling mortality rate.
- Because dry, loose sand can be easily displaced by heavy equipment, logging roads may need to be stabilized.
- Because the slope increases the hazard of erosion, special care is needed in areas where the surface soil is disturbed.

Interpretive Groups

Land capability classification: None assigned

Woodland ordination symbol: None assigned

Michigan soil management group: None assigned

Primary plant association: 2, Mixed oak-Red maple-Starflower

Secondary plant association: 3, Northern red oak-Red maple-Mapleleaf viburnum

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

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 4 inches—black sand

Subsurface layer:

4 to 8 inches—light brownish gray sand

Subsoil:

8 to 9 inches—dark reddish brown, mottled sand

9 to 24 inches—dark yellowish brown and yellowish brown, mottled sand

Substratum:

24 to 60 inches—light yellowish brown, mottled sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat poorly drained

Seasonal high water table: At a depth of 0.5 foot to 1.5 feet at some time 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 soil and similar soils: 70 to 80 percent

Contrasting inclusions: 20 to 30 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils on low knolls
- The very poorly drained, dysic Borosaprists in depressions

Similar inclusions:

- Sandy soils that have a fine textured substratum
- Soils that have an accumulation of organic material on the surface
- Soils that have a cemented subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow

Management measures:

- 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 using 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: 7, Northern red oak-Red maple-Leatherleaf-Blueberry

Secondary plant association: 8, Red maple-Balsam fir-Bunchberry dogwood

263A—Argic Endoaquods, 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

0 to 99 inches—variable

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Moderate

Drainage class: Somewhat poorly drained

Seasonal high water table: At a depth of 0.5 foot to 1.5 feet at some time 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

Argic Endoaquods and similar soils: 70 to 80 percent

Contrasting inclusions: 20 to 30 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils on low knolls
- The very poorly drained, dysic Borosaprists in depressions

Similar inclusions:

- Sandy soils that have a fine textured substratum
- Soils that have an accumulation of organic material on the surface
- Soils that have a cemented subsoil

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow

Management measures:

- 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 using 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: 8, Red maple-Balsam fir-Bunchberry dogwood

Secondary plant association: 7, 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

Organic mat:

0 to 3 inches—partially decomposed leaf litter

Surface layer:

3 to 7 inches—pinkish gray loamy sand

Subsoil:

7 to 21 inches—dark brown and yellowish brown, mottled sand

21 to 24 inches—light brownish gray, mottled fine sand

24 to 63 inches—dark brown and brown, mottled clay

Substratum:

63 to 80 inches—brown, mottled clay

Soil Properties and Qualities

Permeability: Rapid in the upper part and very slow in the lower part

Available water capacity: Moderate

Drainage class: Somewhat poorly drained

Seasonal high water table: At a depth of 0.5 foot to 1.5 feet at some time 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 soil and similar soils: 70 to 80 percent

Contrasting inclusions: 20 to 30 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Kellogg soils on low knolls
- The very poorly drained, dysic Borosaprists in depressions

Similar inclusions:

- Sandy soils that do not have a fine textured substratum
- Soils that have an accumulation of organic material on the surface

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow

Management measures:

- 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 using 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: 9, Mixed ash-Basswood-Downy yellow violet

Secondary plant association: 8, Red maple-Balsam fir-Bunchberry dogwood

271—Typic Endoaquods, sandy, wet-Typic Endoaquods, sandy 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

Typic Endoaquods, wet

0 to 99 inches—variable

Typic Endoaquods

0 to 99 inches—variable

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Typic Endoaquods, wet—poorly drained; Typic Endoaquods—somewhat poorly drained

Seasonal high water table: Typic Endoaquods, wet—1 foot above to 1 foot below the surface at some time from October through May; Typic Endoaquods—at a depth of 0.5 foot to 1.5 feet at some time from October through May

Composition

Typic Endoaquods, wet, and similar soils: 40 to 60 percent

Typic Endoaquods and similar soils: 30 to 50 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils on low knolls
- The very poorly drained, euic Borosaprists in drainageways
- The very poorly drained, dysic Borosaprists in depressions

Similar inclusions:

- Poorly drained, sandy soils that have a loamy substratum
- Soils that have a thicker accumulation of organic material on the surface
- Sandy soils that have a cemented subsoil

Use and Management

Land use: Woodland

Major management concerns: Seasonal high water table, windthrow

Management measures:

- 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 using 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: 7, Northern red oak-Red maple-Leatherleaf-Blueberry

Secondary plant association: None assigned

275—Wakeley-Leafriver 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

Wakeley

Surface layer:
 0 to 4 inches—black muck

Substratum:
 4 to 28 inches—brown and grayish brown, mottled loamy sand
 28 to 80 inches—brown and dark brown, mottled clay

Leafriver

Surface layer:
 0 to 9 inches—black muck

Subsurface layer:
 9 to 12 inches—very dark grayish brown fine sandy loam

Substratum:
 12 to 28 inches—grayish brown, mottled sand
 28 to 60 inches—olive gray and gray sand

Soil Properties and Qualities

Permeability: Wakeley—rapid in the upper part, slow in the lower part; Leafriver—rapid

Available water capacity: Moderate

Drainage class: Very poorly drained

Seasonal high water table: Wakeley—perched 1 foot above to 1 foot below the surface at some time from October through May; Leafriver—1 foot above to 1 foot below the surface at some time from October through May

Surface runoff: Very slow or ponded

Flooding: None

Organic matter content: Wakeley—moderate; Leafriver—high

Hazard of water erosion: Slight

Hazard of soil blowing: Slight

Composition

Wakeley and similar soils: 40 to 60 percent

Leafriver and similar soils: 40 to 60 percent

Contrasting inclusions: 10 to 20 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell soils on low knolls
- The very poorly drained, dysic Borosapristis in depressions

Similar inclusions:

- Sandy soils that have a fine textured surface layer
- Soils that have a thick accumulation of organic material

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation, windthrow

Management measures:

- 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 using 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: Vw

Woodland ordination symbol: Wakeley—3W; Leafriver—2W

Michigan soil management group: Wakeley—4/1c; Leafriver—5c

Primary plant association: 8, Red maple-Balsam fir-Bunchberry dogwood

Secondary plant association: 7, Northern red oak-Red maple-Leatherleaf-Blueberry

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: 1 foot above to 1 foot below 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 and lake plains and on flood plains

Slope: Nearly level

Shape of areas: Oval

Size of areas: 5 to 200 acres

Reference Profile

Surface layer:

0 to 10 inches—black muck

Subsoil:

10 to 25 inches—black muck

Substratum:

25 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 at some time 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 low ridges

Similar inclusions:

- Soils that have organic material at a depth of less than 16 inches
- Soils that have organic material at a depth of more than 50 inches

Use and Management

Land use: Woodland

Major management concerns: Equipment limitation

Management measures:

- 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: 10, 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 11 inches—black muck

Subsoil:

11 to 24 inches—dark reddish brown muck

24 to 51 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 at some time 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:*

- The 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 measures:

- 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: 11, Northern whitecedar-Eastern hemlock-Canada violet

Secondary plant association: 9, Mixed ash-Basswood-Downy yellow violet

347F—Kalkaska sand, 8 to 50 percent slopes, dissected**Setting**

Landform: Hills and ridges on moraines

Distinctive landscape features: Dissected landscape

Shape of areas: Irregular

Size of areas: 3 to 230 acres

Typical Profile

Organic mat:

0 to 2 inches—partially decomposed leaf litter

Surface layer:

2 to 6 inches—very dark gray sand

Subsurface layer:

6 to 11 inches—grayish brown sand

Subsoil:

11 to 14 inches—dark brown sand

14 to 44 inches—brown, dark yellowish brown, and yellowish brown sand

Substratum:

44 to 80 inches—yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Somewhat excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Slow or medium

Flooding: None

Organic matter content: Low

Hazard of water erosion: Moderate or severe

Hazard of soil blowing: Severe

Composition

Kalkaska soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions*Contrasting inclusions:*

- The excessively drained Rubicon soils in landscape positions similar to those of the Kalkaska soil
- The somewhat excessively drained Graycalm soils, which have a lighter colored subsoil that contains more clay than that of the Kalkaska soil; in landscape positions similar to those of the Kalkaska soil

Similar inclusions:

- Soils that have bands of gravelly sand in the substratum
- Soils that have thin bands of loamy sand in the subsoil or substratum

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Erosion hazard, equipment limitation, seedling mortality

Management measures:

- Establishing logging roads and skid roads in the less sloping areas in the ravines or diagonally across the side slopes helps to control erosion.
- Special logging methods, such as yarding the logs with a cable, are effective in minimizing erosion in the steeper areas.
- Because the slope and loose sand can interfere with the traction of wheeled equipment, year-round logging roads should be stabilized.
- The best sites for log landings are the less sloping areas in the ravines or adjacent nearly level areas.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.
- The use of mechanical planters is limited by the slope. Hand planting of seedlings may be desirable.

Buildings

Major management concerns: Slope

Suitability:

- Because of the slope, most areas of this soil are generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Slope

Suitability:

- Because of the slope, most areas of this soil are generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: VIIs

Woodland ordination symbol: 3R

Michigan soil management group: 5a

348—Pickford muck**Setting**

Landform: Low flats and shallow depressions on lake plains

Slope: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 3 to 70 acres

Typical Profile

Surface layer:

0 to 3 inches—black muck

Subsurface layer:

3 to 10 inches—black, mottled silty clay and grayish brown, mottled clay

Subsoil:

10 to 32 inches—reddish gray and reddish brown, mottled clay

Substratum:

32 to 80 inches—reddish brown, mottled clay

Soil Properties and Qualities

Permeability: Very slow

Available water capacity: High

Drainage class: Poorly drained

Seasonal high water table: Perched 1 foot above to 1 foot below the surface at some time from September through June

Surface runoff: Very slow

Flooding: None

Organic matter content: High

Hazard of water erosion: Slight

Hazard of soil blowing: Moderate

Composition

Pickford soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The moderately well drained Croswell and Kellogg soils on low knolls
- The somewhat poorly drained Au Gres and Bowers soils in the slightly higher landscape positions

Similar inclusions:

- Soils that have bands of silty clay loam or silt loam in the subsoil or substratum
- Soils that have a surface layer of muck more than 8 inches thick

Use and Management

Land use: Dominant use—woodland

Woodland

Major management concerns: Equipment limitation, seedling mortality, windthrow hazard, plant competition

Management measures:

- Using heavy equipment only when the soil is relatively dry, is frozen, or has an adequate snow cover helps to prevent the formation of deep ruts.
- Log landings should be established in areas of drier, more suitable soils.
- Windthrow can be minimized by using harvest methods that do not leave the remaining trees widely spaced.
- Trees are generally not planted on this soil because of wetness, severe seedling mortality, and plant competition.

Buildings

Major management concerns: Ponding

Suitability:

- Because of ponding, this soil is generally unsuited to building site development.

Septic tank absorption fields

Major management concerns: Ponding

Suitability:

- Because of ponding, this soil is generally unsuited to septic tank absorption fields.

Interpretive Groups

Land capability classification: Vw

Woodland ordination symbol: 6W

Michigan soil management group: 1c

349B—Hartwick sand, 0 to 6 percent slopes**Setting**

Landform: Flats or low knolls on outwash plains and moraines

Shape of areas: Irregular or linear

Size of areas: 5 to 210 acres

Typical Profile

Surface layer:

0 to 2 inches—black sand

Subsurface layer:

2 to 4 inches—brown sand

Subsoil:

4 to 8 inches—dark brown sand

8 to 30 inches—strong brown very gravelly sand and yellowish brown sand

Substratum:

30 to 80 inches—light yellowish brown very gravelly sand and pale brown and light yellowish brown sand

Soil Properties and Qualities

Permeability: Rapid

Available water capacity: Low

Drainage class: Excessively drained

Seasonal high water table: At a depth of more than 6 feet

Surface runoff: Very slow

Flooding: None

Organic matter content: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Composition

Hartwick soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Inclusions

Contrasting inclusions:

- The excessively drained Grayling and Rubicon soils, which contain less gravel than the Hartwick soil; in landscape positions similar to those of the Hartwick soil
- The somewhat excessively drained Graycalm and Kalkaska soils in landscape positions similar to those of the Hartwick soil

Similar inclusions:

- Soils that do not have free carbonates in the substratum
- Soils that have more gravel in the subsoil and substratum
- Soils that have a darker subsoil

Use and Management

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

Woodland

Major management concerns: Equipment limitation, seedling mortality

Management measures:

- Because loose sand can interfere with the traction of wheeled equipment, logging roads should be stabilized.
- Planting seedlings when the soil is moist and planting special nursery stock can reduce the seedling mortality rate. Replanting may be needed in some areas.

Buildings

Major management concerns: Cutbanks cave

Management measures:

- Because cutbanks are unstable and are subject to caving, trench walls should be reinforced.

Septic tank absorption fields

Major management concerns: Rapid permeability

Management measures:

- 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: 4S

Michigan soil management group: 5.3a

Use and Management of the Soils

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

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

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

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

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

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

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. A summary is in the section "Interpretive Groups."

Crops and Pasture

In this section, the system of land capability classification used by the Natural Resources Conservation Service is explained and prime farmland is described.

Less than 1 percent of the land in Crawford County is used for crops and pasture. 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.

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 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 5. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Also 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, 1978). More detailed information about these groups is available from the local office of the Michigan State University Cooperative Extension Service.

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 land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. 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 3,000 acres in the survey area, or less than 1 percent of the total acreage, meets the soil requirements for prime farmland. Most of this land is in Frederic, Maple Forest, and South Branch Townships. These areas are mainly in associations 3 and 9, which are described under the heading "General Soil Map Units." Most of the prime farmland is used for hay or is idle land. About 45 percent of the prime farmland is woodland.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 6. This list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil

maps in this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Woodland Management and Productivity

Ken Phillips, assistant area forester, Michigan Department of Natural Resources, helped prepare this section.

About 273,000 acres in the county, or 76 percent of the land area, is commercial forest land (Jakes, 1980). Nearly 62 percent of this land, or about 168,000 acres, is managed by the State or Federal government. More than 37 percent, or nearly 103,000 acres, consists of privately owned tracts, most of which are relatively small. Less than 1 percent of the commercial forest land is owned and managed by forest industry companies.

The majority of the woodland is dominated by jack pine, red pine, red oak, red maple, or aspen. The woodland on the sandy outwash plains is most commonly dominated by relatively pure stands of jack pine. The woodland on the sandy and loamy upland moraines in the central and southern parts of the county is dominantly red oak, red maple, red pine, jack pine, and aspen. Small areas of mixed sugar maple, beech, and basswood occur in the northwestern part of the county, mainly on the loamy and sandy remnant moraines in Frederic and Maple Forest Townships. Less than 5 percent of the woodland occurs as wetland. Most of the forested wetlands are northern whitecedar, black spruce, tamarack, balsam fir, or jack pine.

Woodland Products

The wood industry is of vital importance to the economy of Crawford County. The harvesting and processing of wood products accounts for the employment of a large percentage of the workforce. Because of the large amount of forest land in the county and the close proximity to wood processing industries, the future economy of the county will continue to be based on woodland products. Proper woodland management, on both public and private lands, will be required to ensure that the desired types of raw materials will be available in sufficient quantities to meet the future demands of the forest industry.

Many forest products are produced within the county. The most important of these are described in the following paragraphs.

Pulpwood.—Crawford County ranks as one of the largest producers of pulpwood in the northern part of Michigan's Lower Peninsula. Most of the pulpwood is harvested from even-aged stands that are mature or over-mature. These stands originated from large-scale wildfires during the post-logging era near the turn of the century. Nearly 80 percent of the pulpwood cut is either jack pine (fig. 13) or aspen. Oak accounts for only 9

percent of the total production (Smith and others, 1988). Pulpwood production will remain important in the future because of the close proximity of high-volume mills.

Lumber and Pallets.—Red oak and red pine account for nearly 60 percent of the sawtimber harvested in the county (Smith and others, 1988). Most of the sawlogs harvested are those that are sorted out during commercial pulpwood logging operations. Few of the logs produced are of veneer quality, but some are shipped out of the county for processing. Most logs are of lower quality and are generally made into low-grade lumber or pallets. Some plantations and naturally occurring stands of red pine are managed for high-quality lumber production, utility poles, or logs for log homes. Some isolated stands of red oak are also managed for long-term sawlog production.

Fuel Wood.—A large percentage of the hardwood cut in the county is used to supply the fuel wood market. This market provides a strong demand for material that would otherwise have a low market value. Approximately 39 percent of the households in the county use wood as either a primary or secondary heat source. Much of the fuel wood resource is also being directed to several wood-using energy plants in the county and in surrounding counties. These plants produce electricity from steam-driven turbines that use wood as a fuel source.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil (USDA/NRCS, National Forestry Manual). 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 in a pure stand under natural conditions. The number 1 indicates low potential productivity; 2 or 3, moderate; 4 or 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; *L*, low strength; and *N*, snowpack. 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*, *L*, and *N*.

In table 7, *slight*, *moderate*, and *severe* indicate the



Figure 13.—The sandy outwash plains in Crawford County are dominated by relatively pure stands of jack pine, which is used mainly for pulpwood.

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 is determined through the use of standard yield tables (USDA/NRCS, 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 are important to the economy of Crawford County. Table 8 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 to well 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 (fig. 14).

In table 8, 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 Communities

Table 9 lists plants that are typically associated with the soils in the survey area. The information in table 9 is based on sample sites. Sample sites were selected for vegetative analysis after detailed soil maps and soil series descriptions were completed in an area. Once the soils were verified, representative vegetative communities were selected in areas that were relatively free from recent disturbances, such as fire, tree harvesting, or noticeable insect or disease infestations. The sample sites were in areas that exhibited typical stocking densities.

The plots sampled were approximately 10,000 square feet. Plant species were identified and recorded and an ocular estimate was made of the percent coverage for each species. Tree species were recorded by estimating the percent canopy coverage, and other plants were recorded by estimating the percent ground coverage. Coverage values were grouped into seven classes to facilitate compilation and to clarify results. The seven classes are: 1—less than 1 percent coverage; 2—1 to 5 percent coverage; 3—5 to 25 percent coverage; 4—25 to 50 percent coverage; 5—50 to 75 percent coverage; 6—75 to 95 percent coverage; and 7—95 to 100 percent coverage (Pregitzer and others, 1987).

The number that follows each plant species in table 9 represents the mean coverage class for that species for the map unit or soil listed. This number can be correlated to the relative dominance of overstory and understory vegetation. Plants that have a high number cover more of the canopy or ground than those that have a low number.

The plants listed in table 9 for each map unit are a composite of two to ten sample sites. They are considered the typical plants that occur in areas of a map unit, but they are not the only plants that may occur. Only common names are used for the plants in table 9 (USDA/NRCS, National List of Common Plant Names).



Figure 14.—Winter is a preferred operating season on the droughty, sandy soils in the survey area.

Plant Associations

The Ecological Classification System (ECS) for the Huron-Manistee National Forests (Pregitzer and others, 1987) 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 each map unit in the survey area. The primary plant association and secondary plant association are specified at the end of some map unit descriptions in the section "Detailed Soil Map Units" and are listed under the heading "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*), cove blueberry (*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 nudicaulis*), lily of the valley (*Maianthemum canadense*), large-leaved aster (*Aster macrophyllus*), 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 claytoni*)**

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 claytoni*), 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 dogwood
(*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 dogwood (*Cornus canadensis*), goldthread (*Coptis groenlandica*),

wintergreen (*Gaultheria procumbens*), and spinulose 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 northern whitecedar (*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, euc, 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

Farmstead 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 the local office of the Natural Resources Conservation Service or of the Cooperative Extension Service or from a commercial nursery.

Recreation

Because about 61 percent of the county is publicly owned, recreational opportunities abound. Popular activities include fishing, canoeing, hunting, bird watching, skiing, snowmobiling, camping, hiking, and horseback riding. Popular attractions include Hartwick Pines State Park, North Higgins Lake State Park, the Au Sable and Manistee Rivers, the Shore-to-Shore Riding Trail, 31 public fishing access sites, 10 State Forest campgrounds, and Lake Margrethe.

Recreation and tourism are important to the local economy. In 1989, about 27 percent of the private sector jobs were associated with tourism-related businesses.

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.

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

Crawford County has a diversity of wildlife habitat and wildlife species. Woodland habitat is the most abundant. It provides food and shelter for common upland game animals, such as white-tailed deer, cottontail rabbit, gray squirrel, and fox squirrel. Black bear, coyote, red fox, gray fox, porcupine, badger, striped skunk, woodchuck, raccoon, red squirrel, flying squirrel, and opossum also inhabit the area. Common upland game birds include ruffed grouse, woodcock, snipe, and wild turkey.

The Kirtland's warbler is an endangered songbird that nests in Crawford County. The preferred nesting habitat for this bird is young stands of jack pine. Habitat improvement projects have been established on State Forest lands and in the Huron National Forest. These projects are designed to attract and maintain continual nesting populations of this species (fig. 15). Threatened bird species in the survey area include the bald eagle, osprey, and common loon. Threatened and endangered plant species include the fairy-slipper, prairie agoseris, false violet, and Houghton's goldenrod.

Wetland habitat provides food and cover for wildlife species, such as beaver, bobcat, muskrat, mink, otter, and various types of waterfowl, herons, and shore birds.

Most of the woodland habitat in the survey area can be improved by increasing the food and cover available to wildlife. Planting grasses, small grain, and food-producing shrubs in woodland areas increases the supply of available food. Planting conifers, thick shrubs, and shelterbelts can improve the cover for wildlife.

The 71 miles of mainstream channels, 133 miles of tributary streams, and 40 lakes in the county provide excellent habitat for a variety of fish species. The Au Sable River, the Manistee River, and some of the creeks contain good populations of brook trout and brown trout. The county is recognized as having some of the best trout fishing streams in Michigan. The lakes offer habitat for common game fish, such as northern pike, walleye, smallmouth bass, largemouth bass, and trout. Common panfish include crappie, perch, and bluegill.

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

In table 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 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 fescue, lovegrass, brome grass, 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 big bluestem, violets, ragweed, wintergreen, and bunchberry.

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



Figure 15.—Some areas of jack pine in the Huron National Forest are managed as habitat for the endangered Kirtland's warbler. Pictured is an area of Grayling sand, 0 to 6 percent slopes.

hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, beech, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. 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 smartweed, cattail, bog laurel, leatherleaf, 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 woodchuck, ground squirrel, meadowlark, field sparrow, cottontail, and red fox.

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

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

Engineering

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

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood

of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

Building Site Development

Table 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 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, 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. A high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

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

Sanitary Facilities

Table 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, and flooding affect absorption of the effluent. Large stones interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel are less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

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

Table 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, 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 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, a high water table, slope, and flooding affect both types of landfill. Texture, stones, 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 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 are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal 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 fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or 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, permeability of the aquifer, and quality of the water. 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

clay 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 large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for

drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones. The performance of a system is affected by the depth of the root zone, 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, and slope affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

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 or higher taxonomic unit 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

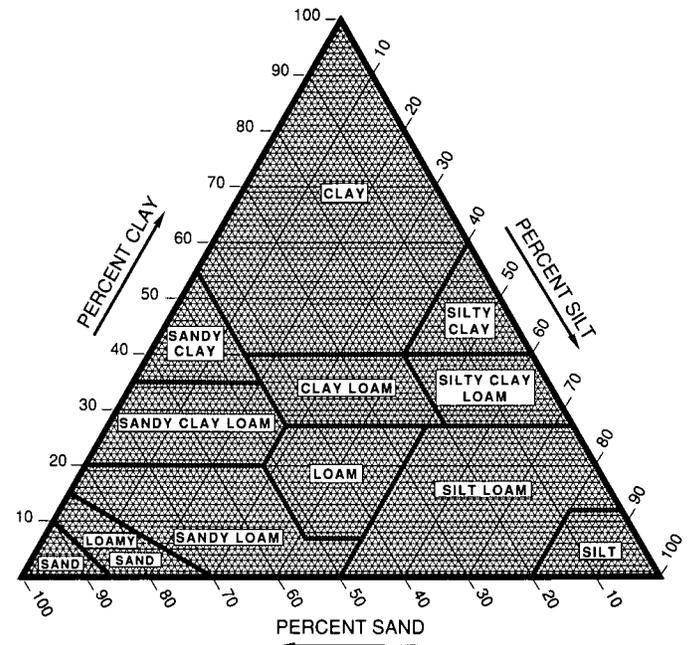


Figure 16.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry 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 (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $\frac{1}{3}$ -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; *high*, more than 6 percent; and *very high*, greater than 9 percent.

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 0.02 to 0.64. Other factors being equal, 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. The soils assigned to group 1 are the most susceptible to soil blowing, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

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.

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

Soil and Water Features

Table 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 based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, 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 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, and water standing in swamps and marshes is considered ponding rather than flooding.

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, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (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 observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 19 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of

the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 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.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

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.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975; USDA, 1992). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Spodosol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Orthod (*Orth*, meaning the common ones, plus *od*, from Spodosol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplorthods (*Hapl*, meaning minimal horizonation, plus *orthod*, the suborder of the Spodosols that has a horizon characterized by an accumulation of aluminum, iron, and organic carbon in which no one of the elements dominates).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the

name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplorthods.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy, mixed, frigid Typic Haplorthods.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Some higher taxonomic units are also described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975) and in "Keys to Soil Taxonomy" (USDA, 1992). Unless otherwise indicated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series or higher taxonomic unit are described in the section "Detailed Soil Map Units."

Allendale Series

The Allendale series consists of somewhat poorly drained soils on lake plains and outwash plains. These

soils formed in sandy material and in the underlying clayey deposits. Permeability is rapid in the sandy material and very slow in the clayey material. Slope ranges from 0 to 3 percent.

Typical pedon of Allendale sand, in an area of Wakeley-Allendale complex, 0 to 3 percent slopes, 2,200 feet west and 1,650 feet north of the southeast corner of sec. 17, T. 27 N., R. 1 W., Lovells Township:

Oe—0 to 3 inches; very dark grayish brown (10YR 3/2), partially decomposed leaf litter and grass with about 10 percent uncoated sand grains; abrupt wavy boundary.

E—3 to 7 inches; pinkish gray (7.5YR 6/2) sand, gray (10YR 6/1) dry; very weak medium granular structure parting to single grain; loose; many fine and medium roots; moderately acid; abrupt wavy boundary.

Bs1—7 to 16 inches; dark brown (7.5YR 4/4) sand; common medium distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure parting to weak very fine granular; very friable; many fine and medium roots; strongly acid; gradual wavy boundary.

Bs2—16 to 21 inches; yellowish brown (10YR 5/6) sand; common medium distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure parting to weak very fine granular; very friable; many fine and medium roots; moderately acid; gradual wavy boundary.

E'—21 to 24 inches; light brownish gray (10YR 6/2) fine sand, white (10YR 8/2) dry; common medium faint light gray (10YR 7/2) and common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure parting to weak very fine granular; very friable; common fine and medium roots; about 5 percent fine and medium gravel; moderately acid; abrupt wavy boundary.

2Bt—24 to 49 inches; dark brown (7.5YR 4/4) clay; common medium distinct strong brown (7.5YR 5/8) and common medium prominent gray (10YR 6/1) mottles; strong coarse angular blocky structure; very firm; common fine and medium roots; many faint dark brown (7.5YR 3/4) clay films on faces of pedis; about 5 percent fine and medium gravel in the upper 4 inches; slightly acid; gradual wavy boundary.

2BC—49 to 63 inches; brown (7.5YR 5/4) clay; common medium distinct strong brown (7.5YR 5/8) and many coarse prominent greenish gray (5GY 5/1) mottles; weak coarse subangular blocky structure; very firm; common fine and medium roots; neutral; gradual wavy boundary.

2C—63 to 80 inches; brown (7.5YR 5/4) clay; common

medium distinct strong brown (7.5YR 5/8) and many coarse prominent greenish gray (5GY 5/1) mottles; massive; strongly effervescent; moderately alkaline.

The thickness of the sandy layers ranges from 20 to 30 inches. The content of gravel ranges from 0 to 5 percent in the E and B horizons.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. It is sand. Some pedons have a thin A horizon above the E horizon. This horizon, if it occurs, has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The Bs1 horizon has hue of 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 6 to 8. These horizons are sand or loamy sand.

The E' horizon has the same colors as the E horizon. It is fine sand or sand.

The 2Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay or clay.

The 2BC horizon has the same colors and textures as the 2Bt horizon.

The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is silty clay or clay.

Aquents

Aquents consist of very poorly drained, rapidly permeable to slowly permeable soils on lake plains, outwash plains, and moraines. These soils formed in sandy to clayey glaciofluvial material. Slope is 0 to 1 percent.

The surface layer is typically black (10YR 2/1) muck or mucky peat 3 to 16 inches thick.

The upper part of the mineral layers has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 1 or 2. The lower part has hue of 5YR to 5Y, value of 5 or 6, and chroma of 1 to 3.

The mineral layers range from sand to clay.

Arenic Eutroboralfs

Arenic Eutroboralfs consist of well drained, moderately permeable and moderately slowly permeable soils on moraines and outwash plains. These soils formed in sandy and loamy glacial till or outwash material. Slope ranges from 0 to 18 percent.

These soils typically have a sandy cap, 20 to 40 inches thick, overlying loamy materials. Stratified materials are commonly below the loamy materials. The content of gravel ranges from 0 to 10 percent.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 1. It is sand or loamy sand.

The E horizon has hue of 7.5YR or 10YR, value of 4

to 6, and chroma of 2 or 3. It is sand or loamy sand.

The Bw horizons have hue of 7.5YR or 10YR and value and chroma of 4 to 6. Value and chroma of 4 do not occur together. The Bw horizons are sand or loamy sand.

The 2Bt horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam.

The 2C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam.

The 3C horizons are variable in color and texture. They are commonly stratified sands, loamy sands, or loams.

Argic Endoaquods

Argic Endoaquods consist of somewhat poorly drained, rapidly permeable soils on outwash plains and lake plains. These soils formed in sandy outwash or lacustrine materials. Slope ranges from 0 to 4 percent.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is sand.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 3. It is sand.

The Bs horizons have hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 3 to 6. They are sand or loamy sand.

The E' horizon has colors similar to those of the E horizon. It is sand.

The Bt or 2Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. The texture ranges from loamy sand to clay.

The C or 2C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 6. The texture ranges from sand to clay.

Au Gres Series

The Au Gres series consists of somewhat poorly drained soils on outwash plains and stream terraces. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 3 percent.

Typical pedon of Au Gres sand, 0 to 3 percent slopes, 1,850 feet south and 100 feet west of the center of sec. 5, T. 26 N., R. 4 W., Grayling Township:

Oe—0 to 2 inches; partially decomposed leaves, twigs, and pine needles; abrupt wavy boundary.

A—2 to 4 inches; black (N 2/0) sand, dark gray (10YR 4/1) dry; moderate fine and medium subangular blocky structure; very friable; many fine and medium and common coarse roots; about 20 percent bleached sand grains from the E horizon; extremely acid; abrupt smooth boundary.

E—4 to 8 inches; light brownish gray (10YR 6/2) sand, light gray (10YR 7/2) dry; weak medium granular structure; very friable; common fine to coarse roots; very strongly acid; abrupt irregular boundary.

Bhs—8 to 9 inches; dark reddish brown (5YR 3/2) sand; common medium prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine to coarse roots; about 35 percent strongly cemented ortstein occurring as tongues; very strongly acid; abrupt irregular boundary.

Bs—9 to 17 inches; dark yellowish brown (10YR 4/6) sand; many fine prominent strong brown (7.5YR 5/8) and common medium prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure parting to weak fine granular; very friable; common fine and medium roots; strongly acid; gradual wavy boundary.

BC—17 to 24 inches; yellowish brown (10YR 5/4) sand; common fine prominent strong brown (7.5YR 5/8) mottles; very weak medium subangular blocky structure parting to single grain; loose; few fine and medium roots; strongly acid; gradual wavy boundary.

C—24 to 60 inches; light yellowish brown (10YR 6/4) sand; common fine prominent (7.5YR 5/8) mottles; single grain; loose; moderately acid.

The thickness of the solum ranges from 20 to 31 inches. The content of gravel ranges from 0 to 10 percent throughout the profile. All horizons are sand.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 3.

The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3.

The Bs horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 to 6. The content of ortstein in the Bhs and Bs horizons ranges from 0 to 40 percent.

The BC horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4.

Ausable Series

The Ausable series consists of very poorly drained soils on narrow flood plains. These soils formed in a thin mantle of organic material and sandy alluvium. Permeability is moderate or moderately rapid in the organic material and rapid in the sandy material. Slope ranges from 0 to 2 percent.

Typical pedon of Ausable muck, in an area of Ausable-Bowstring mucks, frequently flooded, 1,500

feet east and 500 feet south of the northwest corner of sec. 27, T. 27 N., R. 3 W., Grayling Township:

- Oa—0 to 10 inches; muck, black (N 2/0) broken face and rubbed; about 20 percent fiber, 5 percent rubbed; weak medium granular structure; very friable; primarily herbaceous fiber; slightly acid; abrupt wavy boundary.
- C—10 to 20 inches; brown (10YR 5/3) sand that has thin layers of very dark brown (10YR 2/2) muck up to 2 inches thick; common medium faint dark grayish brown (10YR 4/2) mottles; single grain; loose; about 3 percent fine and medium gravel; neutral; clear wavy boundary.
- Cg1—20 to 37 inches; gray (5Y 5/1) gravelly sand that has thin layers of very dark grayish brown (10YR 3/2) muck up to 1 inch thick; single grain; loose; about 20 percent fine and medium gravel; slightly alkaline; clear wavy boundary.
- Cg2—37 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; about 5 percent fine and medium gravel; slightly alkaline.

The thickness of the organic material at the surface ranges from 8 to 14 inches. Thin bands of organic material occur in the control section. The content of gravel typically ranges from 0 to 20 percent by volume in the mineral material, but some thin strata may contain up to 40 percent gravel.

The Oa horizon and the thin bands of organic material in the C horizons have hue of 7.5YR or 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2.

The C horizons have hue of 10YR, 5Y, or 5GY, value of 4 to 6, and chroma of 1 to 3. They are dominantly sand, loamy sand, or the gravelly analogs of these textures. The individual bands of organic material range in thickness from $\frac{1}{8}$ inch to 4 inches with a total combined thickness of 4 to 10 inches. Some pedons have thin strata of very gravelly sand, very gravelly loamy sand, or loamy material.

Blue Lake Series

The Blue Lake series consists of well drained soils on moraines and outwash plains. These soils formed in sandy and loamy material. Permeability is moderately rapid. Slope ranges from 0 to 18 percent.

Typical pedon of Blue Lake loamy sand, 0 to 6 percent slopes, 1,800 feet south and 1,500 feet west of the northeast corner of sec. 33, T. 28 N., R. 4 W., Frederic Township:

- Oe—0 to 1 inch; partially decomposed leaf litter; abrupt wavy boundary.

- A—1 to 2 inches; very dark grayish brown (10YR 3/2) loamy sand, gray (10YR 5/1) dry; moderate fine subangular blocky structure; very friable; many fine and medium and few coarse roots; about 3 percent fine and medium gravel; strongly acid; abrupt smooth boundary.
- E—2 to 6 inches; brown (7.5YR 5/2) loamy sand, pinkish gray (7.5YR 6/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; very friable; common fine and medium and few coarse roots; about 3 percent fine and medium gravel; strongly acid; abrupt wavy boundary.
- Bhs—6 to 10 inches; dark reddish brown (5YR 3/2) loamy sand; moderate medium subangular blocky structure; friable; common fine and medium and few coarse roots; about 5 percent weakly cemented ortstein; about 3 percent fine and medium gravel; strongly acid; abrupt wavy boundary.
- Bs—10 to 21 inches; dark yellowish brown (10YR 4/4) loamy sand; moderate medium subangular blocky structure parting to moderate fine granular; very friable; few fine and medium roots; about 3 percent fine and medium gravel; moderately acid; clear wavy boundary.
- E and Bt—21 to 71 inches; light yellowish brown (10YR 6/4) sand (E), light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; bands of brown (7.5YR 5/4) and strong brown (7.5YR 5/6) loamy sand and sandy loam (Bt); moderate very fine to medium subangular blocky structure; friable; few fine and medium roots in the upper half of the horizon; common faint strong brown (7.5YR 4/6) clay films on faces of peds and clay bridges between sand grains; bands range in thickness from $\frac{1}{8}$ inch to 3 inches with a total accumulation of about 9 inches; about 7 percent fine and medium gravel; about 1 percent cobbles; moderately acid; gradual wavy boundary.
- C—71 to 80 inches; brown (10YR 5/3) sand; single grain; loose; moderately acid.

The thickness of the solum ranges from 50 to more than 70 inches. The content of gravel ranges from 0 to 10 percent throughout the profile, and the content of cobbles ranges from 0 to 3 percent.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly loamy sand, but the range includes sand.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2. It is sand or loamy sand.

The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. It is sand or loamy sand.

The Bs horizon has hue of 7.5YR or 10YR, value of

4 or 5, and chroma of 4 to 6. It is loamy sand or sand. The Bhs and Bs horizons have 0 to 15 percent weakly cemented chunks or tongues of ortstein.

The depth to the E and Bt horizon ranges from about 18 to 31 inches. The E part of the E and Bt horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand or loamy sand. The Bt part has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is loamy sand or sandy loam. The Bt part occurs as bands 1/8 inch to 4 inches thick with a total accumulation of 6 to 12 inches.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3.

Borosaprists

Borosaprists consist of very poorly drained, moderately rapidly permeable to moderately slowly permeable soils on lake plains, outwash plains, and moraines. These soils formed in organic material. Slope is 0 to 1 percent.

The thickness of the organic material ranges from 16 to more than 50 inches. The soils may be dysic or euic.

Surface textures are typically muck or mucky peat in euic areas and peat in dysic areas. Subsurface layers are dominantly muck. Organic layers have hue of 5YR, 7.5YR, or 10YR, value of 2 to 4, and chroma of 1 to 4. Colors in euic areas are dominantly black or dark reddish brown. They are dominantly dark brown in dysic areas.

Mineral layers in the substratum have hue of 5YR to 5Y, value of 5 or 6, and chroma of 1 to 3. Textures range from sand to sandy clay loam.

Bowers Series

The Bowers series consists of somewhat poorly drained soils on lake plains. These soils formed in stratified, loamy material. Permeability is slow. Slope ranges from 0 to 3 percent.

Typical pedon of Bowers loam, in an area of Bowers-Deerheart complex, 0 to 3 percent slopes, 350 feet north and 700 feet east of the southwest corner of sec. 15, T. 25 N., R. 2 W., South Branch Township:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; very friable; many fine and common medium roots; neutral; abrupt smooth boundary.

B/E—8 to 11 inches; about 70 percent dark brown (10YR 4/3) silty clay loam (B); few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; about 30 percent pockets and ped coatings of grayish brown

(10YR 5/2) sandy loam (E), light gray (10YR 7/2) dry; many fine roots; common distinct dark brown (7.5YR 4/4) clay films on faces of peds and in root channels; neutral; clear wavy boundary.

Bt—11 to 25 inches; dark brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure parting to moderate fine subangular blocky; firm; common fine roots; common distinct dark brown (7.5YR 4/4) clay films on faces of peds and in root channels; neutral; clear wavy boundary.

BC—25 to 45 inches; brown (10YR 5/3) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and common fine distinct gray (10YR 5/1) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; common distinct light gray (10YR 7/2) calcium carbonate accumulations on faces of peds; strongly effervescent; moderately alkaline; clear wavy boundary.

C—45 to 80 inches; light yellowish brown (2.5Y 6/4), stratified silty clay loam and silt loam; common medium prominent brownish yellow (10YR 6/6) and gray (5Y 6/1) mottles; massive; common distinct light gray (10YR 7/2) calcium carbonate accumulations along fracture planes; common prominent light brownish gray (10YR 6/2) gleyed coatings along fracture planes; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 24 to 50 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly loam, but the range includes sandy loam and fine sandy loam.

The E part of the B/E horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. It is loam or sandy loam. Some pedons have an E or an E/B horizon.

The B part of the B/E horizon and the Bt horizon have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. They are silty clay loam or clay loam.

The BC horizon has colors and textures similar to those of the Bt horizon.

The C horizon has hue of 7.5YR to 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is stratified silty clay loam and silt loam.

Bowstring Series

The Bowstring series consists of very poorly drained soils on narrow flood plains. These soils formed in more than 51 inches of organic material that has thin layers of sand. Permeability is moderately rapid to

moderately slow. Slope is 0 to 1 percent.

Typical pedon of Bowstring muck, in an area of Ausable-Bowstring mucks, frequently flooded, 2,300 feet east and 800 feet south of the northwest corner of sec. 35, T. 27 N., R. 4 W., Frederic Township:

Oa1—0 to 19 inches; muck, black (N 2/0) broken face and rubbed; about 10 percent fiber, less than 2 percent rubbed; moderate medium and coarse subangular blocky structure parting to weak fine granular; very friable; common fine and medium and few coarse roots; primarily herbaceous fibers with about 5 percent woody fragments; thin bands of gray (5Y 5/1) sand in the lower 5 inches; neutral; clear smooth boundary.

Oa2—19 to 34 inches; muck, dark reddish brown (5YR 2/2) broken face and black (10YR 2/1) rubbed; about 30 percent fiber, less than 2 percent rubbed; massive; primarily herbaceous fibers; slightly alkaline; abrupt smooth boundary.

Cg—34 to 38 inches; gray (5Y 5/1) sand; single grain; loose; thin bands of very dark brown (10YR 2/2) muck; slightly alkaline; abrupt smooth boundary.

O'a—38 to 60 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; about 15 percent fiber, less than 2 percent rubbed; massive; primarily herbaceous fibers; thin bands of gray (5Y 5/1) sand throughout the horizon; slightly alkaline.

The organic material is primarily herbaceous, but woody material makes up as much as 30 percent in some pedons. Thin layers of mineral soil material are within the organic material. The thickness of the Cg horizon does not exceed 8 inches. Depth to the Cg horizon ranges from 18 to 48 inches.

The O horizons have hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2, or they are neutral in hue and have value of 2. The organic material is dominantly muck, but some pedons have thin layers of mucky peat.

The C horizon has hue of 10YR or 5Y, value of 5 or 6, and chroma of 1 or 2. It is sand or fine sand.

Croswell Series

The Croswell series consists of moderately well drained soils on stream terraces and outwash plains. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 6 percent.

Typical pedon of Croswell sand, in an area of Croswell-Au Gres sands, 0 to 3 percent slopes, 1,200 feet west and 1,250 feet north of the southeast corner of sec. 15, T. 28 N., R. 1 W., Lovells Township:

Oe—0 to 1 inch; partially decomposed leaves, grass, and pine needles; abrupt wavy boundary.

A—1 to 2 inches; black (10YR 2/1) sand, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; very friable; many fine and medium and few coarse roots; about 30 percent uncoated sand grains from the E horizon; extremely acid; abrupt smooth boundary.

E—2 to 5 inches; brown (7.5YR 5/2) sand, pinkish gray (7.5YR 6/2) dry; weak medium granular structure; very friable; many fine and medium and few coarse roots; about 2 percent fine and medium gravel; very strongly acid; abrupt wavy boundary.

Bs1—5 to 11 inches; dark brown (7.5YR 4/4) sand; weak medium subangular blocky structure parting to weak fine granular; very friable; common fine and medium and few coarse roots; about 2 percent fine and medium gravel; strongly acid; clear wavy boundary.

Bs2—11 to 16 inches; strong brown (7.5YR 4/6) sand; weak medium subangular blocky structure parting to weak fine granular; very friable; common fine and medium and few coarse roots; strongly acid; clear wavy boundary.

BC—16 to 30 inches; yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) sand; common fine prominent strong brown (7.5YR 4/6) mottles beginning at a depth of 25 inches; single grain; loose; few fine and medium roots; about 3 percent fine and medium gravel; strongly acid; gradual wavy boundary.

C—30 to 80 inches; pale brown (10YR 6/3) sand; common medium prominent yellowish brown (10YR 5/8) mottles; single grain; loose; about 3 percent fine and medium gravel; moderately acid.

The thickness of the solum ranges from 25 to 45 inches. The content of gravel ranges from 0 to 15 percent throughout the profile. All horizons are sand. The depth to mottling ranges from 20 to 40 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2.

The Bs1 horizon has hue of 7.5YR, value of 3 or 4, and chroma of 4. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The BC horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. The content of ortstein in the B horizons ranges from 0 to 20 percent. The ortstein occurs as chunks or tongues.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4.

Dawson Series

The Dawson series consists of very poorly drained soils on outwash plains and lake plains. These soils

formed in 16 to 51 inches of organic material overlying sand. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sand. Slope ranges from 0 to 2 percent.

Typical pedon of Dawson peat, in an area of Dawson-Loxley peats, 1,900 feet south and 2,800 feet east of the northwest corner of sec. 22, T. 28 N., R. 2 W., Lovells Township:

Oi—0 to 4 inches; peat, dark yellowish brown (10YR 4/4) broken face, yellowish brown (10YR 5/4) rubbed; about 100 percent fiber, 95 percent rubbed; massive; common fine and medium roots; primarily sphagnum moss fibers; extremely acid; abrupt smooth boundary.

Oa1—4 to 9 inches; muck, black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed; about 40 percent fiber, 10 percent rubbed; massive; primarily herbaceous fibers; extremely acid; abrupt wavy boundary.

Oa2—9 to 40 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; about 20 percent fiber, less than 5 percent rubbed; massive; primarily herbaceous fibers; extremely acid; abrupt wavy boundary.

Oa3—40 to 43 inches; muck, black (N 2/0) broken face and rubbed; about 15 percent fiber, less than 1 percent rubbed; massive; primarily herbaceous fibers; very strongly acid; abrupt wavy boundary.

A—43 to 51 inches; very dark grayish brown (10YR 3/2) sand; single grain; loose; very strongly acid; abrupt wavy boundary.

C—51 to 60 inches; dark brown (7.5YR 3/4) sand; single grain; loose; strongly acid.

The organic material is primarily herbaceous. The depth to the mineral horizon ranges from 16 to 51 inches.

The surface tier has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. The subsurface and bottom tiers have hue of 5YR to 10YR or are neutral in hue. They have value of 2 to 4 and chroma of 0 to 3. They are dominantly muck, but some pedons have layers of mucky peat having a total thickness of less than 10 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 1 to 3. It is sand.

The C horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. It is sand.

Deerheart Series

The Deerheart series consists of poorly drained soils in depressions on lake plains. These soils formed in stratified silty and loamy glaciolacustrine deposits.

Permeability is slow. Slope ranges from 0 to 2 percent.

Typical pedon of Deerheart silt loam, in an area of Bowers-Deerheart complex, 0 to 3 percent slopes, 750 feet north and 800 feet east of the southwest corner of sec. 15, T. 25 N., R. 2 W., South Branch Township:

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; many fine prominent strong brown (7.5YR 4/6) mottles; moderate fine and medium subangular blocky structure; friable; many fine and common medium roots; about 1 percent fine gravel; slightly acid; abrupt smooth boundary.

Bg—6 to 27 inches; gray (10YR 5/1) silty clay loam; many fine prominent yellowish brown (10YR 5/8) and common fine distinct gray (5Y 5/1) mottles; moderate medium and coarse subangular blocky structure; firm; common fine and few medium roots; few distinct dark grayish brown (10YR 4/2) clay coatings in root channels; about 1 percent fine gravel; neutral; clear wavy boundary.

BC—27 to 43 inches; light olive brown (2.5Y 5/4) silty clay loam that has thin strata of silt and silt loam; many medium prominent yellowish brown (10YR 5/8) and common coarse prominent light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; firm; common prominent greenish gray (5GY 5/1) gley coatings on faces of peds and along fracture planes; about 10 percent light gray (10YR 7/1) calcium carbonate accumulations along faces of peds; about 1 percent fine gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C—43 to 80 inches; brown (10YR 5/3) silty clay loam stratified with light olive brown (2.5Y 5/4) very fine sandy loam, silt, and silt loam; many coarse distinct yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; massive; firm; about 1 percent fine and medium gravel; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 20 to 48 inches. The depth to free carbonates ranges from 20 to 35 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam and silty clay loam. Pedons in undisturbed areas have a thin O horizon overlying an A horizon.

The Bg horizon has hue of 10YR to 5G, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or clay loam.

The BC horizon has hue of 2.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is dominantly silty clay

loam or clay loam that has thin strata of clay, silt, silt loam, or very fine sandy loam.

The C horizon has hue of 7.5YR to 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is dominantly silty clay loam or clay loam that has strata of loamy very fine sand, very fine sandy loam, silt, silt loam, and clay.

Entic Haplorthods

Entic Haplorthods consist of excessively drained, rapidly permeable soils on outwash plains, lake plains, and moraines. These soils formed in sandy glacial drift. Slope ranges from 0 to 45 percent.

These soils are classified as sandy, mixed, frigid Entic Haplorthods.

Reference pedon of Entic Haplorthods, sandy, in an area of Entic Haplorthods, sandy-Alfic Haplorthods, sandy complex, rolling, 500 feet west and 10 feet south of the northeast corner of sec. 22, T. 26 N., R. 5 E., in Alcona County, Michigan:

- Oe—0 to 1 inch; partially decomposed hardwood and coniferous leaf litter.
- A—1 to 3 inches; black (10YR 2/1) sand; weak fine granular structure; very friable; many very fine and fine roots; strongly acid; clear wavy boundary.
- E—3 to 7 inches; brown (7.5YR 5/3) sand; weak fine granular structure; very friable; many very fine, common fine, and few medium roots; strongly acid; clear wavy boundary.
- Bs1—7 to 11 inches; dark brown (7.5YR 4/4) sand; weak medium granular structure; very friable; many fine and few medium and coarse roots; strongly acid; clear smooth boundary.
- Bs2—11 to 23 inches; strong brown (7.5YR 4/6) sand; weak medium granular structure; very friable; common fine and medium and few coarse roots; strongly acid; clear smooth boundary.
- BC—23 to 30 inches; brownish yellow (10YR 6/6) sand; weak fine subangular blocky structure; strongly acid; gradual smooth boundary.
- C1—30 to 66 inches; very pale brown (10YR 7/4) sand; single grain; loose; few medium roots; moderately acid; gradual wavy boundary.
- C2—66 to 180 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; moderately acid.

The thickness of the solum ranges from 20 to 50 inches. The content of gravel ranges from 0 to 10 percent throughout the solum.

The A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3. It is dominantly sand, but the range includes fine sand and loamy sand.

The E horizon has hue of 10YR or 7.5YR, value of 5

to 7, and chroma of 2 to 4. It has textures similar to those of the A horizon.

The Bs horizons have hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. They are sand, loamy sand, or fine sand.

The BC horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6.

The C horizons have hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 4 to 6. They are sand or coarse sand. Sandy clay loam or clay loam is below a depth of 40 inches in the loamy substratum phase. Gravelly sand or gravelly coarse sand is in some pedons.

Eutroboralfs

Eutroboralfs consist of well drained or moderately well drained, moderately permeable or moderately rapidly permeable soils on moraines and outwash plains. These soils formed in sandy and loamy material. Slope ranges from 0 to 45 percent.

The thickness of the solum ranges from 40 to more than 80 inches. The content of gravel ranges from 0 to 15 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is loamy sand or sand.

The Bw horizons have hue of 10YR, value of 4 to 6, and chroma of 4 to 8, or they have hue of 7.5YR, value of 4 or 5, and chroma of 6. They are sand or loamy sand.

The E part of the E and Bt and B/E horizons has hue of 10YR, value of 5 to 7, and chroma of 2 to 4. It is sand or loamy sand.

The Bt part of the E and Bt and B/E horizons has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The Bt part of the E and Bt horizon consists of lamellae $\frac{1}{8}$ inch to 3 inches thick. The B part of the B/E horizon and the Bt lamellae have a total accumulation of more than 6 inches. They are sandy loam or loamy sand.

Some pedons have a C horizon, which has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sand.

Feldhauser Series

The Feldhauser series consists of moderately well drained soils on moraines and outwash plains. These soils formed in loamy till or glaciofluvium underlain by sandy outwash deposits. Permeability is moderate in the loamy material and rapid in the sandy material. Slope ranges from 0 to 6 percent.

Typical pedon of Feldhauser fine sandy loam, 0 to 6 percent slopes, 2,550 feet west and 900 feet south of the northeast corner of sec. 28, T. 28 N., R. 3 W., Maple Forest Township:

Ap—0 to 10 inches; dark brown (10YR 3/3) fine sandy

loam, light brownish gray (10YR 6/2) dry; moderate medium and coarse subangular blocky structure; friable; many fine roots; about 5 percent fine and medium gravel; about 1 percent cobbles; moderately acid; abrupt smooth boundary.

Bw—10 to 18 inches; dark yellowish brown (10YR 4/4) fine sandy loam; moderate medium and coarse subangular blocky structure; friable; many fine roots; about 5 percent fine and medium gravel; about 1 percent cobbles; moderately acid; clear wavy boundary.

E—18 to 21 inches; yellowish brown (10YR 5/4) fine sandy loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; friable; common fine roots; about 5 percent fine and medium gravel; about 1 percent cobbles; moderately acid; clear wavy boundary.

Bt1—21 to 30 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate coarse subangular blocky structure; firm; common fine roots; many prominent strong brown (7.5YR 4/6) and many faint dark brown (10YR 4/3) clay films on faces of peds and in root channels; about 5 percent fine and medium gravel; about 1 percent cobbles; moderately acid; clear wavy boundary.

Bt2—30 to 39 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine and medium prominent yellowish red (5YR 5/8) mottles; moderate coarse subangular blocky structure; firm; common fine roots; many prominent strong brown (7.5YR 4/6) and many faint dark brown (10YR 4/3) clay films on faces of peds and in root channels; about 5 percent fine and medium gravel; about 1 percent cobbles; moderately acid; clear wavy boundary.

2E and Bt—39 to 54 inches; light yellowish brown (10YR 6/4) sand, light brownish gray (10YR 6/2) dry (E); very weak coarse subangular blocky structure parting to single grain; loose; lamellae of strong brown (7.5YR 4/6) loamy sand (Bt); weak fine and medium subangular blocky structure; very friable; common clay bridging between sand grains; lamellae are ¼ inch to 2 inches thick; about 10 percent fine and medium gravel; moderately acid; clear wavy boundary.

2C—54 to 80 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 10 percent fine and medium gravel; neutral.

Lamellae extend to a depth of 30 to 60 inches. The thickness of the solum ranges from 35 to more than 60 inches. The content of gravel ranges from 0 to 10 percent throughout the profile, and the content of cobbles ranges from 0 to 5 percent.

The Ap horizon has hue of 10YR, value of 2 to 4,

and chroma of 1 to 3. Dry value is 6 or more. This horizon is dominantly fine sandy loam, but the range includes sandy loam or loam. Pedons in undisturbed areas have a thin O horizon overlying an A horizon. Some pedons have a thin E horizon below an A horizon.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 4 to 6. It is sandy loam, fine sandy loam, or loam.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is sandy loam, fine sandy loam, or loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 3 to 6. It sandy loam, fine sandy loam, or loam.

The E part of the 2E and Bt horizon has the same colors as the E horizon. It is sand or loamy sand. The Bt part of the 2E and Bt horizon consists of lamellae ¼ inch to 2 inches thick. It has the same colors as the Bt horizon. It is sand, loamy sand, or sandy loam.

The 2C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 to 6. It is sand or loamy sand.

Glossic Eutroboralfs

Glossic Eutroboralfs consist of well drained, moderately permeable soils on moraines. These soils formed in loamy and sandy glacial till. Slope ranges from 0 to 30 percent.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is dominantly sandy loam, but the range includes loamy sand.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam or loamy sand.

The E part of the B/E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. It is sandy loam or loamy sand.

The Bt part of the B/E horizon and the Bt horizon have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4. They are sandy clay loam, sandy loam, loam, or clay loam.

The C or 2C horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6, and chroma of 4 to 6. It is loamy sand, sandy loam, loam, sandy clay loam, or clay loam. It is commonly stratified.

Graycalm Series

The Graycalm series consists of somewhat excessively drained soils on outwash plains, kames, and moraines. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 50 percent.

Typical pedon of Graycalm sand (fig. 17), 0 to 6

percent slopes, 2,150 feet south and 1,400 feet east of the northwest corner of sec. 19, T. 25 N., R. 4 W., Beaver Creek Township:

- Oe—0 to 2 inches; partially decomposed leaf litter.
- A—2 to 5 inches; dark brown (10YR 4/3) sand, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to weak fine granular; very friable; many very fine to medium and few coarse roots; about 2 percent fine and medium gravel; very strongly acid; abrupt wavy boundary.
- Bw1—5 to 18 inches; dark yellowish brown (10YR 4/4) sand; weak medium subangular blocky structure parting to weak fine granular; very friable; common very fine to medium roots; strongly acid; clear wavy boundary.
- Bw2—18 to 27 inches; yellowish brown (10YR 5/4) sand; very weak coarse subangular blocky structure parting to single grain; very friable to loose; common fine and few coarse roots; about 5 percent fine and medium gravel; strongly acid; clear wavy boundary.
- E and Bt—27 to 80 inches; light yellowish brown (10YR 6/4) sand, very pale brown (10YR 7/3) dry (E); single grain; loose; lamellae of yellowish brown (10YR 5/6) loamy sand and strong brown (7.5YR 4/6) sandy loam (Bt); moderate very fine to medium subangular blocky structure; friable; few fine to coarse roots; about 5 percent fine and medium gravel; lamellae are $\frac{1}{8}$ to 1 inch thick with a total accumulation of about 4 inches; moderately acid.

The solum thickness ranges from 50 to more than 80 inches. The content of gravel ranges from 0 to 15 percent throughout the profile. The depth to the first Bt lamellae ranges from 25 to 48 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly sand, but the range includes loamy sand. Some pedons have an E horizon as much as 3 inches thick. This horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3.

The Bw horizon has hue of 10YR, value of 3 to 6, and chroma of 4 to 6, or it has hue of 7.5YR, value of 4 or 5, and chroma of 6. It is sand or loamy sand.

The E part of the E and Bt horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand or loamy sand. The Bt part of the E and Bt horizon has hue of 7.5YR or 10YR, value of 3 to 6, and chroma of 4 to 6. It is loamy sand or sandy loam. The Bt part consists of lamellae $\frac{1}{8}$ inch to 2 inches thick with a total accumulation of less than 6 inches.

Some pedons have a C horizon, which has hue of 10YR, value of 6 or 7, and chroma of 3 or 4. It is sand.

Grayling Series

The Grayling series consists of excessively drained soils on outwash plains, kames, and moraines. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 45 percent.

Typical pedon of Grayling sand (fig. 18), 0 to 6 percent slopes, 2,500 feet north and 1,200 feet east of the southwest corner of sec. 19, T. 27 N., R. 4 W., Frederic Township:

- A—0 to 3 inches; black (10YR 2/1) sand, very dark grayish brown (10YR 3/2) dry; mixed with about 25 percent grayish brown (10YR 5/2), uncoated sand grains; weak fine granular structure; very friable; many very fine and fine and common medium and coarse roots; very strongly acid; abrupt wavy boundary.
- Bw1—3 to 10 inches; strong brown (7.5YR 4/6) sand; weak fine and medium subangular blocky structure parting to single grain; very friable; common very fine and fine and few medium and coarse roots; about 1 percent fine and medium gravel; moderately acid; gradual wavy boundary.
- Bw2—10 to 18 inches; dark yellowish brown (10YR 4/6) sand; weak fine and medium subangular blocky structure parting to single grain; very friable; common very fine and fine roots; about 2 percent fine and medium gravel; slightly acid; gradual wavy boundary.
- BC—18 to 23 inches; brownish yellow (10YR 6/6) sand; single grain; loose; few fine roots; about 2 percent fine and medium gravel; slightly acid; gradual wavy boundary.
- C—23 to 80 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 3 percent fine and medium gravel; slightly acid.

The thickness of the solum ranges from 15 to 32 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is sand. Some pedons have a thin O horizon above the A horizon.

The Bw horizon has hue of 10YR and value and chroma of 4 to 6, or it has hue of 7.5YR, value of 5 or 6, and chroma of 4 to 6. The BC horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. The B horizons are sand.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is sand or coarse sand.

Haplorthods

Haplorthods consist of excessively drained to moderately well drained, rapidly permeable soils on

outwash plains. These soils formed in dominantly sandy outwash materials. Slope ranges from 0 to 45 percent.

The thickness of the solum ranges from 20 to 50 inches. The texture is dominantly sand throughout the profile, but some loamy sand is in the subsoil and coarse sand is in the substratum. The content of coarse fragments ranges from 0 to 15 percent.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3.

The Bs1 horizon has hue of 5YR or 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 8.

The C horizon has hue of 10YR, value of 5 to 7, and chroma of 3 to 6.

Hartwick Series

The Hartwick series consists of excessively drained soils on outwash plains and moraines. These soils formed in sandy and gravelly glaciofluvial material. Permeability is rapid. Slope ranges from 0 to 6 percent.

Typical pedon of Hartwick sand, 0 to 6 percent slopes, in a forested area beneath a 1-inch layer of fresh, undecomposed needles, twigs, and grass; 600 feet east and 550 feet south of the northwest corner of sec. 3, T. 27 N., R. 3 W., Grayling Township:

- A—0 to 2 inches; black (N 2/0) sand, black (10YR 2/1) dry; mixed with 20 percent brown (7.5YR 5/2), uncoated sand grains; weak fine subangular blocky structure; very friable; many fine, common medium, and few coarse roots; about 3 percent fine gravel; very strongly acid; abrupt smooth boundary.
- E—2 to 4 inches; brown (7.5YR 5/2) sand, pinkish gray (7.5YR 6/2) dry; very weak fine subangular blocky structure parting to weak fine granular; very friable; many fine, common medium, and few coarse roots; about 3 percent fine gravel; strongly acid; abrupt wavy boundary.
- Bs1—4 to 8 inches; dark brown (7.5YR 3/4) sand; moderate fine and medium subangular blocky structure; very friable; many fine, common medium, and few coarse roots; about 8 percent fine gravel and 2 percent medium gravel; about 1 percent cobbles; moderately acid; clear wavy boundary.
- Bs2—8 to 24 inches; strong brown (7.5YR 4/6) very gravelly sand; weak fine and medium subangular blocky structure parting to weak fine granular; very friable; common fine and few medium and coarse roots; columns of yellowish brown (10YR 5/6) (70 percent) and dark reddish brown (5YR 3/2) (30

percent) moderately cemented ortstein 1 to 3 inches wide extending through the horizon; columns are 24 to 36 inches apart; ortstein occupies about 5 percent of the horizon; about 20 percent fine, 10 percent medium, and 5 percent coarse gravel; about 1 percent cobbles; moderately acid; clear wavy boundary.

BC—24 to 30 inches; yellowish brown (10YR 5/6) sand; weak fine and medium subangular blocky structure parting to single grain; very friable to loose; few fine, medium, and coarse roots; about 5 percent fine and 2 percent medium gravel; moderately acid; clear wavy boundary.

2C1—30 to 39 inches; light yellowish brown (10YR 6/4) very gravelly sand; single grain; loose; few fine and medium roots; about 35 percent fine, 10 percent medium, and 5 percent coarse gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

2C2—39 to 80 inches; pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) sand; single grain; loose; about 5 percent fine and 2 percent medium gravel; slightly alkaline.

The depth to free carbonates ranges from 25 to 50 inches. The content of gravel ranges from 0 to 50 percent by volume in individual horizons or strata but averages 10 to 35 percent in the particle-size control section. The content of gravel below a depth of 40 inches averages less than 25 percent. The content of cobbles ranges from 0 to 3 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 3. The A and E horizons are dominantly sand, but the range includes loamy sand and the gravelly analogs of sand and loamy sand. Some pedons have an Ap horizon, which has colors similar to those of the A horizon.

The Bs1 horizon has hue of 7.5YR and value and chroma of 3 or 4. Value and chroma of 3 do not occur together. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The Bs horizons are sand, loamy sand, or the gravelly or very gravelly analogs of these textures. The content of ortstein in the Bs horizons ranges from 0 to 20 percent.

The BC horizon has hue of 10YR, value of 4 to 6, and chroma of 6 to 8. It is sand, loamy sand, or the gravelly or very gravelly analogs of these textures.

The C horizons have hue of 10YR, value of 6 or 7, and chroma of 2 to 4. They are dominantly sand that has thin strata of gravelly sand or very gravelly sand.

Histosols

Histosols consist of very poorly drained, moderately rapidly permeable to moderately slowly permeable soils on lake plains, outwash plains, and moraines. These soils formed in organic material. Slope is 0 to 1 percent.

Thickness of the organic material ranges from 16 to more than 50 inches. Surface horizons are dominantly muck or mucky peat, but the range includes peat. Subsurface horizons are dominantly muck, but the range includes mucky peat. Organic materials typically have hue of 5YR, 7.5YR, or 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. Mineral horizons in the substratum range from sand to clay. They have hue of 5YR to 5Y, value of 5 or 6, and chroma of 1 to 3.

Kalkaska Series

The Kalkaska series consists of somewhat excessively drained soils on outwash plains and moraines. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 50 percent.

Typical pedon of Kalkaska sand (fig. 19), 0 to 6 percent slopes, 1,900 feet south and 800 feet east of the northwest corner of sec. 24, T. 28 N., R. 4 W., Frederic Township:

Oe—0 to 2 inches; partially decomposed leaf litter.

A—2 to 6 inches; very dark gray (10YR 3/1) sand, dark gray (10YR 4/1) dry; weak medium granular structure; very friable; many fine and common medium and coarse roots; about 30 percent uncoated sand grains from the E horizon; about 2 percent fine gravel; about 2 percent cobbles; strongly acid; abrupt wavy boundary.

E—6 to 11 inches; grayish brown (10YR 5/2) sand, light brownish gray (10YR 6/2) dry; very weak fine subangular blocky structure parting to single grain; very friable to loose; common fine to coarse roots; about 4 percent fine and medium gravel; about 2 percent cobbles; strongly acid; abrupt wavy boundary.

Bhs—11 to 14 inches; dark brown (7.5YR 3/2) sand; weak fine subangular blocky structure parting to single grain; very friable; many fine to coarse roots; about 5 percent vertical tongues of moderately cemented ortstein extending down into the Bs1 horizon; about 4 percent fine and medium gravel; about 2 percent cobbles; strongly acid; abrupt irregular boundary.

Bs1—14 to 22 inches; brown (7.5YR 4/4) sand; weak fine and medium subangular blocky structure parting to single grain; very friable to loose;

common fine to coarse roots; about 5 percent vertical tongues of moderately cemented ortstein; about 4 percent fine and medium gravel; about 2 percent cobbles; strongly acid; clear wavy boundary.

Bs2—22 to 37 inches; dark yellowish brown (10YR 4/6) sand; weak fine and medium subangular blocky structure parting to single grain; very friable to loose; common medium and few coarse roots; about 5 percent vertical tongues of weakly cemented ortstein in the upper 8 inches; about 4 percent fine and medium gravel; about 2 percent cobbles; strongly acid; clear wavy boundary.

BC—37 to 44 inches; yellowish brown (10YR 5/6) sand; weak fine and medium subangular blocky structure parting to single grain; very friable to loose; few fine to coarse roots; about 4 percent fine and medium gravel; about 2 percent cobbles; strongly acid; gradual wavy boundary.

C—44 to 80 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 4 percent fine and medium gravel; about 2 percent cobbles; strongly acid.

The thickness of the solum ranges from 30 to 50 inches. The content of gravel ranges from 0 to 10 percent throughout the profile, and the content of cobbles ranges from 0 to 3 percent.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is dominantly sand, but the range includes loamy sand.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 or 2. It is sand or loamy sand.

The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. It is sand or loamy sand.

The Bs1 horizon has hue of 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 5 or 6. The content of ortstein in the B horizons ranges from 0 to 30 percent. The Bs horizons are sand.

The BC horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is sand.

The C horizon has hue of 10YR, value of 5 to 7, and chroma of 4 to 6. It is sand.

Kellogg Series

The Kellogg series consists of moderately well drained soils on lake plains and outwash plains. These soils formed in sandy outwash material underlain by clayey lacustrine deposits. Permeability is rapid in the sandy material and very slow in the clayey material. Slope ranges from 0 to 6 percent.

Typical pedon of Kellogg sand (fig. 20), 0 to 6 percent slopes, 700 feet south and 400 feet west of the

northeast corner of sec. 13, T. 25 N., R. 2 W., South Branch Township:

- Oe—0 to 2 inches; black (N 2/0), partially decomposed leaves, needles, and twigs; abrupt wavy boundary.
- E—2 to 6 inches; pinkish gray (7.5YR 6/2) sand, pinkish gray (7.5YR 7/2) dry; weak fine subangular blocky structure parting to single grain; very friable; many fine and common medium and coarse roots; about 1 percent fine gravel; strongly acid; abrupt wavy boundary.
- Bs1—6 to 14 inches; dark brown (7.5YR 4/4) sand; weak fine and medium subangular blocky structure; very friable; common fine to coarse roots; about 1 percent fine gravel; about 1 percent cobbles; strongly acid; gradual wavy boundary.
- Bs2—14 to 26 inches; strong brown (7.5YR 5/6) sand; weak fine and medium subangular blocky structure; very friable; common fine to coarse roots; about 4 percent fine gravel; about 2 percent cobbles; moderately acid; abrupt wavy boundary.
- 2B/E—26 to 29 inches; about 60 percent dark brown (7.5YR 4/4) silty clay (B); common fine prominent yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; firm; completely surrounded by or penetrated by tongues of pinkish gray (7.5YR 6/2) loamy sand, pinkish gray (7.5YR 7/2) dry (E); moderate fine and medium subangular blocky structure; friable; few fine and common medium roots; about 1 percent fine gravel; slightly acid; clear irregular boundary.
- 2Bt—29 to 40 inches; dark brown (7.5YR 4/4) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to strong medium and coarse angular blocky; very firm; few fine to coarse roots; many distinct strong brown (7.5YR 4/6) clay films on faces of peds; slightly alkaline; clear irregular boundary.
- 2C—40 to 80 inches; brown (7.5YR 5/4) silty clay; many fine prominent olive yellow (2.5Y 6/6) and common fine prominent yellowish brown (10YR 5/8) mottles; massive; very firm; few fine and medium roots in the upper 24 inches; strongly effervescent; moderately alkaline.

The depth to the 2Bt horizon ranges from 20 to 40 inches. The depth to carbonates ranges from 24 to 50 inches. The content of gravel ranges from 0 to 10 percent in the sandy material and from 0 to 2 percent in the underlying clay material. The content of cobbles ranges from 0 to 3 percent in the sandy material.

The O horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The E horizon has hue of 7.5YR or 10YR, value of 5

or 6, and chroma of 2 or 3. It is dominantly sand, but the range includes loamy sand. Some pedons have a thin A or Ap horizon above the E horizon. This horizon has colors similar to those of the O horizon.

The Bs1 horizon has hue of 7.5YR and value and chroma of 3 or 4. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 5 or 6. The content of ortstein in the Bs horizons ranges from 0 to 20 percent. The Bs horizons are sand or loamy sand.

The B part of the 2B/E horizon and the Bt horizon have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 5. They are clay, silty clay, or silty clay loam. The E part of the 2B/E horizon has colors and textures similar to those of the E horizon. Some pedons have an E' or E/B horizon above the 2Bt horizon.

The 2C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay, silty clay, or silty clay loam.

Kinross Series

The Kinross series consists of poorly drained soils on outwash plains and lake plains. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 2 percent.

Typical pedon of Kinross muck, in an area of Kinross-Au Gres complex, 0 to 3 percent slopes, 100 feet south and 2,030 feet west of the northeast corner of sec. 5, T. 26 N., R. 4 W., Grayling Township:

- Oa—0 to 3 inches; muck, black (10YR 2/1) broken face and rubbed; about 80 percent fiber, 15 percent rubbed; weak medium granular structure; very friable; many fine to coarse roots; extremely acid; abrupt smooth boundary.
- E—3 to 10 inches; grayish brown (10YR 5/2) sand, light gray (10YR 7/2) dry; common medium faint dark grayish brown (10YR 4/2) mottles; very weak very fine subangular blocky structure; very friable; common fine and medium roots; strongly acid; abrupt irregular boundary.
- Bhs—10 to 14 inches; dark reddish brown (5YR 3/2) sand; moderate medium subangular blocky structure; friable; common fine and medium roots; ortstein occupies about 40 percent of the horizon and occurs as horizontal layers and vertical tongues; about 20 percent tongues of E material; very strongly acid; clear wavy boundary.
- Bs—14 to 22 inches; yellowish brown (10YR 5/6) sand; common medium distinct pale brown (10YR 6/3) mottles; weak fine subangular blocky structure; very friable; common fine roots; about 20 percent tongues of E and Bhs material; strongly acid; clear wavy boundary.
- C—22 to 60 inches; yellowish brown (10YR 5/4) sand;

common fine prominent strong brown (7.5YR 4/6) mottles; single grain; loose; moderately acid.

The thickness of the solum ranges from 16 to 28 inches. All mineral horizons are sand.

The Oa horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 1 or 2.

The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3.

The Bs horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The content of ortstein ranges from 10 to 45 percent in the Bhs and Bs horizons. Some pedons have a BC horizon, which has hue of 10YR, value of 4 or 5, and chroma of 4 to 6.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4.

Klacking Series

The Klacking series consists of well drained soils on outwash plains, kames, and moraines. These soils formed in sandy and loamy material. Permeability is moderately rapid. Slope ranges from 0 to 45 percent.

Typical pedon of Klacking loamy sand (fig. 21), in an area of Graycalm-Klacking complex, 0 to 6 percent slopes, 925 feet east and 210 feet south of the northwest corner of sec. 26, T. 25 N., R. 4 W., Beaver Creek Township:

Oe—0 to 1 inch; partially decomposed pine needles, grass, and leaves.

A—1 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; mixed with 30 percent grayish brown (10YR 5/2), uncoated sand grains; moderate fine subangular blocky structure parting to weak medium granular; very friable; common fine and medium and few coarse roots; about 3 percent fine and medium gravel; strongly acid; abrupt wavy boundary.

Bw1—3 to 13 inches; dark yellowish brown (10YR 4/6) sand; moderate medium subangular blocky structure parting to weak medium granular; very friable; common fine and medium and few coarse roots; about 3 percent fine and medium gravel; about 2 percent cobbles; strongly acid; clear wavy boundary.

Bw2—13 to 21 inches; yellowish brown (10YR 5/6) sand; moderate medium subangular blocky structure parting to weak fine granular; very friable; few fine to coarse roots; about 5 percent fine and medium gravel; about 2 percent cobbles;

moderately acid; clear wavy boundary.

E and Bt—21 to 39 inches; light yellowish brown (10YR 6/4) sand, very pale brown (10YR 7/3) dry (E); weak medium subangular blocky structure parting to single grain; very friable to loose; lamellae of brown (7.5YR 5/4) loamy sand (Bt); moderate very fine and fine subangular blocky structure; friable; lamellae are about 1/8 to 1/4 inch thick with a total accumulation of about 2 inches; about 2 percent fine and medium gravel; about 2 percent cobbles; moderately acid; clear wavy boundary.

B/E—39 to 46 inches; about 70 percent brown (7.5YR 5/4) sandy loam (Bt); moderate medium subangular blocky structure; friable; about 30 percent light yellowish brown (10YR 6/4) sand, light gray (10YR 7/2) dry (E); weak fine subangular blocky structure parting to single grain; very friable to loose; about 5 percent fine and medium gravel; about 2 percent cobbles; moderately acid; abrupt broken boundary.

E' and B't—46 to 80 inches; light yellowish brown (10YR 6/4) sand, light gray (10YR 7/2) dry (E); single grain; loose; lamellae of dark brown (7.5YR 4/4) loamy sand and sandy loam (Bt); moderate very fine to medium subangular blocky structure; friable; lamellae are 1/8 to 1 inch thick with a total accumulation of about 4 inches; about 5 percent fine and medium gravel; about 2 percent cobbles; slightly acid.

The thickness of the solum ranges from 48 to more than 80 inches. The content of gravel ranges from 0 to 10 percent throughout the profile.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly loamy sand, but the range includes sand. Some pedons have a thin E horizon, which has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3.

The Bw horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6, or it has hue of 7.5YR, value of 4 or 5, and chroma of 6. It is sand or loamy sand.

The E part of the E and Bt and B/E horizons has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sand or loamy sand.

The Bt part of the E and Bt and B/E horizons has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The Bt part of the E and Bt horizon consists of lamellae 1/8 inch to 2 inches thick. The B part of the B/E horizon and the Bt lamellae have a total accumulation of more than 6 inches. They are sandy loam or loamy sand.

Some pedons have a C horizon, which has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sand.

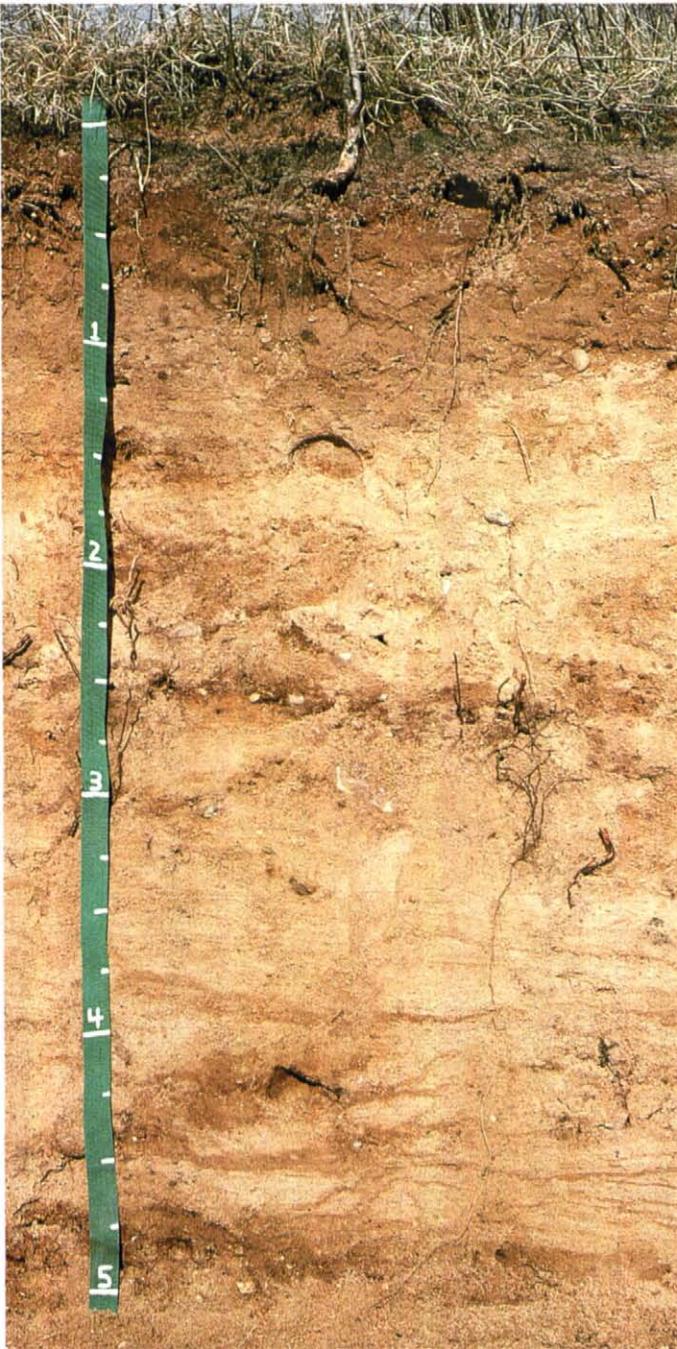


Figure 17.—Profile of Graycalm sand. This soil is similar to Grayling sand (fig. 18) but has thin lamellae in the lower part of the subsoil. Depth is marked in feet.

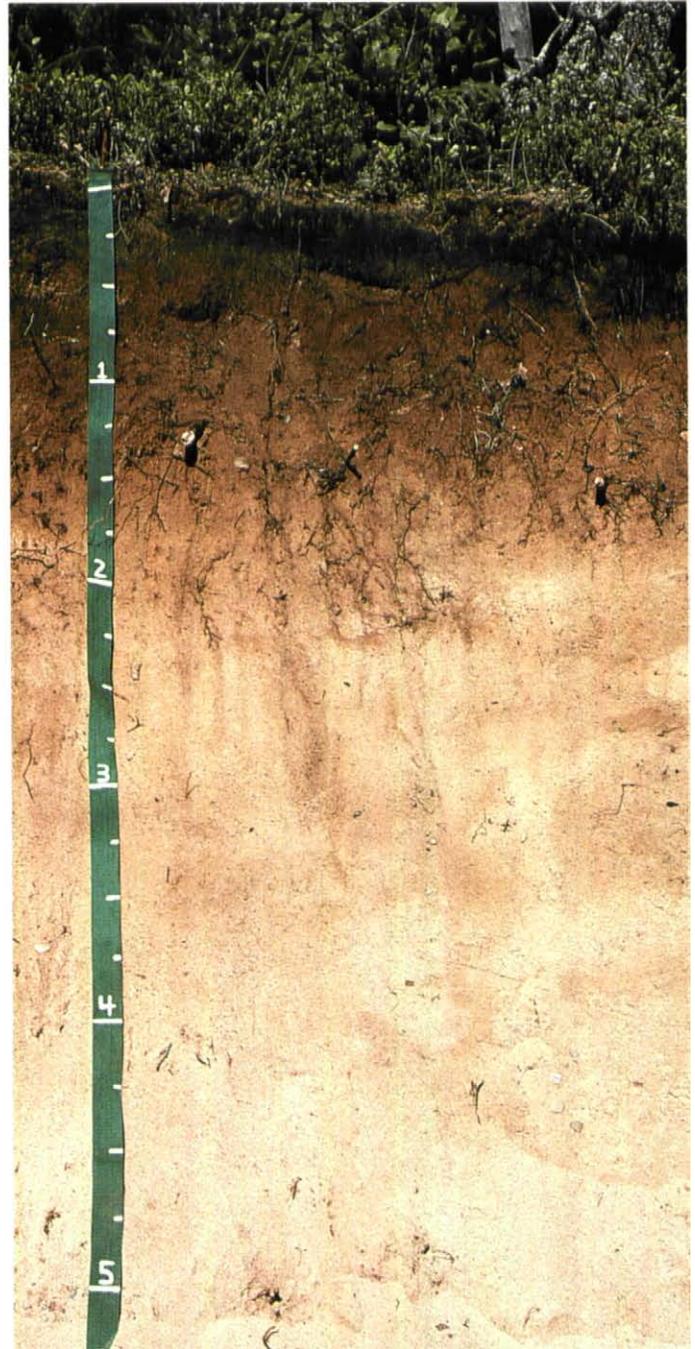


Figure 18.—Profile of Grayling sand. This soil is on outwash plains. It generally has a thin solum and does not have an E horizon. Depth is marked in feet.



Figure 19.—Profile of Kalkaska sand, Michigan's state soil. The dark, enriched upper part of the subsoil is typically 1 to 4 inches thick. Depth is marked in feet.

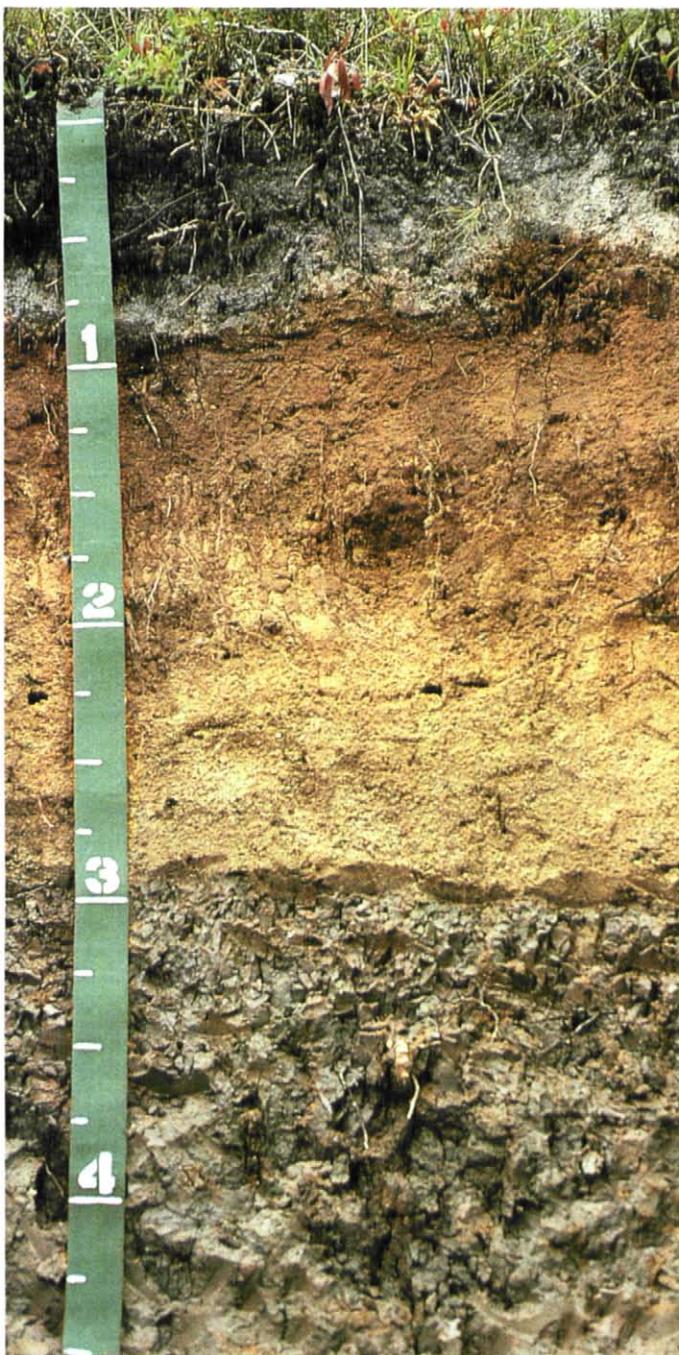


Figure 20.—Profile of Kellogg sand. This soil has a spodic horizon in the sandy upper part of the profile and is clayey in the lower part of the subsoil and in the substratum. A perched water table is above the clay during the wettest parts of the year. Depth is marked in feet.



Figure 21.—Profile of Klacking loamy sand. The upper part of the subsoil is weakly developed and is underlain by an area of clay enrichment. This area is in turn underlain by sandy material that contains lamellae. Depth is marked in feet.

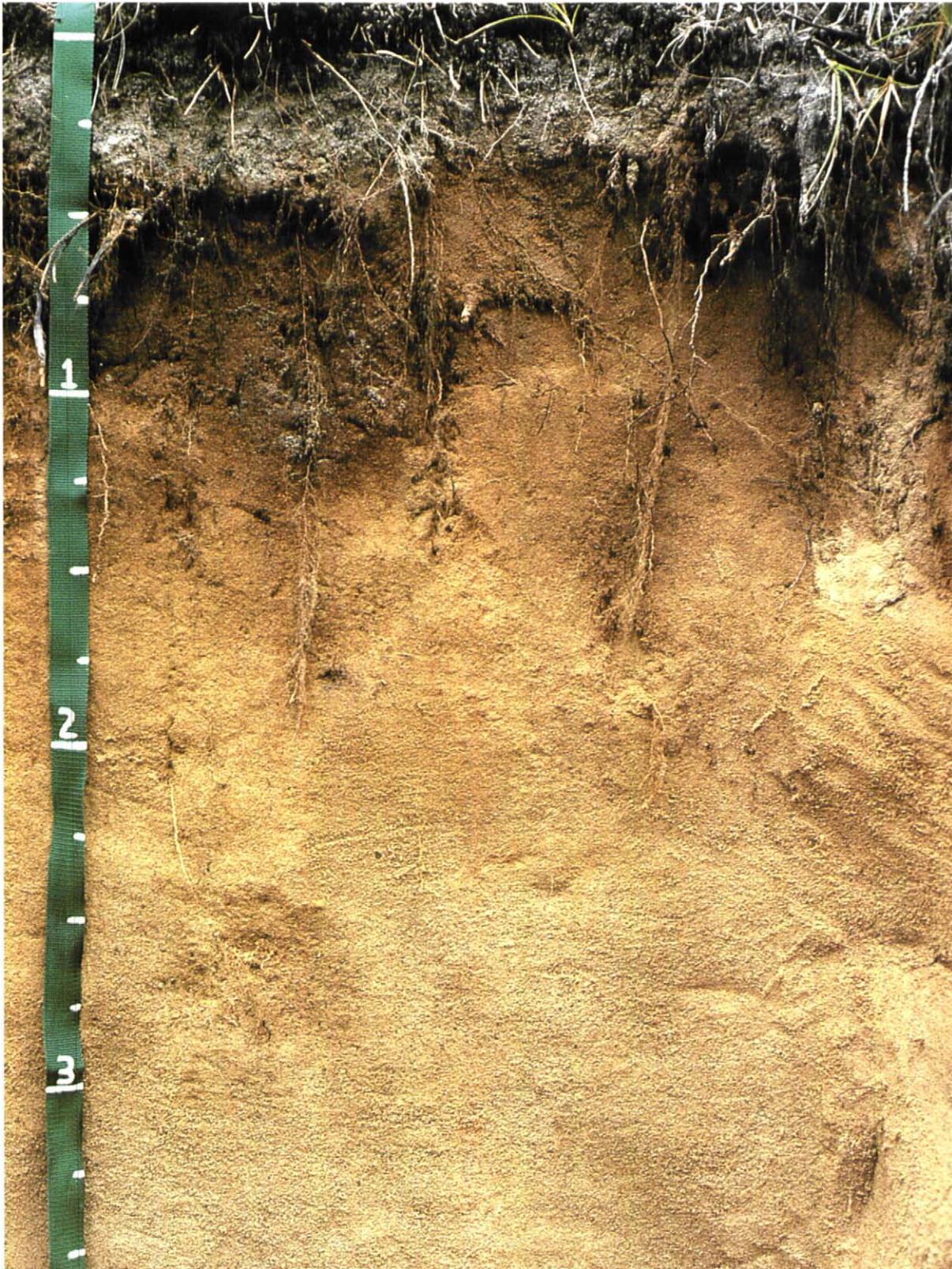


Figure 22.—Profile of Rubicon sand. Iron and aluminum and some organic compounds have been leached from the gray subsoil. Depth is marked in feet.

Kneff Series

The Kneff series consists of moderately well drained soils on lake plains. These soils formed in stratified loamy and silty lacustrine material. Permeability is moderately slow. Slope ranges from 0 to 6 percent.

Typical pedon of Kneff very fine sandy loam, 0 to 6 percent slopes, 1,900 feet north and 1,050 feet west of the southeast corner of sec. 31, T. 25 N., R. 1 W., South Branch Township:

- Ap—0 to 8 inches; dark grayish brown (10YR 4/2) very fine sandy loam, light brownish gray (10YR 6/2) dry; moderate medium and coarse subangular blocky structure; friable; many very fine and fine roots; about 5 percent fine and medium gravel; strongly acid; abrupt smooth boundary.
- B/E—8 to 14 inches; about 60 percent dark brown (7.5YR 4/4) silty clay loam (B); moderate medium and coarse subangular blocky structure; firm; surrounded by brown (10YR 5/3) very fine sandy loam (E), light gray (10YR 7/2) dry; many very fine and fine roots; about 3 percent fine and medium gravel; strongly acid; clear wavy boundary.
- Bt1—14 to 23 inches; dark brown (7.5YR 4/4) silty clay loam; strong coarse angular blocky structure; firm; common very fine and fine roots; many faint dark brown (7.5YR 3/4) clay films on faces of peds and in root channels; strongly acid; clear wavy boundary.
- Bt2—23 to 29 inches; dark brown (7.5YR 4/4) silty clay loam; common medium distinct strong brown (7.5YR 4/6) mottles; strong coarse angular blocky structure; firm; common very fine and fine roots; many faint dark brown (7.5YR 3/4) clay films on faces of peds and in root channels; strongly acid; clear wavy boundary.
- C1—29 to 61 inches; stratified dark brown (10YR 4/3) silty clay loam, silt loam, and silty clay and dark yellowish brown (10YR 4/6) very fine sandy loam; common medium prominent strong brown (7.5YR 4/6) and few fine prominent gray (5Y 6/1 and 5YR 6/1) mottles; massive; few fine roots in the upper 12 inches; slightly effervescent; slightly alkaline; clear wavy boundary.
- 2C2—61 to 80 inches; stratified pale brown (10YR 6/3) sand, brown (10YR 4/3) silty clay loam, and pale brown (10YR 6/3) silt loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; sand is loose, loamy bands are firm; loamy bands are ¼ inch to 6 inches thick; slightly effervescent; slightly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to carbonates ranges from 20 to 34

inches. The depth to the sandy substratum ranges from 60 to 80 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes silt loam.

The B part of the B/E horizon and the Bt horizons have hue of 7.5YR, value of 4, and chroma of 3 or 4. They are silty clay loam or silt loam.

The E part of the B/E horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. It is very fine sandy loam or silt loam. Some pedons have an E or an E/B horizon.

The C horizon has hue of 7.5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. It is stratified silty clay loam, silt loam, or very fine sandy loam.

The 2C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly sand that has strata of silt loam or silty clay loam.

Leafriver Series

The Leafriver series consists of very poorly drained soils on outwash plains and lake plains. These soils formed in a thin organic mantle overlying sandy material. Permeability is moderate or moderately rapid in the organic material and rapid in the sandy material. Slope is 0 to 1 percent.

Typical pedon of Leafriver muck, 300 feet north and 900 feet east of the southwest corner of sec. 5, T. 26 N., R. 4 W., Grayling Township:

- Oa—0 to 9 inches; muck, black (N 2/0) broken face and rubbed; about 20 percent fiber, 2 percent rubbed; moderate medium subangular blocky structure; very friable; many fine and medium and common coarse roots; slightly acid; abrupt wavy boundary.
- A—9 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam; moderate medium subangular blocky structure; very friable; common fine and medium roots; slightly acid; abrupt irregular boundary.
- Cg1—12 to 28 inches; grayish brown (2.5Y 5/2) sand; few fine prominent yellowish brown (10YR 5/6) mottles; single grain; loose; about 2 percent fine gravel; neutral; gradual wavy boundary.
- Cg2—28 to 60 inches; olive gray (5Y 5/2) and gray (5Y 6/1) sand; single grain; loose; about 2 percent fine gravel; neutral.

The thickness of the organic material ranges from 8 to 14 inches. The content of gravel ranges from 0 to 5 percent in the mineral material.

The Oa horizon has hue of 5YR to 10YR or is neutral in hue. It has value of 2 and chroma of 0 to 2.

The A horizon has hue of 10YR, value of 2 or 3, and

chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes fine sand or loamy fine sand.

The Cg horizons have hue of 10YR to 5GY, value of 4 to 6, and chroma of 1 or 2. They are dominantly sand, but the range includes loamy sand or fine sand. Some pedons have thin layers of loamy material ranging from 1/8 inch to 3 inches in thickness.

Loxley Series

The Loxley series consists of very poorly drained soils on outwash plains and lake plains. These soils formed in organic material more than 51 inches thick. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Typical pedon of Loxley peat, in an area of Dawson-Loxley peats, 1,900 feet east and 1,250 feet south of the northwest corner of sec. 30, T. 28 N., R. 2 W., Lovells Township:

Oi—0 to 6 inches; peat, yellowish brown (10YR 5/6) broken face and rubbed; 100 percent fiber, 98 percent rubbed; massive; predominantly sphagnum moss fibers; extremely acid; abrupt wavy boundary.

Oa1—6 to 14 inches; muck, black (N 2/0) broken face and rubbed; about 10 percent fiber, 3 percent rubbed; weak very thick platy structure parting to weak medium and coarse subangular blocky; very friable; primarily herbaceous fibers; extremely acid; abrupt smooth boundary.

Oa2—14 to 34 inches; muck, dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 2.5/2) rubbed; about 15 percent fiber, 3 percent rubbed; weak thick platy structure; very friable; primarily herbaceous fibers; a few thin black (N 2/0) charcoal layers; extremely acid; clear smooth boundary.

Oa3—34 to 42 inches; muck, dark reddish brown (5YR 2.5/2) broken face, black (N 2/0) rubbed; about 8 percent fiber, 3 percent rubbed; massive; very friable; primarily herbaceous fibers; extremely acid; clear smooth boundary.

Oa4—42 to 60 inches; muck, very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 35 percent fiber, 10 percent rubbed; massive; very friable; primarily herbaceous fibers; very strongly acid.

The surface layer is dominantly fibric material. It has hue of 10YR, value of 4 or 5, chroma of 2 to 6.

The sapric material is primarily herbaceous. It has hue of 5YR to 10YR or is neutral in hue. It has value of 2 to 5 and chroma of 0 to 2. The subsurface and bottom tiers are dominantly muck, but some pedons contain small amounts of woody fragments.

Lupton Series

The Lupton series consists of very poorly drained soils on outwash plains and lake plains. These soils formed in organic material more than 51 inches thick. Permeability is moderately slow to moderately rapid. Slope ranges from 0 to 2 percent.

Typical pedon of Lupton muck, in an area of Tawas-Lupton mucks, 600 feet south and 725 feet west of the northeast corner of sec. 12, T. 28 N., R. 1 W., Lovells Township:

Oa1—0 to 9 inches; muck, black (10YR 2/1) broken face and rubbed; about 5 percent fiber, 2 percent rubbed; moderate medium and coarse subangular blocky structure; friable; many fine and common coarse roots; primarily herbaceous fibers; slightly acid; abrupt smooth boundary.

Oa2—9 to 18 inches; muck, black (10YR 2/1) broken face and rubbed; about 10 percent fiber, 5 percent rubbed; moderate fine and medium subangular blocky structure; friable; primarily woody fibers; moderately acid; clear smooth boundary.

Oa3—18 to 30 inches; muck, black (10YR 2/1) broken face and rubbed; about 15 percent fiber, 10 percent rubbed; moderate medium and coarse subangular blocky structure parting to weak fine and medium subangular blocky; friable; primarily woody fibers; about 10 percent woody fragments; moderately acid; gradual wavy boundary.

Oa4—30 to 60 inches; muck, black (N 2/0) broken face and rubbed; about 8 percent fibers, 5 percent rubbed; massive; primarily woody fibers; moderately acid.

The organic material is primarily woody. It has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. It is dominantly muck, but some pedons have thin layers of peat or mucky peat.

Montcalm Series

The Montcalm series consists of well drained soils on moraines and outwash plains. These soils formed in sandy and loamy material. Permeability is moderately rapid. Slope ranges from 0 to 6 percent.

Typical pedon of Montcalm loamy sand, 0 to 6 percent slopes, 600 feet east and 100 feet south of the northwest corner of sec. 34, T. 28 N., R. 2 W., Lovells Township:

Oe—0 to 1 inch; partially decomposed leaf litter; 30 percent sand grains from the E horizon.

E—1 to 4 inches; brown (7.5YR 5/2) loamy sand, pinkish gray (7.5YR 6/2) dry; very weak fine subangular blocky structure; very friable; many fine

and medium and common coarse roots; moderately acid; abrupt wavy boundary.

Bs—4 to 17 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; many fine and medium and common coarse roots; about 2 percent fine and medium gravel; moderately acid; clear wavy boundary.

E/B—17 to 19 inches; about 90 percent light yellowish brown (10YR 6/4) loamy sand, very pale brown (10YR 7/2) dry (E); moderate medium subangular blocky structure; very friable; about 10 percent strong brown (7.5YR 5/6) sandy loam (B); few fine and medium roots; about 5 percent fine and medium gravel; slightly acid; clear wavy boundary.

Bt—19 to 35 inches; strong brown (7.5YR 5/6) sandy loam; moderate medium angular blocky structure; firm; few fine and medium roots; common faint strong brown (7.5YR 4/6) clay films on faces of peds and in root channels; thin coatings of light yellowish brown (10YR 6/4) loamy sand (E) between faces of peds; about 10 percent fine and medium gravel; slightly acid; clear wavy boundary.

E and Bt—35 to 63 inches; yellowish brown (10YR 5/4) sand, pale brown (10YR 6/3) dry (E); single grain; loose; lamellae of strong brown (7.5YR 4/6) loamy sand (Bt); moderate fine and medium subangular blocky structure; friable; few fine and medium roots; common clay bridging between sand grains; lamellae are ¼ to 1 inch thick with a total accumulation of about 4 inches; about 5 percent fine and medium gravel; slightly acid; gradual wavy boundary.

C—63 to 70 inches; light brown (7.5YR 6/4) sand; single grain; loose; about 5 percent fine and medium gravel; slightly effervescent; slightly alkaline.

The thickness of the solum ranges from 50 to 66 inches. The content of gravel ranges from 0 to 10 percent throughout the profile. The content of cobbles ranges from 0 to 5 percent.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 or 2. Some pedons have a thin A horizon above a discontinuous E horizon. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1. The A and E horizons are dominantly loamy sand, but the range includes sand.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is sand or loamy sand.

The E part of the E/B horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand or loamy sand.

The B part of the E/B horizon and the Bt horizon have hue of 7.5YR or 10YR, value of 3 to 5, and

chroma of 4 to 6. They are sandy loam or sandy clay loam. Some pedons have an E' or B/E horizon above the Bt horizon. This horizon has the same colors and textures as the E/B horizon.

The E part of the E and Bt horizon has the same colors and textures as the E part of the E/B horizon. The Bt part of the E and Bt horizon consists of lamellae ½ inch to 2 inches thick. It has the same colors as the Bt horizon. It is loamy sand or sandy loam.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand.

Perecheney Series

The Perecheney series consists of moderately well drained soils on ground moraines, edges of outwash plains, and lake plains. These soils formed in sandy outwash material underlain by loamy and sandy glaciofluvial material. Permeability is rapid in the sandy material and moderately slow in the loamy material. Slope ranges from 0 to 6 percent.

Typical pedon of Perecheney sand, 0 to 6 percent slopes, 550 feet east and 1,600 feet north of the southwest corner of sec. 11, T. 25 N., R. 3 W., Beaver Creek Township:

Oe—0 to 1 inch; black (N 2/0), partially decomposed leaf litter; abrupt smooth boundary.

A—1 to 3 inches; black (10YR 2/1) sand, dark grayish brown (10YR 4/2) dry; mixed with 30 percent grayish brown (10YR 5/2), uncoated sand grains; weak fine and medium subangular blocky structure parting to weak medium granular; very friable; many fine and common medium and coarse roots; about 2 percent fine and medium gravel; strongly acid; abrupt wavy boundary.

Bw1—3 to 18 inches; strong brown (7.5YR 4/6) sand; weak fine and medium subangular blocky structure parting to weak fine granular; very friable; many fine and few medium and coarse roots; about 4 percent fine and medium gravel; strongly acid; clear wavy boundary.

Bw2—18 to 27 inches; yellowish brown (10YR 5/6) sand; weak fine and medium subangular blocky structure parting to weak fine granular; very friable; few fine and medium roots; about 6 percent fine and medium gravel; moderately acid; clear wavy boundary.

Bw3—27 to 36 inches; brownish yellow (10YR 6/6) sand; few fine prominent strong brown (7.5YR 5/8) mottles; very weak medium subangular blocky structure parting to single grain; very friable to loose; few fine and medium roots; about 6 percent fine and medium gravel; moderately acid; abrupt wavy boundary.

E/B—36 to 38 inches; about 85 percent pale brown (10YR 6/3) sand, very pale brown (10YR 7/3) dry (E); common fine prominent strong brown (7.5YR 5/8) mottles; very weak fine subangular blocky structure parting to single grain; very friable to loose; surrounding dark yellowish brown (10YR 4/4) sandy clay loam (Bt); strong medium subangular blocky structure; firm; few fine and medium roots; about 4 percent fine and medium gravel; moderately acid; abrupt wavy boundary.

2Bt—38 to 52 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium prominent strong brown (7.5YR 5/8) mottles; strong coarse subangular blocky structure; firm; few fine and medium roots; many distinct brown (7.5YR 5/4) clay films on faces of peds; about 4 percent fine and medium gravel; slightly acid; abrupt wavy boundary.

3C—52 to 80 inches; light yellowish brown (10YR 6/4) sand and dark brown (7.5YR 4/4) loamy sand; common medium prominent yellowish brown (10YR 5/8) mottles; single grain; loose; thin strata of dark brown (10YR 4/3) silt loam; about 2 percent fine gravel; slightly acid.

The thickness of the sandy mantle ranges from 20 to 50 inches. The depth to the base of the argillic horizon ranges from 40 to more than 60 inches. The content of gravel ranges from 0 to 10 percent throughout the profile, and the content of cobbles ranges from 0 to 5 percent.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly sand, but the range includes loamy sand or loamy fine sand. Some pedons have a thin E horizon below the A horizon. This horizon has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. It has textures similar to those of the A horizon.

The Bw horizon has hue of 10YR and value and chroma of 3 to 6, or it has hue of 7.5YR, value of 4 or 5, and chroma of 6. It is sand, loamy sand, or loamy fine sand.

The E part of the E/B horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand, loamy sand, or loamy fine sand. The B part has colors and textures similar to those of the 2Bt horizon. Some pedons have an E, E', or B/E horizon or a combination of these horizons above the 2Bt horizon.

The 2Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5, and chroma of 3 to 6. It is sandy clay loam or clay loam.

The 3C horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 5. It is dominantly sand or loamy sand that has thin strata of loamy or silty material.

Pickford Series

The Pickford series consists of poorly drained soils on lake plains. These soils formed in clayey lacustrine deposits. Permeability is very slow. Slope ranges from 0 to 2 percent.

Typical pedon of Pickford muck, 1,100 feet north and 1,250 feet east of the southwest corner of sec. 33, T. 27 N., R. 1 W., Lovells Township:

Oa—0 to 3 inches; muck, black (N 2/0) broken face and rubbed; about 40 percent fiber, 15 percent rubbed; moderate fine subangular blocky structure; very friable; many fine and common medium and coarse roots; dominantly herbaceous fiber; slightly acid; abrupt smooth boundary.

A—3 to 6 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; common fine prominent yellowish brown (10YR 5/8) mottles; strong medium subangular blocky structure; firm; many fine, common medium, and few coarse roots; slightly acid; abrupt wavy boundary.

Eg—6 to 10 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; common fine prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; strong coarse angular blocky structure; very firm; common fine and medium and few coarse roots; slightly acid; abrupt irregular boundary.

Bg—10 to 14 inches; reddish gray (5YR 5/2) clay; many medium prominent yellowish brown (10YR 5/8) and few fine prominent greenish gray (5GY 6/1) mottles; strong coarse angular blocky structure; very firm; few fine and medium roots; common distinct very dark gray (10YR 3/1) clay and organic coatings in root channels and along fracture planes; neutral; clear wavy boundary.

BC—14 to 32 inches; reddish brown (5YR 5/4) clay; many medium prominent yellowish brown (10YR 5/8) and common fine prominent greenish gray (5GY 6/1) mottles; weak medium prismatic structure parting to strong medium angular blocky; very firm; few fine and medium roots; common distinct very dark gray (10YR 3/1) clay and organic coatings in root channels and along fracture planes; common prominent white (N 8/0) calcium carbonate coatings along fracture planes and faces of peds; slightly effervescent; slightly alkaline; clear wavy boundary.

C—32 to 80 inches; reddish brown (5YR 5/4) clay; many medium prominent yellowish brown (10YR 5/8) and greenish gray (5GY 6/1) mottles; massive; strongly effervescent; moderately alkaline.

The depth to carbonates ranges from 14 to 30 inches.

The O horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is dominantly muck, but the range includes mucky peat.

The A horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. It is silty clay or clay.

The Eg horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is silty clay or clay.

The Bg horizon has hue of 5YR, value of 4 or 5, and chroma of 2. It is silty clay or clay.

The BC horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay or clay.

The C horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. It is silty clay or clay.

Psammentic Eutroboralfs

Psammentic Eutroboralfs consist of well drained, rapidly permeable soils on overwashed end moraines and ground moraines. These soils formed in sandy glaciofluvial material. Slope ranges from 0 to 50 percent.

Reference pedon of Psammentic Eutroboralfs, in an area of Psammentic Eutroboralfs, sandy-Typic Udipsamments, banded substratum complex, nearly level and undulating; 660 feet east and 1,320 feet south of the northwest corner of sec. 28, T. 26 N., R. 1 W., South Branch Township:

A—0 to 2 inches; very dark grayish brown (10YR 3/2) sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine and common medium roots; strongly acid; abrupt smooth boundary.

Bw1—2 to 10 inches; dark yellowish brown (10YR 4/4) sand; weak fine granular structure; friable; many fine, many medium, and common coarse roots; about 7 percent gravel; strongly acid; clear wavy boundary.

Bw2—10 to 22 inches; yellowish brown (10YR 5/4) sand; weak fine granular structure; friable; many fine and common medium roots; about 9 percent gravel; slightly acid; clear wavy boundary.

Bw3—22 to 32 inches; yellowish brown (10YR 5/6) sand; weak fine granular structure; friable; common medium and few fine roots; about 11 percent gravel; slightly acid; clear irregular boundary.

B/E—32 to 54 inches; about 60 percent strong brown (7.5YR 4/6) loamy sand (Bt); surrounded by light yellowish brown (10YR 6/4) sand, very pale brown (10YR 7/3) dry (E); moderate medium subangular blocky structure; friable; few fine and medium roots; about 6 percent gravel; slightly acid; clear irregular boundary.

E and Bt—54 to 75 inches; yellowish brown (10YR 5/4) sand, light yellowish brown (10YR 6/2) dry (E); lamellae of strong brown (7.5YR 4/6) loamy sand (Bt); weak fine subangular blocky structure; friable; few fine and medium roots; about 9 percent gravel; slightly acid; abrupt irregular boundary.

C—75 to 180 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 5 percent gravel; slightly acid.

The thickness of the solum ranges from 48 to 80 inches. The content of gravel ranges from 0 to 10 percent throughout the profile.

The A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 8. It is sand.

The E part of the B/E and E and Bt horizons has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sand. The Bt part has hue of 7.5YR or 10YR, value of 3 to 6, and chroma of 4 to 6. It is loamy sand.

The C horizon has hue of 10YR, value of 6 or 7, and chroma of 3 or 4. It is sand.

Rubicon Series

The Rubicon series consists of excessively drained soils on outwash plains, stream terraces, and moraines. These soils formed in sandy material. Permeability is rapid. Slope ranges from 0 to 50 percent.

Typical pedon of Rubicon sand (fig. 22), 0 to 6 percent slopes, 480 feet east and 650 feet north of the center of sec. 2, T. 27 N., R. 4 W., Frederic Township:

Oe—0 to 1 inch; partially decomposed leaf litter; abrupt smooth boundary.

A—1 to 2 inches; black (N 2/0) sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; intermixed with 30 percent uncoated sand grains from the E horizon; many fine and medium and few coarse roots; about 2 percent fine and medium gravel; strongly acid; abrupt wavy boundary.

E—2 to 6 inches; brown (7.5YR 5/2) sand, pinkish gray (7.5YR 7/2) dry; very weak medium subangular blocky structure parting to weak fine granular; very friable; many fine and medium and few coarse roots; about 2 percent fine and medium gravel; strongly acid; abrupt wavy boundary.

Bs1—6 to 10 inches; dark brown (7.5YR 4/4) sand; weak medium subangular blocky structure parting to weak medium granular; very friable; many fine and medium and few coarse roots; about 2 percent fine and medium gravel; strongly acid; abrupt irregular boundary.

Bs2—10 to 21 inches; dark yellowish brown (10YR 4/6) sand; weak medium subangular blocky structure parting to weak fine granular; very friable; about 15 percent tongues of Bs1 material; common fine and medium and few coarse roots; about 2 percent fine and medium gravel; moderately acid; clear wavy boundary.

BC—21 to 35 inches; yellowish brown (10YR 5/6) sand; weak coarse subangular blocky structure parting to single grain; very friable to loose; about 5 percent moderately cemented and 10 percent weakly cemented ortstein occurring as tongues 1 to 3 inches in diameter; few fine and medium roots; about 5 percent fine and medium gravel; moderately acid; gradual wavy boundary.

C—35 to 80 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 8 percent fine and medium gravel; moderately acid.

The thickness of the solum ranges from 24 to 50 inches. All of the mineral horizons are sand. The content of coarse fragments ranges from 0 to 15 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3.

The Bs1 horizon has hue of 7.5YR and value and chroma of 3 or 4. Value and chroma of 3 do not occur together. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 5 to 8.

The BC horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. The content of ortstein in the Bs and BC horizons ranges from 0 to 20 percent.

The C horizon has hue of 10YR, value of 5 to 7; and chroma of 3 to 6. It is sand or coarse sand.

Tawas Series

The Tawas series consists of very poorly drained soils on outwash plains and lake plains. These soils formed in organic material 16 to 51 inches thick over sandy deposits. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying sand. Slope ranges from 0 to 2 percent.

Typical pedon of Tawas muck, in an area of Tawas-Lupton mucks, 1,300 feet west and 600 feet north of the southeast corner of sec. 25, T. 27 N., R. 2 E., Grayling Township:

Oa1—0 to 10 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; about 15 percent fiber, 5 percent rubbed; weak medium granular structure; very friable; woody and herbaceous

fibers; moderately acid; clear smooth boundary.

Oa2—10 to 14 inches; muck, dark reddish brown (5YR 3/3) broken face and rubbed; about 70 percent fiber, 10 percent rubbed; weak medium platy structure; very friable; primarily woody fibers; slightly acid; clear wavy boundary.

Oa3—14 to 24 inches; muck, black (10YR 2/1) broken face and rubbed; about 15 percent fiber, 5 percent rubbed; massive; woody and herbaceous fibers; neutral; clear smooth boundary.

Cg—24 to 26 inches; dark gray (10YR 4/1) sand; single grain; loose; slightly acid; clear smooth boundary.

C—26 to 60 inches; brown (10YR 5/3) sand; single grain; loose; neutral.

The organic material is primarily woody. Depth to the sandy mineral layers ranges from 16 to 51 inches.

The surface layer has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The subsurface and bottom tiers have hue of 5YR to 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. They are dominantly muck, but some pedons have thin layers of mucky peat.

The C horizons have hue of 10YR, value of 3 to 5, and chroma of 1 to 3. They are sand or gravelly sand.

Typic Endoaquods

Typic Endoaquods consist of somewhat poorly drained and poorly drained, rapidly permeable soils on lake plains and outwash plains. These soils formed in sandy lacustrine or outwash material. Slope ranges from 0 to 2 percent.

An organic surface layer, 2 to 7 inches thick, is typically on the surface. It is dominantly partially decomposed forest litter in the somewhat poorly drained areas and muck or mucky peat in the poorly drained areas. It has hue of 5YR to 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

Some pedons have an A horizon. This horizon has hue of 7.5YR or 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2.

The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 3. It is sand, loamy sand, or fine sand.

The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. It is sand, loamy sand, or fine sandy loam.

The Bs horizon has hue of 7.5YR or 10YR, value of 3 to 6, and chroma of 4 to 6. It is sand, loamy sand, or fine sandy loam.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand, loamy sand, or fine sand.

Typic Udipsamments

Typic Udipsamments consist of moderately well drained and excessively drained, rapidly permeable soils on outwash plains, stream terraces, and overwashed moraines. These soils formed in sandy glaciofluvial material. Slope ranges from 0 to 50 percent.

Reference pedon of Typic Udipsamments, nearly level and undulating, 2,620 feet north and 20 feet east of the southwest corner of sec. 4, T. 26 N., R. 5 E., in Alcona County, Michigan:

- Oi—1 inch to 0; undecomposed hardwood and coniferous leaf litter.
- A—0 to 2 inches; very dark gray (10YR 3/1) sand, dark grayish brown (10YR 4/2) dry; weak medium granular structure; very friable; many very fine and fine roots; strongly acid; abrupt wavy boundary.
- E—2 to 4 inches; light brownish gray (10YR 6/2) sand, light gray (10YR 7/2) dry; weak medium subangular blocky structure; very friable; strongly acid; abrupt wavy boundary.
- Bw—4 to 22 inches; dark yellowish brown (10YR 4/4) sand; weak coarse subangular blocky structure; very friable; strongly acid; clear wavy boundary.
- BC—22 to 40 inches; yellowish brown (10YR 5/6) sand; single grain; loose; strongly acid; gradual wavy boundary.
- C—40 to 180 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; strongly acid.

The thickness of the solum ranges from 20 to 40 inches. The content of gravel ranges from 0 to 10 percent throughout the profile.

The A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 to 3.

The E horizon, if it occurs, has hue of 10YR, value of 4 to 6, and chroma of 2 or 3. It is sand or loamy sand.

The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sand or loamy sand.

The C horizon has hue of 10YR or 7.5YR, value of 6 or 7, and chroma of 4 to 6. It is sand or coarse sand. Loamy sand, coarse loamy sand, and gravelly loamy sand may occur below a depth of 60 inches. Banded substratum phases have thin loamy sand or sandy loam bands below a depth of 60 inches. Loamy substratum phases have sandy loam to sandy clay loam below a depth of 40 inches. A seasonal high water table is below a depth of 3 feet in some pedons.

Udipsamments

Udipsamments consist of excessively drained and somewhat excessively drained, rapidly permeable soils

on outwash plains. These soils formed in sands. Slope ranges from 0 to 40 percent.

These soils are on the bottoms and sides of borrow pits or in areas of sandy filled land. They have hue of 10YR, value of 5 to 7, and chroma of 3 or 4. They are sand or loamy sand.

Udorthents

Udorthents consist of well drained, moderately permeable or moderately slowly permeable soils on moraines. These soils formed in loamy glacial till. Slope ranges from 0 to 12 percent.

These soils are on the bottoms and sides of borrow pits or in areas of loamy filled land. They have hue of 5YR, 7.5YR, or 10YR, value of 4 to 6, and chroma of 3 or 4. Textures include sandy loam, loam, and clay loam.

Wakeley Series

The Wakeley series consists of very poorly drained soils on lake plains and outwash plains. These soils formed in sandy outwash underlain by clayey lacustrine deposits. Permeability is rapid in the sandy material and slow or very slow in the clayey material. Slope ranges from 0 to 2 percent.

Typical pedon of Wakeley muck, in an area of Wakeley-Allendale complex, 0 to 3 percent slopes, 1,650 feet east and 400 feet north of the southwest corner of sec. 12, T. 25 N., R. 2 W., South Branch Township:

- Oa—0 to 4 inches; muck, black (N 2/0) broken face and rubbed; about 15 percent fiber, 10 percent rubbed; moderate very fine and fine subangular blocky structure; very friable; many fine, common medium, and few coarse roots; about 10 percent uncoated sand grains in the lower part of the horizon; slightly acid; abrupt wavy boundary.
- C—4 to 23 inches; brown (10YR 5/3) loamy sand; few medium distinct gray (10YR 5/1) and few coarse distinct yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure parting to single grain; loose; common fine roots; about 2 percent coarse gravel and 1 percent cobbles; slightly acid; abrupt wavy boundary.
- Cg—23 to 28 inches; grayish brown (2.5Y 5/2) loamy sand; many medium and coarse prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) mottles; massive; friable; about 5 percent medium and coarse gravel; neutral; abrupt wavy boundary.
- 2C1—28 to 58 inches; brown (7.5YR 5/4) clay; common medium prominent yellowish brown (10YR 5/6) and many medium and coarse prominent greenish gray

(5GY 6/1) mottles; massive; firm; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C2—58 to 80 inches; dark brown (10YR 4/3) clay; common fine prominent strong brown (7.5YR 4/6) and few fine distinct gray (10YR 5/1) mottles; massive; firm; strongly effervescent; moderately alkaline.

Depth to the clayey lacustrine sediment ranges from 20 to 35 inches. The content of gravel ranges from 0 to 15 percent in the sandy material and from 0 to 5 percent in the clayey material. The content of cobbles ranges from 0 to 3 percent in the sandy material.

The Oa horizon has hue of 7.5YR or 10YR or is

neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. It is dominantly muck, but the range includes mucky peat. Some pedons have a thin A or Ap horizon, which has colors similar to those of the Oa horizon. The A or Ap horizon is sand, loamy sand, loamy fine sand, or the mucky analogs of these textures.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 3 or 4. It is sand or loamy sand.

The Cg horizon has hue of 10YR to 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is sand or loamy sand.

The 2C horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 to 4. It is dominantly clay or silty clay, but the range includes clay loam or silty clay loam. Some pedons have thin strata or varves of loamy or sandy material.

Formation of the Soils

In this section, the factors of soil formation and their relationship to the soils in the survey area are described. The processes of soil formation are also explained.

Factors of Soil Formation

Soil forms through the interaction of five major factors (Jenny, 1941). These are the physical, chemical, and mineral composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the parent material.

Climate and plant and animal life are the active forces of soil formation. They slowly change the parent material into a natural body of soil that has genetically related layers, or horizons. The effects of climate and plant and animal life are conditioned by relief. The nature of the parent material affects the kind of soil that forms and in extreme cases determines it almost entirely. Finally, time is needed for the differentiation of soil horizons.

The factors of soil formation are so closely related in their effects on the soils that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soil. The parent materials of the soils in Crawford County were deposited by glaciers or by meltwater from the glaciers about 12,500 to 14,500 years ago. Some of these parent materials have been reworked and redeposited by the subsequent action of water. Although most of the parent materials are of similar glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Crawford County were

deposited as glacial outwash and, to a lesser extent, as glacial till, lacustrine material, organic material, and alluvium.

Glacial outwash was deposited by running water from melting glaciers. The size of the particles depends on the speed of the stream that carried the material. As the water slowed down, the coarse particles were deposited first. Finer particles, such as very fine sand, silt, and clay, were carried by slowly moving water. Outwash deposits generally occur as layers of particles of similar size, such as sand, coarse sand, and gravel. Most of the outwash in the county was deposited during the retreat of Port Huron and Port Bruce ice, approximately 12,500 to 14,500 years ago (Burgis and Eschman, 1981). Grayling and Hartwick soils are examples of soils that formed in outwash material.

Glacial till was deposited directly by glaciers with a minimum of water action. It is a mixture of particles of different sizes. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water. Most of the glacial till in Crawford County is buried under sandy outwash. A few high plateaus in the northwestern part of the county have remnant caps of brownish sandy loam till at the surface. This material was deposited during the retreat of Port Bruce ice, approximately 13,500 to 14,500 years ago. Feldhauser soils formed in ablation till and in the underlying outwash material.

Lacustrine material was deposited from still or ponded glacial meltwater. Because the coarser particles were deposited as outwash by moving glacial meltwater, only the finer particles, such as very fine sand, silt, and clay, remained to settle out in still water. The soils in Crawford County that formed in lacustrine deposits typically are moderately fine textured and fine textured. Bowers and Pickford soils are examples. During the time of the Port Huron ice, the Au Sable River drainageway was dammed by glacial ice. This damming created a glacial lake along the Au Sable River drainageway and its tributaries in the eastern and southeastern parts of the county. Lacustrine sediments of calcareous silt and clay material were deposited before the dam broke, draining the lake. In many areas

the lacustrine deposits are overlain by sandy outwash of variable thickness.

Organic material mainly occurs as deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions on outwash plains and lake plains. Grasses and sedges growing around the edges of these lakes died, and their residue fell to the bottom. Because the areas were wet, the plant remains did not decompose but remained around the edge of the lake. Later, water-tolerant trees grew in these areas. After these trees died, their residue became part of the organic accumulation. Eventually, the lakes were filled with organic material and developed into areas of muck. Lupton soils formed in organic material.

Alluvium was recently deposited by floodwater along streams. It varies in texture, depending on the speed of the water from which it was deposited. Most of the alluvium in the county is coarse textured material stratified with organic deposits. Ausable soils are examples of alluvial soils.

Plant and Animal Life

Plants have affected the soils in Crawford County more significantly than other living organisms. Bacteria, fungi, and earthworms, however, also have been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic matter on and in the soil depends on the kinds of native plants that grew on the soil. The remains of these plants accumulated on the surface, decayed, and eventually became organic matter. The roots of the plants provide channels for the downward movement of water through the soil. They also add organic matter as they decay. Bacteria in the soil help to break down the organic matter into plant nutrients.

The native vegetation in Crawford County was a mixture of coniferous and deciduous trees. Differences in natural soil drainage and parent material have affected the composition of the forest species. The well drained Blue Lake soils, on remnant moraines in the northwestern part of the county, generally supported sugar maple, beech, and basswood. The excessively drained Grayling soils, on outwash plains, dominantly supported jack pine. The very poorly drained Tawas and Lupton soils supported northern whitecedar, black spruce, and tamarack.

Climate

Climate determines the kind of plant and animal life on and in the soil and the amount of water available for the weathering of minerals and the translocation of soil

material. Through its influence on soil temperatures, climate also determines the rate of chemical reaction in the soil. The climate in Crawford County is cool and humid. It is presumed to be similar to the climate that existed during the period when the soils were forming.

The soils in Crawford County differ from the soils that formed under a dry, warm climate and from those that formed under a moist, hot climate. The temperature is relatively uniform throughout the county, but there are significant variations in annual precipitation, mainly in the form of snow. The highlands in the northwestern part of the county receive an average annual snowfall of 130 inches, mainly because of lake effect and elevation. The southeastern part of the county receives an average of only 70 inches (Hickok and others). This moisture difference, in part, accounts for a greater degree of weathering and translocation of iron, aluminum, and humus in the soils in the northwestern part of the county than those in the southeast. Because of this transfer, the Kalkaska and Rubicon soils in the northwestern part of the county have a darker B horizon than the Grayling soils in the southeast.

Relief

Relief has markedly affected the soils in Crawford County through its influence on natural drainage, runoff, erosion, plant cover, and soil temperature. Slopes range from 0 to 50 percent. Natural soil drainage ranges from excessively drained on high knolls to very poorly drained in depressions.

Through its effect on soil aeration, drainage influences the color of the soil. Runoff is most rapid on the steeper slopes. In some low areas, water is temporarily ponded. Water and air move freely through well drained soils but slowly through very poorly drained soils. In Blue Lake and other well aerated, well drained soils, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. Poorly aerated, poorly drained soils are dull gray and mottled. Pickford soils are examples.

Time

Generally, a long time is needed for the development of distinct horizons in a soil. Differences in the length of time that the parent material has been in place are commonly reflected in the degree of profile development. The soils in Crawford County range from young to mature. Most of the soils that formed in glacial deposits have been exposed to the soil-forming processes long enough for the development of distinct horizons. Blue Lake soils are examples of these older soils. Ausable soils are examples of young soils. They formed in recent alluvial sediments and have not been

in place long enough for the development of distinct horizons.

Processes of Soil Formation

Several processes were involved in the development of horizons in the soils of Crawford County. These were the accumulation of organic matter, the leaching of lime (calcium carbonate) and other bases, the reduction and transfer of iron, and the formation and translocation of clay minerals. More than one of these processes have helped to differentiate horizons in most of the soils.

As organic matter accumulated at the surface, an A horizon formed. If the soil is plowed, the A horizon is mixed into a plow layer, or Ap horizon. The content of organic matter in the surface layer of the soils in Crawford County ranges from high to low. For example, it is high in Leafriver soils and low in Grayling soils.

The leaching of carbonates and other bases has occurred in most of the soils. The leaching of bases usually precedes the translocation of silicate clay minerals. Most of the soils are moderately leached or strongly leached. Bowers soils, for example, are

leached to a depth of 15 to 30 inches, and Blue Lake soils are leached to a depth of more than 60 inches. Differences in the depth of leaching are the result of time and parent material.

Gleying, or the reduction and transfer of iron, is evident in somewhat poorly drained to very poorly drained soils. Pickford soils are examples. A gray color in the subsoil indicates the reduction and loss of iron.

The translocation of clay minerals has contributed to horizon development. An eluviated, or leached, E horizon is lower in content of clay and typically is lighter in color than the illuviated B horizon. The B horizon typically has an accumulation of clay (clay films) in pores and on the faces of peds. Soils in which clay has been translocated were probably leached of carbonates and soluble salts to a considerable extent before the translocation of clay took place. Feldhauser soils are examples of soils in which clay in the form of clay films has accumulated in the B horizon.

In some soils, such as Kalkaska soils, iron, aluminum, and humus have been transferred from the A horizon to the B horizon. Because of this transfer, the B horizon is dark brown.

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Conservation tillage. A tillage system that does not

invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained*. These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or

colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity, or capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

Flat. A general term for a level or nearly level surface, or a small area of land marked by little or no relief.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads,

buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable

layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain (geology). A nearly level surface marking the floor of an extinct lake filled in by well sorted, coarse textured to fine textured, stratified sediments.

Lamellae. Thin layers in the soil where illuviated clay particles have accumulated. These layers generally form in sandy soils and are commonly irregular or discontinuous.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat. Organic soil material intermediate in degree of decomposition between the less decomposed peat and the more decomposed muck.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value of 6.6 to 7.3.
(See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic mat. A zone of accumulation of organic material, such as leaves, twigs, and grasses, in various stages of decomposition. This zone lies above the mineral soil. It is often described in forested regions and is commonly called a duff layer.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Ortstein. A hardened mass or layer in the soil in which the cementing material consists of illuviated compounds of iron and aluminum and organic matter.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated

hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitted outwash. Outwash with pits or kettles produced by the partial or complete burial of glacial ice and the subsequent thaw of the ice and collapse of the surface materials.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential native plant community. See Climax plant community.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Relief. The elevations or inequalities of a land surface, considered collectively.

Remnant moraine. A moraine that was deposited during an older glacial period and that remains after subsequent glacial advances.

Ridge. A long, narrow elevation of the land surface, generally sharp crested and steep sided and forming an extended upland between valleys.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off

the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, slope classes are as follows:

Level.....	0 to 2 percent
Nearly level.....	0 to 3 percent

Gently undulating	0 to 6 percent
Undulating	2 to 6 percent
Gently rolling	6 to 12 percent
Rolling	6 to 18 percent
Hilly	12 to 25 percent
Steep	18 to 45 percent
Very steep	45 percent and higher

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand.....	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stream terrace. One of a series of platforms in a stream valley, more or less parallel to the stream channel. Terraces originally formed near the level of the stream and represent the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of erosion or deposition.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a

sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed

over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION
(Recorded in the period 1951-80 at Grayling, Michigan)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
° F	° F	° F	° F	° F	Units	In	In	In	In	In	
January-----	25.9	9.3	17.6	48	-23	0	1.70	1.13	2.21	6	24.0
February-----	28.4	7.6	18.0	49	-26	0	1.36	.68	1.95	5	16.3
March-----	38.2	16.5	27.4	64	-16	2	1.85	1.03	2.58	5	14.7
April-----	54.1	30.3	42.2	82	6	47	2.71	1.55	3.72	7	4.6
May-----	67.9	40.5	54.2	89	22	204	3.03	1.92	4.02	7	.4
June-----	76.8	49.9	63.4	93	30	412	3.38	1.67	4.87	7	.0
July-----	80.9	54.1	67.5	95	38	550	3.59	1.97	5.02	6	.0
August-----	78.6	52.7	65.7	94	35	493	3.48	1.84	4.92	7	.0
September---	69.6	45.9	57.8	90	27	260	3.61	1.84	5.14	8	.0
October-----	58.4	37.1	47.8	81	18	92	2.68	1.48	3.74	7	.9
November-----	42.9	27.4	35.2	68	0	8	2.67	1.70	3.55	7	11.9
December-----	30.4	15.3	22.9	55	-16	**	1.89	1.19	2.52	6	20.1
Yearly:											
Average---	54.3	32.2	43.3	---	---	---	---	---	---	---	---
Extreme---	---	---	---	96	-27	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,068	31.95	27.85	35.91	78	92.9

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

** Less than 0.5.

TABLE 2.--FREEZE DATES IN SPRING AND FALL
(Recorded in the period 1951-80 at Grayling, Michigan)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 17	May 31	June 17
2 years in 10 later than--	May 11	May 25	June 11
5 years in 10 later than--	Apr. 30	May 15	May 30
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 2	Sept. 17	Aug. 30
2 years in 10 earlier than--	Oct. 9	Sept. 23	Sept. 5
5 years in 10 earlier than--	Oct. 21	Oct. 4	Sept. 17

TABLE 3.--GROWING SEASON
(Recorded in the period 1951-80 at Grayling, Michigan)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	152	117	82
8 years in 10	159	125	92
5 years in 10	174	141	110
2 years in 10	188	157	128
1 year in 10	196	165	138

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
13	Tawas-Lupton mucks-----	10,597	2.9
14	Dawson-Loxley peats-----	1,858	0.5
15A	Croswell-Au Gres sands, 0 to 3 percent slopes-----	4,116	1.1
16B	Graycalm sand, 0 to 6 percent slopes-----	30,977	8.6
17A	Croswell sand, 0 to 3 percent slopes-----	13,731	3.8
18A	Au Gres sand, 0 to 3 percent slopes-----	1,418	0.4
19	Leafriver muck-----	3,360	0.9
20B	Graycalm-Grayling sands, 0 to 6 percent slopes-----	31,974	8.9
20D	Graycalm-Grayling sands, 6 to 18 percent slopes-----	10,572	2.9
20F	Graycalm-Grayling sands, 18 to 45 percent slopes-----	2,371	0.7
21B	Graycalm-Klacking complex, 0 to 6 percent slopes-----	12,527	3.5
21D	Graycalm-Klacking complex, 6 to 18 percent slopes-----	1,060	0.3
21F	Graycalm-Klacking complex, 18 to 45 percent slopes-----	275	0.1
22B	Montcalm loamy sand, 0 to 6 percent slopes-----	2,021	0.6
23	Ausable-Bowstring mucks, frequently flooded-----	2,353	0.7
24A	Kinross-Au Gres complex, 0 to 3 percent slopes-----	3,519	1.0
31B	Klacking loamy sand, 0 to 6 percent slopes-----	4,747	1.3
32B	Kellogg sand, 0 to 6 percent slopes-----	2,227	0.6
34B	Kneff very fine sandy loam, 0 to 6 percent slopes-----	132	*
35	Kinross muck-----	1,873	0.5
47D	Graycalm sand, 6 to 18 percent slopes-----	4,738	1.3
47F	Graycalm sand, 18 to 45 percent slopes-----	1,144	0.3
48B	Rubicon-Graycalm sands, 0 to 6 percent slopes-----	5,471	1.5
48D	Rubicon-Graycalm sands, 6 to 18 percent slopes-----	2,358	0.7
49B	Kalkaska sand, 0 to 6 percent slopes-----	8,443	2.3
50B	Au Gres-Kinross-Croswell complex, 0 to 6 percent slopes-----	1,024	0.3
51	Tawas-Leafriver mucks-----	7,911	2.2
52B	Blue Lake loamy sand, 0 to 6 percent slopes-----	7,187	2.0
52D	Blue Lake loamy sand, 6 to 18 percent slopes-----	698	0.2
58A	Wakeley-Allendale complex, 0 to 3 percent slopes-----	1,718	0.5
64B	Feldhauser fine sandy loam, 0 to 6 percent slopes-----	2,512	0.7
65F	Rubicon sand, 8 to 50 percent slopes, dissected-----	2,958	0.8
67A	Bowers-Deerheart complex, 0 to 3 percent slopes-----	233	0.1
75B	Rubicon sand, 0 to 6 percent slopes-----	12,019	3.3
75D	Rubicon sand, 6 to 18 percent slopes-----	3,092	0.9
78	Pits, borrow-----	429	0.1
81B	Grayling sand, 0 to 6 percent slopes-----	77,727	21.6
81D	Grayling sand, 6 to 18 percent slopes-----	13,132	3.6
81F	Grayling sand, 18 to 45 percent slopes-----	2,221	0.6
82B	Udorthents, loamy, nearly level and undulating-----	71	*
83B	Udipsamments, nearly level and undulating-----	2,010	0.6
86	Histosols and Aquepts, ponded-----	471	0.1
115D	Kalkaska sand, 6 to 18 percent slopes-----	4,181	1.2
126F	Udipsamments-Haplorthods-Eutroboralfs complex, nearly level to steep-----	8,060	2.2
144B	Perechney sand, 0 to 6 percent slopes-----	1,685	0.5
146F	Rubicon-Graycalm sands, 8 to 50 percent slopes, dissected-----	576	0.2
210B	Grayling sand, nearly level and undulating-----	4,800	1.3
210C	Grayling sand, rolling-----	1,817	0.5
210D	Grayling sand, hilly-----	1,084	0.3
210E	Grayling sand, steep-----	995	0.3
211B	Grayling sand, banded substratum, nearly level and undulating-----	1,256	0.3
211C	Grayling sand, banded substratum, rolling-----	272	0.1
211D	Grayling sand, banded substratum, hilly-----	123	*
211E	Grayling sand, banded substratum, steep-----	448	0.1
212B	Grayling sand, very deep water table, nearly level and undulating-----	3,169	0.9
213B	Graycalm sand, nearly level and undulating-----	353	0.1
215B	Typic Udipsamments, loamy substratum, nearly level and undulating-----	353	0.1
220B	Typic Udipsamments, nearly level and undulating-----	221	0.1
220C	Typic Udipsamments, rolling-----	398	0.1
220D	Typic Udipsamments, hilly-----	628	0.2
221B	Typic Udipsamments, banded substratum, nearly level and undulating-----	2,071	0.6
221C	Typic Udipsamments, banded substratum, rolling-----	3,098	0.9

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
221D	Typic Udipsamments, banded substratum, hilly-----	3,666	1.0
221E	Typic Udipsamments, banded substratum, steep-----	173	*
222B	Typic Udipsamments, very deep water table, nearly level and undulating-----	1,909	0.5
223B	Graycalm-Grayling sands, nearly level and undulating-----	1,551	0.4
223C	Graycalm-Grayling sands, rolling-----	1,947	0.5
223D	Graycalm-Grayling sands, hilly-----	2,737	0.8
224B	Croswell sand, nearly level and undulating-----	445	0.1
225B	Entic Haplorthods, sandy, loamy substratum, nearly level and undulating-----	330	0.1
236B	Arenic Eutroboralfs, nearly level and undulating-----	324	0.1
237B	Glossic Eutroboralfs, nearly level and undulating-----	116	*
239B	Psammentic Eutroboralfs, sandy-Typic Udipsamments, banded substratum complex, nearly level and undulating-----	130	*
239C	Psammentic Eutroboralfs, sandy-Typic Udipsamments, banded substratum complex, rolling-----	78	*
239E	Psammentic Eutroboralfs, sandy-Typic Udipsamments, banded substratum complex, steep	52	*
262A	Au Gres sand, nearly level-----	234	0.1
263A	Argic Endoaquods, nearly level-----	196	0.1
264A	Allendale loamy sand, nearly level-----	111	*
271	Typic Endoaquods, sandy, wet-Typic Endoaquods, sandy complex-----	282	0.1
275	Wakeley-Leafriver complex-----	350	0.1
280	Aquepts and Histosols, ponded-----	73	*
281	Borosaprists, dysic-----	757	0.2
282	Borosaprists, euic-----	926	0.3
347F	Kalkaska sand, 8 to 50 percent slopes, dissected-----	3,077	0.9
348	Pickford muck-----	100	*
349B	Hartwick sand, 0 to 6 percent slopes-----	1,334	0.4
	Water areas less than 40 acres in size-----	1,897	0.5
	Water areas more than 40 acres in size-----	2,944	0.8
	Total-----	360,602	100.0

* Less than 0.1 percent.

TABLE 5.--CAPABILITY CLASSES AND SUBCLASSES

(Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
I	---	---	---	---
II	2,877	2,644	233	---
III	16,293	---	111	16,182
IV	109,176	698	2,676	105,802
V	2,168	---	2,168	---
VI	147,057	---	13,957	133,100
VII	38,065	---	4,211	33,854
VIII	---	---	---	---

TABLE 6.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
34B	Kneff very fine sandy loam, 0 to 6 percent slopes
64B	Feldhauser fine sandy loam, 0 to 6 percent slopes
67A	Bowers-Deerheart complex, 0 to 3 percent slopes (where drained)

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
13: Tawas-----	5W	Slight	Severe	Severe	Severe	Balsam fir----- Northern whitecedar----- Quaking aspen----- Black ash----- Red maple----- Paper birch----- Balsam poplar-----	40 --- --- --- --- --- ---	71 --- --- --- --- --- ---	---
Lupton-----	2W	Slight	Severe	Severe	Severe	Black spruce----- Balsam fir----- Black ash----- Northern whitecedar----- Paper birch----- Tamarack----- Red maple----- Quaking aspen-----	20 46 --- --- --- --- --- ---	29 86 --- --- --- --- --- ---	---
14: Dawson-----	2W	Slight	Severe	Severe	Severe	Black spruce----- Tamarack----- Jack pine-----	15 --- ---	23 --- ---	---
Loxley-----	2W	Slight	Severe	Severe	Severe	Black spruce----- Tamarack-----	15 ---	23 ---	---
15A: Crowell-----	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen----- Red pine----- Jack pine----- Northern red oak----- Black cherry----- Eastern white pine----- Red maple----- White oak-----	68 55 53 --- --- --- --- ---	78 88 83 --- --- --- --- ---	Red pine, eastern white pine, white spruce.
Au Gres-----	6W	Slight	Severe	Moderate	Severe	Quaking aspen----- Balsam fir----- Paper birch----- Red maple----- Eastern white pine----- Jack pine----- Red pine-----	70 --- --- 65 --- 51 61	81 --- --- 40 --- 69 104	White spruce, red pine, eastern white pine, Norway spruce.
16B: Graycalm-----	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen----- Northern red oak----- Red maple----- White oak----- Northern pin oak-----	70 62 --- --- ---	81 54 --- --- ---	Red pine, eastern white pine.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
17A----- Croswell	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen-----	68	78	Red pine, eastern white pine, white spruce.
						Red pine-----	55	88	
						Jack pine-----	53	73	
						Northern red oak----	---	---	
						Black cherry-----	---	---	
						Eastern white pine--	---	---	
Red maple-----	---	---							
18A----- Au Gres	6W	Slight	Severe	Moderate	Severe	Quaking aspen-----	70	81	White spruce, red pine, eastern white pine, Norway spruce.
						Balsam fir-----	---	---	
						Red maple-----	65	40	
						Eastern white pine--	---	---	
						Jack pine-----	51	69	
						Red pine-----	61	104	
Black spruce-----	---	---							
19----- Leafriver	2W	Slight	Severe	Severe	Severe	Quaking aspen-----	45	32	---
						Northern whitecedar-	---	---	
						Tamarack-----	---	---	
						Black spruce-----	---	---	
						Balsam fir-----	---	---	
						Black ash-----	---	---	
						Red maple-----	---	---	
						Paper birch-----	---	---	
20B, 20D: Graycalm-----	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Jack pine-----	56	78	
						Red maple-----	---	---	
						White oak-----	---	---	
Grayling-----	4S	Slight	Moderate	Moderate	Slight	Jack pine-----	48	63	Jack pine, red pine.
						White oak-----	---	---	
						Red pine-----	---	---	
20F: Graycalm-----	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Red pine-----	61	104	
						Red maple-----	---	---	
						White oak-----	---	---	
Grayling-----	4R	Moderate	Moderate	Moderate	Slight	Jack pine-----	48	63	Jack pine, red pine.
						Northern red oak----	---	---	
						White oak-----	---	---	
						Red pine-----	---	---	
21B, 21D: Graycalm-----	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Jack pine-----	56	78	
						Red pine-----	61	104	
						Red maple-----	---	---	
						Northern pin oak----	---	---	
						Quaking aspen-----	60	64	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
21B, 21D: Klacking-----	6S	Slight	Slight	Slight	Slight	Bigtooth aspen-----	70	81	Eastern white pine, red pine.
						White oak-----	57	46	
						Northern red oak----	64	56	
						Red maple-----	---	---	
						Black cherry-----	---	---	
						Northern pin oak----	---	---	
						Red pine-----	---	---	
						Quaking aspen-----	---	---	
Jack pine-----	---	---							
21F: Graycalm-----	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Jack pine-----	56	78	
						Red pine-----	61	104	
						Red maple-----	---	---	
						Northern pin oak----	---	---	
Quaking aspen-----	60	64							
Klacking-----	6R	Moderate	Moderate	Slight	Slight	Bigtooth aspen-----	70	81	Eastern white pine, red pine.
						White oak-----	57	46	
						Northern red oak----	64	56	
						Red maple-----	---	---	
						Black cherry-----	---	---	
						Northern pin oak----	---	---	
						Red pine-----	---	---	
						Quaking aspen-----	---	---	
Jack pine-----	---	---							
22B----- Montcalm	3A	Slight	Slight	Slight	Slight	Sugar maple-----	61	38	Red pine, eastern white pine, white spruce.
						Red maple-----	---	---	
						Northern red oak----	66	60	
						Quaking aspen-----	---	---	
						Red pine-----	---	---	
						Red maple-----	---	---	
						Quaking aspen-----	---	---	
						Bigtooth aspen-----	---	---	
Paper birch-----	---	---							
Balsam fir-----	---	---							
23: Ausable-----	2W	Slight	Severe	Severe	Severe	Northern whitecedar-	15	20	---
						Balsam poplar-----	---	---	
						Paper birch-----	---	---	
						Black ash-----	---	---	
						Quaking aspen-----	---	---	
Black spruce-----	---	---							
Bowstring-----	3W	Slight	Severe	Severe	Severe	Northern whitecedar-	15	20	---
						Black ash-----	---	---	
						Red maple-----	---	---	
						Eastern hemlock-----	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
24A: Kinross-----	2W	Slight	Severe	Severe	Severe	Black spruce----- Jack pine----- Eastern white pine-- Paper birch-----	15 --- --- ---	23 --- --- ---	---
Au Gres-----	6W	Slight	Severe	Moderate	Severe	Quaking aspen----- Bigtooth aspen----- Balsam fir----- Black spruce----- Yellow birch----- Red maple----- Eastern hemlock----- Eastern white pine-- Jack pine----- Red pine-----	70 --- --- --- --- 65 --- --- 51 61	81 --- --- --- --- 40 --- --- 69 104	White spruce, red pine, eastern white pine, Norway spruce.
31B----- Klacking	6S	Slight	Slight	Slight	Slight	Bigtooth aspen----- White oak----- Northern red oak---- Red maple----- Black cherry----- Northern pin oak---- Red pine----- Quaking aspen----- Jack pine-----	70 57 64 --- --- --- --- --- ---	81 46 56 --- --- --- --- ---	Eastern white pine, red pine.
32B----- Kellogg	3S	Slight	Moderate	Moderate	Slight	Northern red oak---- Eastern white pine-- Quaking aspen----- Balsam fir----- Red pine----- Red maple----- Paper birch----- Jack pine----- White oak-----	56 --- 74 --- --- 67 --- --- ---	44 --- 86 --- --- 41 --- ---	Red pine, eastern white pine.
34B----- Kneff	3L	Slight	Severe	Slight	Slight	Red maple----- Eastern hemlock----- White spruce----- Balsam fir----- Northern red oak---- Red pine----- Eastern white pine-- Paper birch-----	62 --- --- --- --- --- --- ---	39 --- --- --- --- --- --- ---	White spruce, red pine, eastern white pine.
35----- Kinross	2W	Slight	Severe	Severe	Severe	Black spruce----- Jack pine----- Eastern white pine-- Paper birch-----	15 --- --- ---	23 --- --- ---	---

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
47D----- Graycalm	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Red maple-----	---	---	
						Northern pin oak----	---	---	
47F----- Graycalm	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Red maple-----	---	---	
						White oak-----	---	---	
48B, 48D: Rubicon-----	4S	Slight	Moderate	Moderate	Slight	Quaking aspen-----	60	64	Red pine, jack pine, eastern white pine.
						Red pine-----	53	82	
						Bigtooth aspen-----	66	75	
						Northern red oak----	---	---	
						Red maple-----	57	36	
						Eastern white pine--	45	75	
Graycalm-----	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen-----	70	81	Red pine, eastern white pine.
						Northern red oak----	62	54	
						Red maple-----	---	---	
						Red pine-----	61	104	
						White oak-----	---	---	
						Eastern white pine--	---	---	
						Quaking aspen-----	60	64	
						---	---	---	
49B----- Kalkaska	3S	Slight	Moderate	Moderate	Slight	Sugar maple-----	64	40	Red pine, eastern white pine.
						Quaking aspen-----	---	---	
						Eastern hophornbeam--	---	---	
						American basswood---	---	---	
						American beech-----	---	---	
						Paper birch-----	---	---	
						Black cherry-----	---	---	
						Red maple-----	63	39	
						Bigtooth aspen-----	80	94	
50B: Au Gres-----	6W	Slight	Severe	Moderate	Severe	Quaking aspen-----	70	81	White spruce, red pine, eastern white pine, Norway spruce.
						Balsam fir-----	---	---	
						Red maple-----	65	40	
						Eastern hemlock-----	---	---	
						Eastern white pine--	---	---	
						Black spruce-----	---	---	
						Jack pine-----	51	69	
Red pine-----	61	104							
Kinross-----	2W	Slight	Severe	Severe	Severe	Black spruce-----	15	23	---
						Jack pine-----	---	---	
						Eastern white pine--	---	---	
						Paper birch-----	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
50B: Croswell-----	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen-----	68	78	Red pine, eastern white pine, white spruce.
						Red pine-----	55	88	
						Jack pine-----	53	83	
						Northern red oak----	---	---	
						Black cherry-----	---	---	
						Eastern white pine--	---	---	
						Red maple-----	---	---	
Paper birch-----	54	55							
51: Tawas-----	5W	Slight	Severe	Severe	Severe	Balsam fir-----	40	71	---
						Northern whitecedar-	---	---	
						Quaking aspen-----	---	---	
						Black ash-----	---	---	
						Red maple-----	---	---	
Paper birch-----	---	---							
Leafriver-----	2W	Slight	Severe	Severe	Severe	Quaking aspen-----	45	32	---
						Northern whitecedar-	---	---	
						Tamarack-----	---	---	
						Black spruce-----	---	---	
						Balsam fir-----	---	---	
						Red maple-----	---	---	
Balsam poplar-----	---	---							
52B, 52D----- Blue Lake	3A	Slight	Slight	Slight	Slight	Sugar maple-----	64	40	Red pine, eastern white pine, jack pine.
						Yellow birch-----	---	---	
						Quaking aspen-----	---	---	
						American beech-----	---	---	
						American basswood--	---	---	
						Bigtooth aspen-----	---	---	
						Red maple-----	---	---	
Eastern hophornbeam-	---	---							
58A: Wakeley-----	3W	Slight	Severe	Severe	Severe	Quaking aspen-----	50	43	Northern whitecedar.
						Black spruce-----	---	---	
						Balsam fir-----	---	---	
						Northern whitecedar-	---	---	
Allendale-----	4W	Slight	Severe	Moderate	Moderate	Quaking aspen-----	60	64	White spruce, eastern white pine.
						Northern red oak----	---	---	
						Eastern white pine--	---	---	
						Red pine-----	---	---	
						Paper birch-----	---	---	
						Balsam fir-----	---	---	
Red maple-----	---	---							
64B----- Feldhauser	3L	Slight	Moderate	Slight	Slight	Sugar maple-----	75	47	Norway spruce, red pine, eastern white pine.
						American beech-----	---	---	
						American basswood--	---	---	
						Paper birch-----	---	---	
						Quaking aspen-----	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
65F----- Rubicon	4R	Moderate	Moderate	Moderate	Slight	Quaking aspen-----	60	64	Red pine, jack pine, eastern white pine.
						Jack pine-----	53	73	
						Red pine-----	53	86	
						Bigtooth aspen-----	66	75	
						Northern red oak-----	---	---	
						Red maple-----	57	36	
						White oak-----	---	---	
Eastern white pine--	45	75							
67A: Bowers-----	7W	Slight	Severe	Slight	Moderate	Balsam fir-----	54	105	White spruce, eastern white pine, Norway spruce.
						White ash-----	---	---	
						Northern red oak-----	---	---	
						Quaking aspen-----	---	---	
Deerheart-----	7W	Slight	Severe	Severe	Severe	Quaking aspen-----	81	96	---
						Balsam fir-----	---	---	
						Northern whitecedar-----	---	---	
75B, 75D----- Rubicon	4S	Slight	Moderate	Moderate	Slight	Quaking aspen-----	60	64	Red pine, jack pine, eastern white pine.
						Jack pine-----	53	73	
						Red pine-----	53	82	
						Bigtooth aspen-----	66	75	
						Northern red oak-----	---	---	
						Red maple-----	57	36	
						White oak-----	---	---	
Eastern white pine--	45	75							
81B, 81D----- Grayling	4S	Slight	Moderate	Moderate	Slight	Jack pine-----	48	63	Jack pine, red pine.
						Northern pin oak-----	43	28	
						White oak-----	---	---	
						Red pine-----	---	---	
						Bigtooth aspen-----	---	---	
						Eastern white pine--	---	---	
81F----- Grayling	4R	Moderate	Moderate	Moderate	Slight	Jack pine-----	48	63	Jack pine, red pine.
						Northern pin oak-----	43	28	
						White oak-----	---	---	
						Red pine-----	---	---	
						Bigtooth aspen-----	---	---	
115D----- Kalkaska	3S	Slight	Moderate	Moderate	Slight	Sugar maple-----	64	40	Red pine, eastern white pine.
						Quaking aspen-----	---	---	
						Black cherry-----	---	---	
						American basswood-----	---	---	
						American beech-----	---	---	
						Paper birch-----	---	---	
						Eastern hophornbeam-----	---	---	
						Red maple-----	63	39	
Bigtooth aspen-----	80	94							

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
144B----- Perecheney	6S	Slight	Moderate	Moderate	Slight	Quaking aspen----- Jack pine----- Northern red oak---- Red maple----- Red pine----- Black cherry----- Eastern white pine-- White oak----- Balsam fir-----	70 --- --- --- --- --- --- --- ---	81 --- --- --- --- --- --- --- ---	Red pine, eastern white pine, white spruce.
146F: Rubicon-----	4R	Moderate	Moderate	Moderate	Slight	Quaking aspen----- Red pine----- Bigtooth aspen----- Northern red oak---- Red maple----- Eastern white pine-- White oak-----	60 53 66 --- 57 45 ---	64 82 75 --- 36 75 ---	Red pine, jack pine, eastern white pine.
Graycalm-----	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen----- Northern red oak---- Red pine----- Paper birch----- Eastern white pine-- Quaking aspen-----	70 62 61 --- --- 60	81 54 107 --- --- 64	Red pine, eastern white pine.
210B, 210C----- Grayling	4S	Slight	Moderate	Moderate	Slight	Jack pine----- Northern pin oak---- White oak----- Red pine----- Quaking aspen-----	48 43 --- --- ---	63 28 --- --- ---	Jack pine, red pine.
210D----- Grayling	4R	Moderate	Moderate	Moderate	Slight	Jack pine----- Northern pin oak---- White oak----- Red pine----- Quaking aspen-----	48 43 --- --- ---	63 28 --- --- ---	Jack pine, red pine.
210E----- Grayling	4R	Severe	Severe	Moderate	Slight	Jack pine----- Northern pin oak---- White oak----- Red pine----- Quaking aspen-----	48 43 --- --- ---	63 28 --- --- ---	Jack pine, red pine.
211B, 211C----- Grayling	4S	Slight	Moderate	Moderate	Slight	Jack pine----- Northern pin oak----	48 43	63 28	Jack pine, red pine.
211D----- Grayling	4R	Moderate	Moderate	Moderate	Slight	Jack pine----- Northern pin oak----	48 43	63 28	Jack pine, red pine.
211E----- Grayling	4R	Severe	Severe	Moderate	Slight	Jack pine----- Northern pin oak----	48 43	63 28	Jack pine, red pine.
212B----- Grayling	4S	Slight	Moderate	Moderate	Slight	Jack pine----- Northern pin oak----	48 43	63 28	Jack pine, red pine.
215B----- Typic Udipsamments	---	Slight	Moderate	Moderate	Slight	---	---	---	---

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
220B, 220C----- Typic Udipsamments	---	Slight	Moderate	Moderate	Slight	---	---	---	---
220D----- Typic Udipsamments	---	Moderate	Moderate	Moderate	Slight	---	---	---	---
221B, 221C----- Typic Udipsamments	---	Slight	Moderate	Moderate	Slight	---	---	---	---
221D----- Typic Udipsamments	---	Moderate	Moderate	Moderate	Slight	---	---	---	---
221E----- Typic Udipsamments	---	Severe	Severe	Moderate	Slight	---	---	---	---
222B----- Typic Udipsamments	---	Slight	Moderate	Moderate	Slight	---	---	---	---
223B, 223C: Graycalm-----	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen----- Northern red oak---- Jack pine----- Red pine----- Paper birch----- Eastern white pine-- Quaking aspen-----	70 62 56 61 --- --- 60	81 54 78 104 --- --- 64	Red pine, eastern white pine.
Grayling-----	4S	Slight	Moderate	Moderate	Slight	Jack pine----- Northern pin oak---- White oak----- Red pine----- Quaking aspen-----	48 43 --- --- ---	63 28 --- --- ---	Jack pine, red pine.
223D: Graycalm-----	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen----- Northern red oak---- Jack pine----- Red pine----- Paper birch----- Eastern white pine-- Quaking aspen-----	70 62 56 61 --- --- 60	81 54 78 104 --- --- 64	Red pine, eastern white pine.
Grayling-----	4R	Moderate	Moderate	Moderate	Slight	Jack pine----- Northern pin oak---- White oak----- Red pine----- Quaking aspen-----	48 43 --- --- ---	63 28 --- --- ---	Jack pine, red pine.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
224B----- Croswell	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen-----	68	78	Red pine, eastern white pine, white spruce.
						Red pine-----	55	88	
						Jack pine-----	53	73	
						Northern red oak----	---	---	
						Black cherry-----	---	---	
						Eastern white pine--	---	---	
						Bigtooth aspen-----	69	80	
						Red maple-----	---	---	
						Paper birch-----	54	55	
225B----- Entic Haplorthods	---	Slight	Moderate	Moderate	Slight	---	---	---	---
239B, 239C: Psammentic Eutroboralfs--	---	Slight	Moderate	Moderate	Slight	---	---	---	---
Typic Udipsamments--	---	Slight	Moderate	Moderate	Slight	---	---	---	---
239E: Psammentic Eutroboralfs--	---	Severe	Severe	Moderate	Slight	---	---	---	---
Typic Udipsamments--	---	Severe	Severe	Moderate	Slight	---	---	---	---
262A----- Au Gres	6W	Slight	Severe	Moderate	Severe	Quaking aspen-----	70	81	White spruce, red pine, eastern white pine, Norway spruce.
						Bigtooth aspen-----	---	---	
						Balsam fir-----	---	---	
						Paper birch-----	---	---	
						Yellow birch-----	---	---	
						Red maple-----	65	40	
						Eastern hemlock----	---	---	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
						Jack pine-----	51	69	
Red pine-----	61	104							
263A----- Argic Endoaquods	---	Slight	Severe	Moderate	Moderate	---	---	---	---
264A----- Allendale	4W	Slight	Severe	Moderate	Moderate	Quaking aspen-----	60	64	White spruce, eastern white pine.
						White ash-----	---	---	
						Eastern white pine--	---	---	
						White spruce-----	---	---	
						Paper birch-----	---	---	
						Balsam fir-----	---	---	
						Red maple-----	---	---	
271: Typic Endoaquods, wet-----	---	Slight	Severe	Severe	Severe	---	---	---	---
Typic Endoaquods----	---	Slight	Severe	Moderate	Severe	---	---	---	---

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Volume*	
275: Wakeley-----	3W	Slight	Severe	Severe	Severe	Quaking aspen----- Black spruce----- Balsam fir----- Northern whitecedar-	50 --- --- ---	43 --- --- ---	Northern whitecedar.
Leafriver-----	2W	Slight	Severe	Severe	Severe	Quaking aspen----- Northern whitecedar- Tamarack----- Black spruce-----	45 --- --- ---	36 --- --- ---	---
281----- Borosaprists	---	Slight	Severe	Severe	Severe	Black spruce-----	---	---	---
282----- Borosaprists	---	Slight	Severe	Severe	Severe	Northern whitecedar-	---	---	---
347F----- Kalkaska	3R	Moderate	Moderate	Moderate	Slight	Sugar maple----- Quaking aspen----- American basswood-- American beech----- Eastern hophornbeam- Black cherry----- Red maple----- Bigtooth aspen-----	64 --- --- --- --- --- 63 80	40 --- --- --- --- --- 39 94	Red pine, eastern white pine.
348----- Pickford	6W	Slight	Severe	Severe	Severe	Balsam fir----- Quaking aspen----- Balsam poplar-----	45 --- ---	83 --- ---	White spruce, eastern white pine.
349B----- Hartwick	4S	Slight	Moderate	Moderate	Slight	Quaking aspen----- Red maple----- Red pine----- Northern red oak---- Eastern white pine-- Sugar maple----- Jack pine----- American beech----- Bigtooth aspen----- Black cherry-----	60 53 55 --- --- --- --- --- --- ---	64 34 88 --- --- --- --- --- --- ---	Red pine, jack pine, eastern white pine.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
13: Tawas-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Lupton-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
14: Dawson-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Loxley-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
15A: Crowell-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Summer, fall, winter.	Slight-----	Slight-----	Slight.
Au Gres-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
16B----- Graycalm	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
17A----- Crowell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Summer, fall, winter.	Slight-----	Slight-----	Slight.
18A----- Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
19----- Leafriver	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
20B: Graycalm-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
Grayling-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
20D: Graycalm-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
Grayling-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
20F: Graycalm-----	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
Grayling-----	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
21B: Graycalm-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
Klacking-----	Slight-----	Slight-----	Slight-----	Year round-----	Slight-----	Slight-----	Slight.
21D: Graycalm-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
Klacking-----	Slight-----	Moderate: slope.	Slight-----	Year round-----	Slight-----	Moderate: slope.	Slight.
21F: Graycalm-----	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
Klacking-----	Moderate*: slope.	Severe: slope.	Moderate*: slope.	Year round-----	Moderate*: slope.	Severe: slope.	Moderate*: slope.
22B----- Montcalm	Slight-----	Slight-----	Slight-----	Year round-----	Slight-----	Slight-----	Slight.
23: Ausable-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
23: Bowstring-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
24A: Kinross-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
Au Gres-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
31B Klacking	Slight-----	Slight-----	Slight-----	Year round----	Slight-----	Slight-----	Slight.
32B Kellogg	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
34B Kneff	Severe: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, winter	Slight-----	Slight-----	Slight.
35 Kinross	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
47D Graycalm	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
47F Graycalm	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
48B: Rubicon-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
Graycalm-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
48D: Rubicon-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
Graycalm-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
49B----- Kalkaska	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
50B: Au Gres-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
Kinross-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
Croswell-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
51: Tawas-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
Leafriver-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
52B----- Blue Lake	Slight-----	Slight-----	Slight-----	Year round-----	Slight-----	Slight-----	Slight.
52D----- Blue Lake	Slight-----	Moderate: slope.	Slight-----	Year round-----	Slight-----	Moderate: slope.	Slight.
58A: Wakeley-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
Allendale-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
64B----- Feldhauser	Moderate: low strength.	Slight-----	Slight-----	Summer, winter	Slight-----	Slight-----	Slight.
65F----- Rubicon	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
67A: Bowers-----	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
67A: Deerheart-----	Severe: wetness, low strength.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
75B----- Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
75D----- Rubicon	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
81B----- Grayling	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
81D----- Grayling	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
81F----- Grayling	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
115D----- Kalkaska	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
144B----- Perecheney	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
146F: Rubicon-----	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
Graycalm-----	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
210B----- Grayling	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
210C----- Grayling	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
210D----- Grayling	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
210E----- Grayling	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
211B----- Grayling	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
211C----- Grayling	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
211D----- Grayling	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
211E----- Grayling	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
212B----- Grayling	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
213B----- Graycalm	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
215B, 220B----- Typic Udipsamments	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
220C----- Typic Udipsamments	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
220D----- Typic Udipsamments	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
221B----- Typic Udipsamments	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
221C----- Typic Udipsamments	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
221D----- Typic Udipsamments	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
221E----- Typic Udipsamments	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
222B----- Typic Udipsamments	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
223B: Graycalm-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
Grayling-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
223C: Graycalm-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
Grayling-----	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
223D: Graycalm-----	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
Grayling-----	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
224B----- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
225B----- Entic Haplorthods	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
236B----- Arenic Eutroboralfs	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
239B: Psammentic Eutroboralfs-----	Slight-----	Slight-----	Slight-----	Year round----	Slight-----	Slight-----	Slight.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
239B: Typic Udipsamments-	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.
239C: Psammentic Eutroboralfs-----	Slight-----	Moderate: slope.	Slight-----	Year round----	Slight-----	Moderate: slope.	Slight.
Typic Udipsamments-	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Moderate: slope.	Slight.
239E: Psammentic Eutroboralfs-----	Severe: slope.	Severe: slope.	Severe: slope.	Year round----	Severe: slope.	Severe: slope.	Severe: slope.
Typic Udipsamments-	Severe: slope.	Severe: slope.	Severe: slope.	Spring, fall, winter.	Severe: slope.	Severe: slope.	Severe: slope.
262A----- Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
263A----- Argic Endoaquods	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
264A----- Allendale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
271: Typic Endoaquods, wet-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
Typic Endoaquods---	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
275: Wakeley-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter	Slight-----	Slight-----	Slight.
Leafriver-----	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.

See footnote at end of table.

TABLE 8.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Soil name and map symbol	Ratings for most limiting season(s)			Preferred operating season(s)	Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads		Logging areas and skid roads	Log landings	Haul roads
281, 282----- Borosapristis	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter-----	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
347F----- Kalkaska	Moderate*: too sandy, slope.	Severe: slope.	Moderate*: too sandy, slope.	Spring, fall, winter.	Moderate*: slope.	Severe: slope.	Moderate*: slope.
348----- Pickford	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Winter-----	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
349B----- Hartwick	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight-----	Slight-----	Slight.

* In some areas the soil may be rated "severe."

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS

(Absence of an entry indicates that information was not available)

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
13----- Tawas-Lupton	Northern whitecedar----- 5	Quaking aspen-- 3	Meadowsweet---- 4	Sensitive fern-- 3	Grasses----- 4
	Black spruce--- 3	Black spruce--- 3	Willow----- 3	Spinulose shield fern----- 3	Horsetail----- 4
	Balsam fir----- 3	Red maple----- 2	Tag alder----- 3	Ladyfern----- 3	Sphagnum moss--- 4
	Quaking aspen-- 3	Northern red oak----- 1	Redosier dogwood----- 3	Crested fern--- 3	Creeping snowberry----- 3
	Tamarack----- 3	Balsam fir----- 1	Leatherleaf--- 1	Cinnamon fern-- 2	Palmateleaf coltsfoot----- 3
	Paper birch--- 3	Black ash----- 1		Oakfern----- 1	Violets----- 3
	Balsam poplar-- 2			Royal fern----- 1	Bunchberry----- 2
	Red maple----- 2			Shining club moss----- 1	Canada blueberry----- 2
	Black ash----- 2				Dewberry----- 2
	Yellow birch--- 1				Goldenrods----- 2
	Black cherry--- 1				Goldthread----- 2
	Eastern white pine----- 1				Labrador tea--- 2
					Miterwort----- 2
					Sedges----- 2
					Skunk cabbage--- 2
					Starflower----- 2
					Twinflower----- 2
				Wild iris----- 2	
				Wild sarsaparilla--- 2	
				Wild strawberry- 2	
				Wintergreen----- 2	
				Yellow beadlily- 2	
				Bedstraw----- 1	
				Brambles----- 1	
				Cattails----- 1	
				Currants----- 1	
				Low sweet blueberry----- 1	
				Virginsbower---- 1	
				Wild lily of the valley----- 1	
14----- Dawson-Loxley	Black spruce--- 2	Black spruce--- 3	Bog birch----- 2	---	Sphagnum moss--- 6
	Tamarack----- 2	Tamarack----- 2	Leatherleaf--- 6		Labrador tea--- 4
	Jack pine----- 2	Jack pine----- 2	Willows----- 1		Sedges----- 3
	Eastern white pine----- 1	Eastern white pine----- 1			Bog laurel----- 2
					Bog rosemary---- 2
				Cotton grass--- 2	
				Low sweet blueberry----- 2	
				Bulrushes----- 1	
				Michigan lily--- 1	

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
15A: Croswell-----	Jack pine----- 4 Red pine----- 3 Eastern white pine----- 3 Quaking aspen-- 2 Black cherry--- 2 Red maple----- 2 Chokecherry--- 2 Paper birch---- 1 Northern red oak----- 1 White oak----- 1	Red maple----- 3 Eastern white pine----- 2 Black cherry--- 2 Northern red oak----- 2 Balsam fir----- 2 Red pine----- 2 White oak----- 1 Chokecherry--- 1 Jack pine----- 1	Beaked hazelnut----- 2 Hawthorn----- 2 Serviceberry--- 1	Brackenfern----- 5	Low sweet blueberry----- 4 Pennsylvania sedge----- 4 Blue cladonia--- 3 Canada blueberry----- 3 Grasses----- 3 Reindeer lichen- 3 Sedges----- 3 Sweetfern----- 3 Brambles----- 2 Blueberries----- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2 Wintergreen----- 2 Large-leaved aster----- 1 Pink lady slipper----- 1 Wild strawberry- 1
Au Gres-----	Red maple----- 3 Eastern white pine----- 3 Red pine----- 3 Jack pine----- 3 Balsam fir----- 3 Black spruce--- 2 Black cherry--- 1 Paper birch---- 1	Red maple----- 2 Eastern white pine----- 2 Red pine----- 2 Black spruce--- 2 Balsam fir----- 3	Serviceberry--- 2 Leatherleaf---- 2	Brackenfern----- 5	Canada blueberry----- 4 Low sweet blueberry----- 3 Pennsylvania sedge----- 3 Sheep laurel--- 3 Wintergreen----- 3 Bunchberry----- 2 Goldthread----- 2 Grasses----- 2 Labrador tea--- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2 Yellow beadlily- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
16B----- Graycalm	Northern red oak----- 4 Red maple----- 4 White oak----- 3 Bigtooth aspen- 3 Northern pin oak----- 2	Black cherry--- 2 Northern red oak----- 2 White oak----- 3 Red maple----- 3 Eastern white pine----- 2 Red pine----- 1	Serviceberry--- 3 Witchhazel----- 3 Beaked hazelnut----- 3 Mapleleaf viburnum----- 2	Brackenfern----- 5	Low sweet blueberry----- 3 Wintergreen----- 3 Brambles----- 2 Canada blueberry----- 2 Large-leaved aster----- 2 Pennsylvania sedge----- 2 Rosy twistedstalk--- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2
17A----- Croswell	Jack pine----- 4 Red pine----- 3 Eastern white pine----- 3 Quaking aspen-- 2 Black cherry--- 2 Red maple----- 2 Chokecherry--- 2 Paper birch---- 1 Northern red oak----- 1	Red maple----- 3 Balsam fir----- 3 Black cherry--- 2 Northern red oak----- 2 Eastern white pine----- 2 Red pine----- 2 White oak----- 1 Chokecherry--- 1 Jack pine----- 1	Beaked hazelnut----- 2 Hawthorn----- 2 Serviceberry--- 1	Brackenfern----- 5	Low sweet blueberry----- 4 Pennsylvania sedge----- 4 Blue cladonia--- 3 Canada blueberry----- 3 Grasses----- 3 Reindeer lichen- 3 Sedges----- 3 Sweetfern----- 3 Wintergreen----- 3 Brambles----- 2 Blueberries----- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2 Large-leaved aster----- 1 Pink lady slipper----- 1 Wild strawberry- 1
18A----- Au Gres	Red maple----- 3 Eastern white pine----- 3 Red pine----- 3 Jack pine----- 3 Balsam fir----- 3 Black spruce--- 2 Paper birch---- 1 Black cherry--- 1	Red maple----- 2 Eastern white pine----- 2 Red pine----- 2 Black spruce--- 2 Balsam fir----- 3	Serviceberry--- 2 Leatherleaf---- 2	Brackenfern----- 5	Canada blueberry----- 4 Low sweet blueberry----- 3 Pennsylvania sedge----- 3 Sheep laurel--- 3 Wintergreen----- 3 Bunchberry----- 2 Goldthread----- 2 Grasses----- 2 Labrador tea--- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2 Yellow beadlily- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
19----- Leafriver	Northern whitecedar---- 3	Red maple----- 2	Tag alder----- 4	Cinnamon fern--- 3	Grasses----- 5
	Red maple----- 3	Paper birch---- 2	Redosier dogwood----- 2	Interrupted fern----- 2	Black snakeroot- 4
	Tamarack----- 3	Quaking aspen-- 1	Silky dogwood-- 1	Oakfern----- 2	Dewberry----- 4
	Black ash----- 3	Chokecherry---- 1	Alternatleaf dogwood----- 1	Sensitive fern-- 5	Horsetail----- 4
	Black spruce--- 2	Balsam fir----- 1	Northern red dogwood----- 1	Spinulose shield fern----- 2	Sedges----- 4
	Paper birch--- 2	Northern red oak----- 1	Willow----- 2	Crested fern--- 3	Baneberry----- 3
	Balsam fir----- 2				Bedstraw----- 3
	Quaking aspen-- 2				Bugleweed----- 3
	Eastern white pine----- 1				Sphagnum moss--- 3
	Chokecherry---- 1				Blueberries----- 3
					Currants----- 2
					Goldthread----- 2
					Heal-all----- 2
					Jack in the pulpit----- 2
					Jewelweed----- 2
				Violets----- 2	
				Wild lily of the valley---- 2	
				Wild sarsaparilla--- 2	
				American fly honeysuckle--- 1	
				Bunchberry----- 1	
				Canada blueberry----- 1	
				Columbine----- 1	
				Marshmarigold--- 1	
				Miterwort----- 1	
				Wild iris----- 1	
				Wild strawberry- 1	
20B----- Graycalm- Grayling	Northern red oak----- 4	Northern red oak----- 3	Serviceberry--- 2	Brackenfern----- 4	Low sweet blueberry----- 3
	White oak----- 3	White oak----- 3	Witchhazel----- 3	Groundcedar----- 3	Pennsylvania sedge----- 3
	Red maple----- 3	Red maple----- 3	Mapleleaf viburnum----- 1		Wintergreen----- 3
	Jack pine----- 3	Black cherry--- 2			Bearberry----- 2
	Bigtooth aspen- 2	Red pine----- 2			Blue cladonia--- 2
	Red pine----- 1	Eastern white pine----- 1			Brambles----- 2
		Bigtooth aspen- 1			Canada blueberry----- 2
		Jack pine----- 1			Grasses----- 2
					Large-leaved aster----- 2
					Reindeer lichen- 2
				Rosy twistedstalk--- 2	
				Starflower----- 2	
				Trailing arbutus----- 2	
				Wild lily of the valley---- 2	
				Pink lady slipper----- 1	
				Sweetfern----- 1	
				Wild sarsaparilla--- 1	
				Wild strawberry- 1	

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
20D, 20F----- Graycalm- Grayling	Northern red oak----- 4	Northern red oak----- 3	Serviceberry--- 2	Brackenfern----- 4	Low sweet blueberry----- 3
	Red pine----- 3	White oak----- 3	Witchhazel----- 3	Groundcedar----- 3	Pennsylvania sedge----- 3
	Red maple----- 3	Red maple----- 3	Mapleleaf viburnum----- 1		Wintergreen----- 3
	White oak----- 2	Black cherry--- 2			Bearberry----- 2
	Bigtooth aspen- 2	Red pine----- 2			Blue cladonia--- 2
		Eastern white pine----- 1			Brambles----- 2
		Bigtooth aspen- 1			Canada blueberry----- 2
					Grasses----- 2
					Large-leaved aster----- 2
					Reindeer lichen- 2
21B, 21D, 21F---- Graycalm- Klacking	Quaking aspen-- 3	Red maple----- 3	Serviceberry--- 3	Brackenfern----- 4	Rosy twistedstalk--- 2
	Bigtooth aspen- 3	Quaking aspen-- 2	Witchhazel----- 3	Shining club moss----- 2	Starflower----- 2
	Northern red oak----- 3	Northern red oak----- 2	Hawthorn----- 3		Trailing arbutus----- 2
	White oak----- 3	Black cherry--- 2	Beaked hazelnut----- 2		Wild lily of the valley----- 2
	Red maple----- 3	Red maple----- 3	Mapleleaf viburnum----- 2		Pink lady slipper----- 1
	Jack pine----- 3	American beech- 2	Upland willow-- 2		Sweetfern----- 1
	Northern pin oak----- 2	White oak----- 2			Wild sarsaparilla--- 1
	Black cherry--- 2	Red pine----- 1			Wild strawberry- 1
	Red pine----- 1				Pennsylvania sedge----- 4
	American beech- 1				Grasses----- 3
Paper birch--- 1				Highbush blueberry----- 3	
				Low sweet blueberry----- 3	
				Wild sarsaparilla--- 3	
				Wintergreen----- 3	
				Brambles----- 2	
				Canada blueberry----- 2	
				Large-leaved aster----- 2	
				Rosy twistedstalk--- 2	
				Starflower----- 2	
				Sweetfern----- 2	
				Trailing arbutus----- 2	
				Wild lily of the valley----- 2	
				Wild strawberry- 2	
				Bedstraw----- 1	
				Bellworts----- 1	
				Fringed polygala----- 1	
				Pink lady slipper----- 1	
				Pyrolas----- 1	

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
22B----- Montcalm	Quaking aspen-- 4 Northern red oak----- 3 Red maple----- 3 Sugar maple----- 3 Bigtooth aspen- 3 Paper birch----- 2 Red pine----- 2 Black cherry--- 1	Quaking aspen-- 3 Red maple----- 3 Black cherry--- 3 Northern red oak----- 2 Sugar maple----- 2 American beech- 2 Bigtooth aspen- 1 White oak----- 1	Beaked hazelnut----- 3 Mapleleaf viburnum----- 3 Serviceberry--- 2 Witchhazel----- 2 Upland willow-- 2	Brackenfern----- 5	Grasses----- 4 Large-leaved aster----- 4 Canada blueberry----- 3 Indian paintbrush----- 3 Pennsylvania sedge----- 3 Wild strawberry- 3 Wintergreen----- 3 Brambles----- 2 Hawkweed----- 2 Northern bush honeysuckle----- 2 Starflower----- 2 Sweetfern----- 2 Violets----- 2 Wild lily of the valley----- 2 Wild sarsaparilla--- 2 Low sweet blueberry----- 1 Princes pine----- 1 Pyrolas----- 1 Rosy twistedstalk--- 1
23**----- Ausable- Bowstring	Northern whitecedar----- 5 Quaking aspen-- 3 Black spruce--- 3 Paper birch----- 2 Balsam poplar-- 2 Black ash----- 2 Eastern hemlock----- 2 Red maple----- 1	Red maple----- 4 Black spruce--- 3	Tag alder----- 4 Willows----- 4 Alternatoleaf dogwood----- 3 Redosier dogwood----- 2 Meadowsweet--- 2	Sensitive fern-- 3 Crested fern--- 2	Sedges----- 5 Grasses----- 4 Goldthread----- 3 Bedstraw----- 2 Canada blueberry----- 2 Goldenrods----- 2 Mints----- 2 Partridgeberry-- 2 Princes pine--- 2 Starflower----- 2 Violets----- 2 Wild strawberry- 2 Jewelweed----- 1 Miterwort----- 1 Nettles----- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
24A: Kinross-----	Jack pine----- 4 Black spruce--- 3	Black spruce--- 3 Jack pine----- 2 Red maple----- 2 Black cherry--- 2 Northern red oak----- 1 White oak----- 1 Tamarack----- 1	Leatherleaf--- 4 Serviceberry--- 1 Tag alder----- 1	---	Labrador tea--- 5 Sphagnum moss--- 5 Low sweet blueberry----- 4 Sheep laurel--- 4 Dewberry----- 3 Goldthread----- 3 Trailing arbutus----- 3 Wild lily of the valley--- 3 Brambles----- 2 Canada blueberry----- 2 Grasses----- 2 Sweetfern----- 1
Au Gres-----	Red maple----- 3 Eastern white pine----- 3 Red pine----- 3 Jack pine----- 3 Balsam fir----- 3 Black spruce--- 2 Black cherry--- 1 Paper birch--- 1	Red maple----- 2 Eastern white pine----- 2 Red pine----- 2 Black spruce--- 2 Balsam fir----- 3	Serviceberry--- 2 Leatherleaf--- 2	Brackenfern--- 5	Canada blueberry----- 4 Low sweet blueberry----- 3 Pennsylvania sedge----- 3 Sheep laurel--- 3 Wintergreen--- 3 Bunchberry--- 2 Goldthread----- 2 Grasses----- 2 Labrador tea--- 2 Starflower--- 2 Trailing arbutus----- 2 Wild lily of the valley--- 2 Yellow beadlily- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
31B----- Klacking	Quaking aspen-- 3	Red maple----- 3	Serviceberry--- 3	Brackenfern----- 4	Pennsylvania
	Northern red oak----- 3	Northern red oak----- 2	Witchhazel----- 3	Shining club moss----- 2	sedge----- 4
	Red maple----- 3	White oak----- 2	Hawthorn----- 3		Grasses----- 3
	Jack pine----- 3	Black cherry--- 2	Upland willow-- 2		Low sweet blueberry----- 3
	Bigtooth aspen- 3	Eastern white pine----- 2	Beaked hazelnut----- 2		Wild sarsaparilla--- 3
	White oak----- 3	American beech- 1			Wintergreen----- 3
	Northern pin oak----- 3	Quaking aspen-- 1			Brambles----- 2
	White oak----- 3	Red pine----- 1			Canada blueberry----- 2
	Black cherry--- 2				Large-leaved aster----- 2
	Red pine----- 1				Starflower----- 2
	American beech- 1				Sweetfern----- 2
					Wild lily of the valley---- 2
					Wild strawberry- 2
					Bedstraw----- 1
					Bellworts----- 1
				Fringed polygala----- 1	
				Pink lady slipper----- 1	
				Pyrolas----- 1	
				Rosy twistedstalk--- 1	
32B----- Kellogg	Quaking aspen-- 3	Northern red oak----- 3	Serviceberry--- 2	Brackenfern----- 5	Canada blueberry----- 3
	Northern red oak----- 3	Quaking aspen-- 2	Hawthorn----- 2		Dewberry----- 3
	Red pine----- 3	White oak----- 2			Grasses----- 3
	Red maple----- 2	Red maple----- 2			Pennsylvania sedge----- 3
	White oak----- 2	Eastern white pine----- 2			Wild strawberry- 3
	Jack pine----- 2	Black cherry--- 2			Wintergreen----- 3
	Paper birch--- 2	Red pine----- 1			Bedstraw----- 2
	Eastern white pine----- 2	Balsam fir----- 1			Low sweet blueberry----- 2
	Balsam fir----- 2				Sedges----- 2
					Starflower----- 2
					Wild lily of the valley---- 2
				Currants----- 1	
				Large-leaved aster----- 1	
				Reindeer lichen- 1	
				Wood anemone---- 1	

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
35----- Kinross	Jack pine----- 4 Black spruce--- 3	Black spruce--- 3 Jack pine----- 2 Red maple----- 2 Black cherry--- 2 Northern red oak----- 1 White oak----- 1 Tamarack----- 1	Leatherleaf--- 4 Serviceberry--- 1 Tag alder----- 1	---	Labrador tea--- 5 Sphagnum moss--- 5 Low sweet blueberry----- 4 Sheep laurel--- 4 Dewberry----- 3 Goldthread----- 3 Trailing arbutus----- 3 Wild lily of the valley--- 3 Brambles----- 2 Canada blueberry----- 2 Grasses----- 2 Sweetfern----- 1
47D, 47F----- Graycalm	Northern red oak----- 4 Red maple----- 4 White oak----- 3 Bigtooth aspen- 3 Northern pin oak----- 2	Black cherry--- 2 Northern red oak----- 2 White oak----- 3 Red maple----- 3 Eastern white pine----- 2 Red pine----- 1	Serviceberry--- 3 Witchhazel--- 3 Beaked hazelnut----- 3 Mapleleaf viburnum----- 2	Brackenfern----- 5	Low sweet blueberry----- 3 Wintergreen----- 3 Brambles----- 2 Canada blueberry----- 2 Large-leaved aster----- 2 Pennsylvania sedge----- 2 Rosy twistedstalk--- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley--- 2
48B, 48D----- Rubicon- Graycalm	Northern red oak----- 4 Quaking aspen-- 3 Bigtooth aspen- 3 White oak----- 3 Red maple----- 3 Eastern white pine----- 2 Red pine----- 2	Northern red oak----- 3 Red maple----- 3 Black cherry--- 2 White oak----- 2 Quaking aspen-- 2 Eastern white pine----- 2 Red pine----- 2 Bigtooth aspen- 2 American beech- 1	Beaked hazelnut----- 2 Serviceberry--- 2 Witchhazel--- 2 Hawthorn----- 1	Brackenfern----- 2	Pennsylvania sedge----- 4 Canada blueberry----- 3 Low sweet blueberry----- 3 Wintergreen----- 3 Blue cladonia--- 2 Brambles----- 2 Grasses----- 2 Reindeer lichen- 2 Rosy twistedstalk--- 2 Starflower----- 2 Sweetfern----- 2 Trailing arbutus----- 2 Wild lily of the valley--- 2 Wild strawberry- 2 Fringed polygala----- 1 Large-leaved aster----- 1 Princes pine--- 1 Violets----- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
49B----- Kalkaska	Sugar maple----- 5 American beech- 3 Quaking aspen-- 3 Eastern hophornbeam--- 2 American basswood----- 2 Bigtooth aspen- 2 Red maple----- 2 Black cherry--- 1 American elm--- 1 Paper birch--- 1	Sugar maple----- 3 American beech- 3 Eastern hophornbeam--- 3 White ash----- 2 Northern red oak----- 2 Red maple----- 2 Black cherry--- 1 American elm--- 1 American basswood----- 1 Pin cherry----- 1 Eastern white pine----- 1 Balsam fir----- 1	Beaked hazelnut----- 2 Serviceberry--- 2 Mapleleaf viburnum----- 2	Brackenfern----- 2 Rattlesnake fern----- 2 Spinulose shield fern----- 1 Groundcedar----- 5 Running-pine--- 3 Shining club moss----- 3 Tree clubmoss--- 1 Staghorn clubmoss----- 1	Trout lily----- 4 Downy yellow violet----- 3 Grasses----- 3 Bedstraw----- 2 Brambles----- 2 Dutchmans breeches----- 2 Large-leaved aster----- 2 Partridgeberry-- 2 Squirrel corn--- 2 Starflower----- 2 Sweet cicely--- 2 Trilliums----- 2 Violets----- 2 Wild lily of the valley----- 2 Wild sarsaparilla--- 2 American fly honeysuckle--- 1 Baneberry----- 1 Hawkweed----- 1 Pennsylvania sedge----- 1 Pyrolas----- 1 Reindeer lichen- 1 Rosy twistedstalk--- 1
50B: Au Gres-----	Red maple----- 3 Eastern white pine----- 3 Red pine----- 3 Jack pine----- 3 Balsam fir----- 3 Black spruce--- 2 Black cherry--- 1 Paper birch--- 1	Red maple----- 2 Eastern white pine----- 2 Red pine----- 2 Black spruce--- 2 Balsam fir----- 3	Serviceberry--- 2 Leatherleaf--- 2	Brackenfern----- 5	Canada blueberry----- 4 Low sweet blueberry----- 3 Pennsylvania sedge----- 3 Sheep laurel--- 3 Wintergreen--- 3 Bunchberry----- 2 Goldthread----- 2 Grasses----- 2 Labrador tea--- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2 Yellow beadlily- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
50B: Kinross-----	Jack pine----- 4 Black spruce--- 3	Black spruce--- 3 Jack pine----- 2 Red maple----- 2 Black cherry--- 2 Northern red oak----- 1 White oak----- 1 Tamarack----- 1	Leatherleaf---- 4 Serviceberry--- 1 Tag alder----- 1	---	Labrador tea--- 5 Sphagnum moss--- 5 Low sweet blueberry----- 4 Sheep laurel---- 4 Dewberry----- 3 Goldthread----- 3 Trailing arbutus----- 3 Wild lily of the valley---- 3 Brambles----- 2 Canada blueberry----- 2 Grasses----- 2 Sweetfern----- 1
Croswell-----	Jack pine----- 4 Red pine----- 3 Eastern white pine----- 3 Quaking aspen-- 2 Black cherry--- 2 Red maple----- 2 Chokecherry--- 2 Paper birch---- 1 Northern red oak----- 1	Red maple----- 3 Balsam fir----- 3 Black cherry--- 2 Northern red oak----- 2 Eastern white pine----- 2 Red pine----- 2 White oak----- 1 Chokecherry--- 1 Jack pine----- 1	Beaked hazelnut----- 2 Hawthorn----- 2 Serviceberry--- 1	Brackenfern----- 5	Low sweet blueberry----- 4 Pennsylvania sedge----- 4 Blue cladonia--- 3 Canada blueberry----- 3 Grasses----- 3 Reindeer lichen- 3 Sedges----- 3 Sweetfern----- 3 Wintergreen---- 3 Brambles----- 2 Blueberries----- 2 Starflower----- 2 Trailing arbutus----- 2 Wild lily of the valley---- 2 Large-leaved aster----- 1 Pink lady slipper----- 1 Wild strawberry- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
51----- Tawas-Leafriver	Northern whitecedar---- 4 Tamarack----- 3 Black spruce--- 3 Balsam fir----- 3 Red maple----- 3 Paper birch---- 3 Black ash----- 2 Quaking aspen-- 2 Balsam poplar-- 2 Eastern white pine----- 1 Chokecherry--- 1	Red maple----- 2 Paper birch---- 2 Quaking aspen-- 2 Black spruce--- 2 Balsam fir----- 1 Northern red oak----- 1 White spruce--- 1 Chokecherry--- 1	Tag alder----- 4 Redosier dogwood----- 3 Willow----- 3 Alternatleaf dogwood----- 1 Silky dogwood-- 1	Cinnamon fern--- 3 Sensitive fern-- 3 Crested fern--- 3 Oakfern----- 2 Interrupted fern----- 2 Spinulose shield fern----- 2	Grasses----- 5 Dewberry----- 4 Horsetail----- 4 Sedges----- 4 Baneberry----- 3 Bedstraw----- 3 Bugleweed----- 3 Sphagnum moss--- 3 Blueberries----- 2 Brambles----- 2 Canada blueberry----- 2 Cattails----- 2 Currants----- 2 Goldthread----- 2 Heal-all----- 2 Jack in the pulpit----- 2 Jewelweed----- 2 Violets----- 2 Wild lily of the valley---- 2 Wild sarsaparilla--- 2 Bunchberry----- 1 Low sweet blueberry----- 1 Marshmarigold--- 1 Miterwort----- 1 Wild iris----- 1 Wild strawberry- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
52B, 52D----- Blue Lake	Sugar maple---- 5 American beech- 4 American basswood----- 3 Bigtooth aspen- 3 Yellow birch--- 2 Red maple----- 2 Eastern hophornbeam--- 2 Black cherry--- 1 Quaking aspen-- 1 Eastern hemlock----- 1	Sugar maple---- 4 American beech- 3 Eastern hophornbeam--- 3 Red maple----- 2 American elm--- 2 Black cherry--- 2 Quaking aspen-- 2 Yellow birch--- 2 White ash----- 1 Chokecherry--- 1 American basswood----- 1 Eastern white pine----- 1 Balsam fir----- 1	Beaked hazelnut----- 2 Red elderberry- 2 Mapleleaf viburnum----- 2 Serviceberry--- 2 Hawthorn----- 1	Spinulose shield fern----- 3 Brackenfern----- 2 Rattlesnake fern----- 1 Tree clubmoss--- 2 Staghorn clubmoss----- 1 Running-pine---- 2	Fringed polygala----- 3 Grasses----- 3 Trout lily----- 3 Bedstraw----- 2 Currants----- 2 Downy yellow violet----- 2 Dutchmans breeches----- 2 False Solomons seal----- 2 Partridgeberry-- 2 Sedges----- 2 Smooth yellow violet----- 2 Squirrel corn-- 2 Sweet cicely---- 2 Trilliums----- 2 Wild lily of the valley----- 2 American fly honeysuckle----- 1 Baneberry----- 1 Pyrolas----- 1 Rosy twistedstalk--- 1 Starflower----- 1 Violets----- 1 Wild sarsaparilla----1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
58A----- Wakeley- Allendale	Quaking aspen-- 4 Black spruce--- 3 Red maple----- 3 Balsam fir----- 3 Paper birch---- 3 Northern whitecedar---- 2 Eastern white pine----- 2 Northern red oak----- 1 Balsam poplar-- 1 American elm--- 1 Red pine----- 1	Red maple----- 3 Paper birch---- 3 Balsam fir----- 3 Eastern white pine----- 2 Pin cherry----- 2 Quaking aspen-- 1 Northern red oak----- 1 White oak----- 1 Red pine----- 1	Tag alder----- 3 Redosier dogwood----- 2 Mapleleaf viburnum----- 2 Beaked hazelnut----- 2 Hawthorn----- 1 Serviceberry--- 1 Witchhazel----- 1 Alternatleaf dogwood----- 1	Brackenfern---- 4 Interrupted fern----- 2 Ladyfern----- 2 Sensitive fern-- 2 Rattlesnake fern----- 1 Tree clubmoss--- 1 Running-pine--- 1	Grasses----- 4 Bedstraw----- 3 Black snakeroot----- 3 Bulrushes----- 3 Bunchberry----- 3 Canada blueberry----- 3 Fringed polygala----- 3 Large-leaved aster----- 3 Partridgeberry-- 3 Wild lily of the valley----- 3 Wild strawberry- 3 Baneberry----- 2 Brambles----- 2 Cinquefoils----- 2 Dewberry----- 2 Dwarf ginseng--- 2 Goldthread----- 2 Horsetail----- 2 Low sweet blueberry----- 2 Miterwort----- 2 Pyrolas----- 2 Sedges----- 2 Starflower----- 2 Wintergreen----- 2 Wood anemone---- 2 Hepatica----- 1 Rosy twistedstalk--- 1 Smooth yellow violet----- 1 Trailing arbutus----- 1 Trillium----- 1 Wild sarsaparilla--- 1 Yellow beadlily- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
64B----- Feldhauser	Sugar maple---- 4	Sugar maple---- 3	Beaked	Brackenfern----- 2	Downy yellow
	American basswood----- 3	American beech- 2	hazelnut----- 1	Ladyfern----- 2	violet----- 4
	Quaking aspen-- 3	Black cherry--- 2	Alternatleaf	Maidenhair fern- 2	Hepatica----- 3
	American beech- 3	Eastern hophornbeam--- 2	dogwood----- 1	Rattlesnake fern----- 2	Sweet cicely--- 3
	Paper birch---- 1	Quaking aspen-- 1	Serviceberry-- 1	Spinulose shield fern----- 2	Trilliums----- 3
	Yellow birch--- 1	American elm--- 1	Red elderberry- 1	Tree clubmoss--- 1	Violets----- 3
		American basswood----- 1	American yew--- 1		Baneberry----- 2
					Bedstraw----- 2
					Blue cohosh--- 2
					Canada white violet----- 2
					Currants----- 2
					Grasses----- 2
					Pennsylvania sedge----- 2
				Squirrel corn--- 2	
				Trout lily----- 2	
				Wild lily of the valley---- 2	
				Wild sarsaparilla--- 2	
				Wild strawberry- 2	
				Brambles----- 1	
				Columbine----- 1	
				Jack in the pulpit----- 1	
				Wild leeks----- 1	
				Wild oats----- 1	
65F----- Rubicon	Northern red oak----- 4	Northern red oak----- 3	Serviceberry--- 2	Brackenfern----- 4	Pennsylvania sedge----- 4
	White oak----- 3	Red maple----- 3	Witchhazel----- 2		Canada blueberry----- 3
	Red maple----- 3	White oak----- 2	Beaked hazelnut----- 2		Low sweet blueberry----- 3
	Quaking aspen-- 3	Quaking aspen-- 2	Hawthorn----- 1		Wintergreen----- 3
	Bigtooth aspen- 3	Black cherry--- 2			Blue cladonia--- 2
	Eastern white pine----- 2	Eastern white pine----- 2			Brambles----- 2
	Red pine----- 3	Red pine----- 2			Grasses----- 2
	Jack pine----- 1	Bigtooth aspen- 2			Reindeer lichen- 2
		American beech- 1			Rosy twistedstalk--- 2
					Starflower----- 2
					Sweetfern----- 2
					Trailing arbutus----- 2
					Wild lily of the valley---- 2
				Fringed polygala----- 1	
				Large-leaved aster----- 1	
				Northern bush honeysuckle--- 1	
				Princes pine--- 1	
				Violets----- 1	
				Wild strawberry- 1	

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
75B, 75D----- Rubicon	Northern red oak----- 4	Northern red oak----- 3	Serviceberry--- 2	Brackenfern----- 4	Pennsylvania sedge----- 4
	White oak----- 3	Red maple----- 3	Witchhazel----- 2		Canada blueberry----- 3
	Red maple----- 3	White oak----- 2	Beaked hazelnut----- 2		Low sweet blueberry----- 3
	Red pine----- 3	Quaking aspen-- 2	Hawthorn----- 1		Wintergreen----- 3
	Quaking aspen-- 3	Black cherry--- 2			Blue cladonia--- 2
	Eastern white pine----- 2	Eastern white pine----- 2			Brambles----- 2
	Bigtooth aspen- 2	Red pine----- 2			Grasses----- 2
	Jack pine----- 1	Bigtooth aspen- 2			Reindeer lichen- 2
		American beech- 1			Rosy twistedstalk--- 2
					Starflower----- 2
					Sweetfern----- 2
			Trailing arbutus----- 2		
			Wild lily of the valley----- 2		
			Fringed polygala----- 1		
			Large-leaved aster----- 1		
			Northern bush honeysuckle--- 1		
			Princes pine--- 1		
			Violets----- 1		
			Wild strawberry- 1		
81B, 81D, 81F---- Grayling	Jack pine----- 5	Jack pine----- 3	Serviceberry--- 2	Brackenfern----- 3 Groundcedar----- 1	Low sweet blueberry----- 5
	Red pine----- 3	Red pine----- 2			Pennsylvania sedge----- 4
	Northern red oak----- 3	Northern red oak----- 2			Bearberry----- 3
	White oak----- 2	White oak----- 2			Blue cladonia--- 3
	Northern pin oak----- 2	Northern pin oak----- 2			Reindeer lichen- 3
	Eastern white pine----- 2	Eastern white pine----- 2			Canada blueberry----- 2
	Pin cherry----- 1	Black cherry--- 2			Grasses----- 2
	Bigtooth aspen- 1	Pin cherry----- 1			Hairgrass----- 2
					Highbush blueberry----- 2
					Sweetfern----- 2
					Trailing arbutus----- 2
			Wintergreen----- 2		

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
115D----- Kalkaska	Sugar maple---- 5	Sugar maple---- 3	Beaked	Brackenfern----- 2	Trout lily----- 4
	American beech- 3	American beech- 3	hazelnut----- 2	Rattlesnake	Downy yellow
	Quaking aspen-- 3	Eastern	Serviceberry--- 2	fern----- 2	violet----- 3
	Eastern	hophornbeam--- 3	Mapleleaf	Spinulose shield	Grasses----- 3
	hophornbeam--- 2	White ash----- 2	viburnum----- 2	fern----- 1	Bedstraw----- 2
	American	Northern red		Groundcedar----- 5	Brambles----- 2
	basswood----- 2	oak----- 2		Running-pine--- 3	Dutchmans
	Bigtooth aspen- 2	Red maple----- 2		Shining club	breeches----- 2
	Red maple----- 2	Black cherry--- 1		moss----- 3	Large-leaved
	Black cherry--- 1	American elm--- 1		Tree clubmoss--- 1	aster----- 2
	American elm--- 1	American		Staghorn	Partridgeberry-- 2
	Paper birch--- 1	basswood----- 1		clubmoss----- 1	Squirrel corn--- 2
		Pin cherry----- 1			Starflower----- 2
		Eastern white			Sweet cicely---- 2
		pine----- 1			Trilliums----- 2
		Balsam fir----- 1			Violets----- 2
					Wild lily of the valley----- 2
				Wild	
				sarsaparilla--- 2	
				American fly	
				honeysuckle---- 1	
				Baneberry----- 1	
				Hawkweed----- 1	
				Pennsylvania	
				sedge----- 1	
				Pyrolas----- 1	
				Reindeer lichen- 1	
				Rosy	
				twistedstalk--- 1	
144B----- Perecheney	Quaking aspen-- 4	Northern red	Serviceberry--- 2	Brackenfern----- 3	Bugleweed----- 3
	Northern red	oak----- 3	Upland willow-- 2	Spinulose shield	Large-leaved
	oak----- 3	Red maple----- 2	Hawthorn----- 2	fern----- 1	aster----- 3
	Eastern white	Black cherry--- 2	Alternateleaf	Tree clubmoss--- 1	Low sweet
	pine----- 3	White oak----- 2	dogwood----- 2		blueberry----- 3
	Jack pine----- 3	Eastern white	Beaked		Pennsylvania
	White oak----- 2	pine----- 2	hazelnut----- 1		sedge----- 3
	Red maple----- 2	Jack pine----- 2			Starflower----- 3
	Red pine----- 2	Balsam fir----- 2			Wild lily of the valley----- 3
	Balsam fir----- 2	Quaking aspen-- 1			Wild strawberry- 3
	Black cherry--- 1				Wintergreen---- 3
					Brambles----- 2
					Canada
					blueberry----- 2
				Cinquefoils---- 2	
				Currants----- 2	
				Bedstraw----- 1	
				Pyrolas----- 1	
				Sweet cicely--- 1	
				Sweetfern----- 1	
				Violets----- 1	
				Wild roses----- 1	

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
146F----- Rubicon- Graycalm	Northern red oak----- 4 Quaking aspen-- 3 Bigtooth aspen- 3 Red maple----- 3 White oak----- 2 Eastern white pine----- 2 Red pine----- 2	Northern red oak----- 3 Red maple----- 3 Black cherry--- 2 White oak----- 2 Quaking aspen-- 2 Eastern white pine----- 2 Red pine----- 2 Bigtooth aspen- 2 American beech- 1	Beaked hazelnut----- 2 Serviceberry--- 2 Witchhazel----- 2 Hawthorn----- 1	Brackenfern----- 4	Pennsylvania sedge----- 4 Canada blueberry----- 3 Low sweet blueberry----- 3 Wintergreen----- 3 Blue cladonia--- 2 Brambles----- 2 Grasses----- 2 Reindeer lichen- 2 Rosy twistedstalk--- 2 Starflower----- 2 Sweetfern----- 2 Trailing arbutus----- 2 Wild lily of the valley----- 2 Wild strawberry- 2 Fringed polygala----- 1 Large-leaved aster----- 1 Princes pine---- 1 Violets----- 1
347F----- Kalkaska	Sugar maple---- 5 American beech- 3 Quaking aspen-- 3 Eastern hophornbeam--- 2 American basswood----- 2 Bigtooth aspen- 2 Red maple----- 2 Black cherry--- 1 American elm--- 1 Paper birch--- 1	Sugar maple---- 3 American beech- 3 Eastern hophornbeam--- 3 White ash----- 2 Northern red oak----- 2 Red maple----- 2 Black cherry--- 1 American elm--- 1 American basswood----- 1 Pin cherry----- 1 Eastern white pine----- 1 Balsam fir----- 1	Beaked hazelnut----- 2 Serviceberry--- 2 Mapleleaf viburnum----- 2	Brackenfern----- 2 Rattlesnake fern----- 2 Spinulose shield fern----- 1 Groundcedar--- 5 Running-pine--- 3 Shining club moss----- 3 Tree clubmoss--- 1 Staghorn clubmoss----- 1	Trout lily----- 4 Downy yellow violet----- 3 Grasses----- 3 Bedstraw----- 2 Brambles----- 2 Dutchmans breeches----- 2 Large-leaved aster----- 2 Partridgeberry-- 2 Squirrel corn--- 2 Starflower----- 2 Sweet cicely--- 2 Trilliums----- 2 Violets----- 2 Wild lily of the valley----- 2 Wild sarsaparilla--- 2 American fly honeysuckle--- 1 Baneberry----- 1 Hawkweed----- 1 Pennsylvania sedge----- 1 Pyrolas----- 1 Reindeer lichen- 1 Rosy twistedstalk--- 1

See footnotes at end of table.

TABLE 9.--PLANT COMMUNITIES ON SELECTED SOILS--Continued

Soil name and map symbol	Extent of major and minor trees*	Extent of seedlings*	Extent of shrubs*	Extent of ferns and clubmoss*	Extent of ground plants*
348----- Pickford	Quaking aspen-- 6	Balsam fir----- 3	Redosier	Brackenfern----- 2	Grasses----- 4
	Balsam fir----- 3	Northern red	dogwood----- 2	Crested fern----- 1	Dewberry----- 3
	Balsam poplar-- 2	oak----- 1	Hawthorn----- 1		Large-leaved aster----- 3
		Red maple----- 1			Black snakeroot-- 2
					Mints----- 2
					Violets----- 2
					Wild lily of the valley----- 2
					Wild strawberry-- 2
					Wood betony-----2
					Bedstraw----- 1
					Bunchberry----- 1
					Heal-all----- 1
					Hepatica----- 1
					Horsetail----- 1
					Miterwort----- 1
					Pyrolas----- 1
					Wild iris----- 1
349B----- Hartwick	Quaking aspen-- 4	Sugar maple----- 3	Serviceberry--- 3	Brackenfern----- 4	Pennsylvania sedge----- 4
	Sugar maple----- 3	Northern red	Upland willow-- 2		Brambles----- 3
	Northern red	oak----- 3	Mapleleaf		Large-leaved aster----- 3
	oak----- 3	Black cherry--- 3	viburnum----- 2		Low sweet blueberry----- 3
	Red maple----- 3	Red pine----- 3	Hawthorn----- 2		Wild strawberry- 3
	Jack pine----- 3	Red maple----- 2			Wintergreen----- 3
	Red pine----- 2	Jack pine----- 2			Goldenrods----- 2
	American beech- 2	Eastern			Reindeer lichen- 2
	Black cherry--- 2	hophornbeam--- 2			Sweetfern----- 2
	Bigtooth aspen- 2	White oak----- 2			Wild lily of the valley----- 2
	Eastern white	White ash----- 1			Canada blueberry----- 1
	pine----- 2				
	White ash----- 1				

* The extent of the plants listed is expressed as a number representing the amount of ground covered by the plants. The number 1 means that the plant covers less than 1 percent of the surface, 2 means 1 to 5 percent, 3 means 5 to 20 percent, 4 means 25 to 50 percent, 5 means 50 to 75 percent, 6 means 75 to 95 percent, and 7 means 95 to 100 percent.

** This map unit is dominated by shrubs in some areas.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil or that the soil is in the Huron National Forest)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
13: Tawas-----	Black spruce, indigo silky dogwood, nannyberry viburnum, common ninebark, redosier dogwood, arrowwood.	Northern whitecedar, green ash.	---	---
Lupton-----	Black spruce, indigo silky dogwood, nannyberry viburnum, common ninebark, redosier dogwood, arrowwood.	Northern whitecedar, green ash.	---	---
15A: Crowell-----	Amur maple, lilac, eastern redcedar, Siberian peashrub.	Red pine, jack pine---	Eastern white pine----	---
Au Gres-----	American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, midwest Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
16B----- Graycalm	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---
17A----- Crowell	Amur maple, lilac, eastern redcedar, Siberian peashrub.	Red pine, jack pine---	Eastern white pine----	---
18A----- Au Gres	American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, midwest Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
20B, 20D: Graycalm-----	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---
Grayling-----	Lilac, silver buffaloberry, Siberian peashrub, smooth sumac, eastern redcedar, staghorn sumac.	Jack pine, eastern white pine, red pine.	---	---
21B, 21D: Graycalm-----	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
21B, 21D: Klacking-----	Lilac, common ninebark, Roselow sargent crabapple, nannyberry viburnum, Amur maple.	White spruce, Siberian crabapple, eastern redcedar.	Norway spruce, eastern white pine, red pine.	Imperial Carolina poplar.
22B----- Montcalm	Amur maple, Siberian peashrub, lilac, northern whitecedar, Roselow sargent crabapple, eastern redcedar.	White spruce, midwest Manchurian crabapple, Norway spruce, jack pine.	Red pine, eastern white pine.	---
24A: Kinross.				
Au Gres-----	American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
31B----- Klacking	Lilac, common ninebark, Roselow sargent crabapple, nannyberry viburnum, Amur maple.	White spruce, Siberian crabapple, eastern redcedar.	Norway spruce, eastern white pine, red pine.	Imperial Carolina poplar.
32B----- Kellogg	Indigo silky dogwood, Amur maple, eastern redcedar, Siberian peashrub, lilac, Roselow sargent crabapple, American cranberrybush.	White spruce, midwest Manchurian crabapple, Norway spruce.	Red pine, eastern white pine.	---
34B----- Kneff	American cranberrybush, common ninebark, lilac.	Northern whitecedar, white spruce, nannyberry viburnum, Amur maple, Siberian crabapple.	Norway spruce, eastern white pine, red pine, green ash.	---
47D----- Graycalm	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---
48B, 48D: Rubicon-----	Eastern redcedar, smooth sumac, silver buffaloberry, lilac, Siberian peashrub, staghorn sumac.	Red pine, eastern white pine, jack pine.	---	---
Graycalm-----	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
49B----- Kalkaska	Lilac, silver buffaloberry, smooth sumac, eastern redcedar, Siberian peashrub, staghorn sumac.	Red pine, jack pine, eastern white pine.	---	---
50B: Au Gres----- Kinross.	American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, midwest Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
Croswell-----	Amur maple, lilac, eastern redcedar, Siberian peashrub.	Red pine, jack pine---	Eastern white pine----	---
51: Tawas----- Leafriver.	Black spruce, indigo silky dogwood, nannyberry viburnum, common ninebark, redosier dogwood, arrowwood.	Northern whitecedar, green ash.	---	---
52B, 52D----- Blue Lake	Lilac, smooth sumac, eastern redcedar, Siberian peashrub, silver buffaloberry, staghorn sumac.	Red pine, jack pine, eastern white pine, Austrian pine.	---	---
58A: Wakeley.				
Allendale-----	Northern whitecedar, American cranberrybush, Roselow sargent crabapple, lilac, nannyberry viburnum.	White spruce, midwest Manchurian crabapple, blue spruce.	Eastern white pine, red maple, Norway spruce.	---
64B----- Feldhauser	Manchurian crabapple, northern whitecedar, lilac, eastern redcedar, Siberian peashrub.	Norway spruce, white spruce, Austrian pine.	Red pine, eastern white pine.	Imperial Carolina poplar.
67A: Bowers----- Deerheart.	American cranberrybush, northern whitecedar, common ninebark, lilac, nannyberry viburnum.	White spruce, midwest Manchurian crabapple.	Eastern white pine, Norway spruce, green ash, red pine.	---

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
75B, 75D----- Rubicon	Eastern redcedar, smooth sumac, silver buffaloberry, lilac, Siberian peashrub, staghorn sumac.	Red pine, eastern white pine, jack pine.	---	---
81B, 81D----- Grayling	Lilac, silver buffaloberry, Siberian peashrub, smooth sumac, eastern redcedar, staghorn sumac.	Jack pine, eastern white pine, red pine.	---	---
115D----- Kalkaska	Lilac, silver buffaloberry, smooth sumac, eastern redcedar, Siberian peashrub, staghorn sumac.	Red pine, jack pine, eastern white pine.	---	---
144B----- Perechenev	Lilac, silver buffaloberry, smooth sumac, eastern redcedar, Siberian peashrub, staghorn sumac.	Red pine, jack pine, eastern white pine.	---	---
146F: Rubicon-----	Eastern redcedar, smooth sumac, silver buffaloberry, lilac, Siberian peashrub, staghorn sumac.	Red pine, eastern white pine, jack pine.	---	---
Graycalm-----	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---
347F----- Kalkaska	Lilac, silver buffaloberry, smooth sumac, eastern redcedar, Siberian peashrub, staghorn sumac.	Red pine, jack pine, eastern white pine.	---	---
349B----- Hartwick	Siberian peashrub, Amur maple, eastern redcedar, lilac, smooth sumac, silver buffaloberry, staghorn sumac.	Red pine, jack pine---	Eastern white pine----	---

TABLE 11.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
13: Tawas-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Lupton-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
14: Dawson-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Loxley-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
15A: Croswell-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Au Gres-----	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
16B----- Graycalm	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
17A----- Croswell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
18A----- Au Gres	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
19----- Leafriver	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
20B: Graycalm-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Grayling-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
20D: Graycalm-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Grayling-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
20F: Graycalm-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
Grayling-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
21B: Graycalm-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Klacking-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.
21D: Graycalm-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Klacking-----	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
21F: Graycalm-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
Klacking-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
22B----- Montcalm	Slight-----	Slight-----	Moderate: slope, small stones.	Slight.
23: Ausable-----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
Bowstring-----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
24A: Kinross-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Au Gres-----	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
31B----- Klacking	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
32B----- Kellogg	Severe: percs slowly, too sandy.	Severe: too sandy, percs slowly.	Severe: too sandy, percs slowly.	Severe: too sandy.
34B----- Kneff	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
35----- Kinross	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
47D----- Graycalm	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
47F----- Graycalm	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
48B: Rubicon-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Graycalm-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
48D: Rubicon-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Graycalm-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
49B----- Kalkaska	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
50B: Au Gres-----	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
Kinross-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Croswell-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
51: Tawas-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Leafriver-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
52B----- Blue Lake	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
52D----- Blue Lake	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
58A: Wakeley-----	Severe: ponding, percs slowly, excess humus.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Allendale-----	Severe: wetness, percs slowly, too sandy.	Severe: wetness, too sandy, percs slowly.	Severe: too sandy, wetness, percs slowly.	Severe: wetness, too sandy.
64B----- Feldhauser	Slight-----	Slight-----	Moderate: slope.	Slight.
65F----- Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
67A: Bowers-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Deerheart-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
75B----- Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
75D----- Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
78. Pits				
81B----- Grayling	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
81D----- Grayling	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
81F----- Grayling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
82B----- Udorthents	Variable-----	Variable-----	Variable-----	Variable.
83B----- Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
86: Histosols-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
Aquents-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
115D----- Kalkaska	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
126F: Udipsamments. Haplorthods. Eutroboralfs.				
144B----- Perecheney	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
146F: Rubicon-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
Graycalm-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
210B----- Grayling	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
210C----- Grayling	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
210D----- Grayling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
210E----- Grayling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
211B, 211C----- Grayling	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
211D----- Grayling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
211E----- Grayling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
212B----- Grayling	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
213B----- Graycalm	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
215B, 220B----- Typic Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
220C----- Typic Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
220D----- Typic Udipsamments	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
221B----- Typic Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
221C----- Typic Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
221D----- Typic Udipsamments	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
221E----- Typic Udipsamments	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
222B----- Typic Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
223B: Graycalm----- Grayling-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
223C: Graycalm----- Grayling-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
223D: Graycalm----- Grayling-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
224B----- Crosswell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
225B----- Entic Haplorthods	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
236B----- Arenic Eutroboralfs	Slight-----	Slight-----	Moderate: slope.	Slight.
237B----- Glossic Eutroboralfs	Slight-----	Slight-----	Moderate: slope.	Slight.
239B: Psammentic Eutroboralfs-----	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
239B: Typic Udipsamments---	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
239C: Psammentic Eutroboralfs-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Typic Udipsamments---	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
239E: Psammentic Eutroboralfs-----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
Typic Udipsamments---	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
262A----- Au Gres	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
263A----- Argic Endoaquods	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
264A----- Allendale	Severe: wetness, percs slowly, too sandy.	Severe: wetness, too sandy, percs slowly.	Severe: too sandy, wetness, percs slowly.	Severe: wetness, too sandy.
271: Typic Endoaquods, wet	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Typic Endoaquods----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
275: Wakeley-----	Severe: ponding, percs slowly, excess humus.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Leafriver-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
280: Aguents-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Histosols-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
281, 282----- Borosapristis	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
347F----- Kalkaska	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
348----- Pickford	Severe: ponding, percs slowly, excess humus.	Severe: ponding, excess humus, percs slowly.	Severe: excess humus, ponding, percs slowly.	Severe: ponding, excess humus.
349B----- Hartwick	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

TABLE 12.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
13: Tawas-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Lupton-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
14: Dawson-----	Very poor.	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
Loxley-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
15A: Croswell-----	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
Au Gres-----	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
16B----- Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
17A----- Croswell	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
18A----- Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
19----- Leafriver	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
20B: Graycalm-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Grayling-----	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
20D: Graycalm-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Grayling-----	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
20F: Graycalm-----	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
Grayling-----	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
21B: Graycalm-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
21B: Klacking-----	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
21D: Graycalm-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Klacking-----	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
21F: Graycalm-----	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
Klacking-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
22B----- Montcalm	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
23: Ausable-----	Very poor.	Poor	Poor	Poor	Poor	Fair	Good	Poor	Poor	Fair.
Bowstring-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
24A: Kinross-----	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
Au Gres-----	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
31B----- Klacking	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
32B----- Kellogg	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
34B----- Kneff	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
35----- Kinross	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
47D----- Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
47F----- Graycalm	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
48B: Rubicon-----	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Graycalm-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
48D: Rubicon-----	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Graycalm-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
49B----- Kalkaska	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
50B: Au Gres-----	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Kinross-----	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
Croswell-----	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
51: Tawas-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Leafriver-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
52B----- Blue Lake	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
52D----- Blue Lake	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
58A: Wakeley-----	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Allendale-----	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
64B----- Feldhauser	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
65F----- Rubicon	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
67A: Bowers-----	Fair	Good	Good	Good	Good	Good	Fair	Good	Good	Fair.
Deerheart-----	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
75B----- Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
75D----- Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
78 Pits										
81B----- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
81D----- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
81F----- Grayling	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
82B. Udorthents										
83B. Udipsamments										
86: Histosols. Aquents.										
115D----- Kalkaska	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
126F: Udipsamments. Haplorthods. Eutroboralfs.										
144B----- Perecheney	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
146F: Rubicon----- Graycalm-----	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
210B----- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
210C, 210D----- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
210E, 211B, 211C, 211D, 211E----- Grayling	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
212B----- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
213B----- Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
215B----- Typic Udipsamments	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
220B----- Typic Udipsamments	Poor	Poor	Fair	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
220C, 220D----- Typic Udipsamments	Very poor.	Poor	Fair	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
221B----- Typic Udipsamments	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
221C, 221D, 221E--- Typic Udipsamments	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
222B----- Typic Udipsamments	Poor	Poor	Fair	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
223B: Graycalm----- Grayling-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
223C, 223D: Graycalm----- Grayling-----	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
224B----- Croswell	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
225B----- Entic Haplorthods	Poor	Poor	Fair	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
236B. Arenic Eutroboralfs										
237B. Glossic Eutroboralfs										
239B: Psammentic Eutroboralfs----- Typic Udipsamments	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
239C: Psammentic Eutroboralfs----- Typic Udipsamments	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
239E: Psammentic Eutroboralfs-----	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
239E: Typic Udipsamments	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
262A----- Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
263A. Argic Endoaquods										
264A----- Allendale	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
271: Typic Endoaquods, wet-----	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Typic Endoaquods--	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
275: Wakeley-----	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Leafriver-----	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
280: Aquents. Histosols.										
281----- Borosaprists	Very poor.	Very poor.	Poor	Poor	Poor	Fair	Fair	Very poor.	Poor	Fair.
282----- Borosaprists	Poor	Poor	Poor	Poor	Fair	Good	Good	Very poor.	Fair	Good.
347F----- Kalkaska	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
348----- Pickford	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
349B----- Hartwick	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 13.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
13: Tawas-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Lupton-----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
14: Dawson-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Loxley-----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
15A: Crowell-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
Au Gres-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
16B----- Graycalm	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
17A----- Crowell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
18A----- Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
19----- Leafriver	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
20B: Graycalm-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
Grayling-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
20D: Graycalm-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Grayling-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
20F: Graycalm-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Grayling-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
21B: Graycalm-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
Klackung-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
21D: Graycalm-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Klackung-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
21F: Graycalm-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Klackung-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
22B----- Montcalm	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
23: Ausable-----	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding, excess humus.
Bowstring-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
24A: Kinross-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
24A: Au Gres-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
31B----- Klackung	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
32B----- Kellogg	Severe: cutbanks cave.	Moderate: wetness.	Severe: wetness, shrink-swell.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
34B----- Kneff	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Slight.
35----- Kinross	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
47D----- Graycalm	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
47F----- Graycalm	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
48B: Rubicon-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
Graycalm-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
48D: Rubicon-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Graycalm-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
49B----- Kalkaska	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty, too sandy.
50B: Au Gres-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Kinross-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
Croswell-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
51: Tawas-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Leafriver-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
52B----- Blue Lake	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
52D----- Blue Lake	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
58A: Wakeley-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
Allendale-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness.	Severe: wetness.
64B----- Feldhauser	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Slight.
65F----- Rubicon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
67A: Bowers-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Deerheart-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
75B----- Rubicon	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
75D----- Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
78. Pits						
81B----- Grayling	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
81D----- Grayling	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
81F----- Grayling	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
82B----- Udorthents	Variable-----	Variable-----	Variable-----	Variable-----	Variable-----	Variable.
83B----- Udipsamments	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
86: Histosols-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Aquents-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
115D----- Kalkaska	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, too sandy.
126F: Udipsamments. Haplorthods. Eutroboralfs.						
144B----- Perecheney	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: large stones, droughty, too sandy.
146F: Rubicon-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Graycalm-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
210B----- Grayling	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
210C----- Grayling	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
210D, 210E----- Grayling	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
211B, 211C----- Grayling	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
211D, 211E----- Grayling	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
212B----- Grayling	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty, too sandy.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
213B----- Graycalm	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
215B, 220B----- Typic Udipsamments	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty, too sandy.
220C----- Typic Udipsamments	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, too sandy.
220D----- Typic Udipsamments	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
221B----- Typic Udipsamments	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty, too sandy.
221C----- Typic Udipsamments	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, too sandy.
221D, 221E----- Typic Udipsamments	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
222B----- Typic Udipsamments	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty, too sandy.
223B: Graycalm-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
Grayling-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
223C: Graycalm-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
Grayling-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
223D: Graycalm-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Grayling-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
224B----- Crosswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
225B----- Entic Haplorthods	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty, too sandy.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
275: Wakeley-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
Leafriver-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
280: Aquents-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
Histosols-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
281, 282----- Borosaprists	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
347F----- Kalkaska	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
348----- Pickford	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, excess humus.
349B----- Hartwick	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.

TABLE 14.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13: Tawas-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Lupton-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
14: Dawson-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Loxley-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
15A: Croswell-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Au Gres-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
16B----- Graycalm	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
17A----- Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
18A----- Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
19----- Leafriver	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
20B: Graycalm-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
20B: Grayling-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
20D: Graycalm-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Grayling-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
20F: Graycalm-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Grayling-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
21B: Graycalm-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Klacking-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
21D: Graycalm-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Klacking-----	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
21F: Graycalm-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Klacking-----	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
22B----- Montcalm	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
23: Ausable-----	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
23: Bowstring-----	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
24A: Kinross-----	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Au Gres-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
31B----- Klacking	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
32B----- Kellogg	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
34B----- Kneff	Severe: wetness, percs slowly.	Severe: wetness.	Severe: seepage.	Moderate: wetness.	Fair: too clayey, wetness.
35----- Kinross	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
47D----- Graycalm	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
47F----- Graycalm	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
48B: Rubicon-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Graycalm-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
48D: Rubicon-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Graycalm-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
49B----- Kalkaska	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
50B: Au Gres-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Kinross-----	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Croswell-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
51: Tawas-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Leafriver-----	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
52B----- Blue Lake	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
52D----- Blue Lake	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
58A: Wakeley-----	Severe: ponding, percs slowly, poor filter.	Severe: seepage, excess humus, ponding.	Severe: ponding, too clayey.	Severe: seepage, ponding.	Poor: too clayey, hard to pack, ponding.
Allendale-----	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
64B----- Feldhauser	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
65F----- Rubicon	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
67A: Bowers-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Deerheart-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
75B----- Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
75D----- Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
78. Pits					
81B----- Grayling	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
81D----- Grayling	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
81F----- Grayling	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
82B----- Udorthents	Variable-----	Variable-----	Variable-----	Variable-----	Variable.
83B----- Udipsamments	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
86: Histosols-----	Severe: ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.
Aquents-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
115D----- Kalkaska	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
126F: Udipsamments.					
Haplorthods-----	---	---	---	Severe: slope.	Poor: slope.
Eutroboralfs-----	---	---	---	Severe: slope.	Poor: slope.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
144B----- Perechney	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
146F: Rubicon-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Graycalm-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
210B----- Grayling	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
210C----- Grayling	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
210D, 210E----- Grayling	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
211B, 211C----- Grayling	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
211D, 211E----- Grayling	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
212B----- Grayling	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
213B----- Graycalm	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
215B, 220B----- Typic Udipsamments	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
220C----- Typic Udipsamments	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
220D----- Typic Udipsamments	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
221B----- Typic Udipsamments	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
221C----- Typic Udipsamments	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
221D, 221E----- Typic Udipsamments	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
222B----- Typic Udipsamments	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
223B: Graycalm-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Grayling-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
223C: Graycalm-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Grayling-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
223D: Graycalm-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Grayling-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
224B----- Crowell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
225B----- Entic Haplorthods	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
236B----- Arenic Eutroboralfs	Slight-----	Moderate: slope.	Slight-----	Slight-----	Good.
237B----- Glossic Eutroboralfs	Slight-----	Moderate: slope.	Slight-----	Slight-----	Good.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
239B: Psammentic Eutroboralfs-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Typic Udipsamments-	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
239C: Psammentic Eutroboralfs-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Typic Udipsamments-	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
239E: Psammentic Eutroboralfs-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Typic Udipsamments-	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
262A----- Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
263A----- Argic Endoaquods	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
264A----- Allendale	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
271: Typic Endoaquods, wet-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Typic Endoaquods---	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
275: Wakeley-----	Severe: ponding, percs slowly, poor filter.	Severe: seepage, excess humus, ponding.	Severe: ponding, too clayey.	Severe: seepage, ponding.	Poor: too clayey, hard to pack, ponding.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
275: Leafriver-----	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
280: Aquents-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Histosols-----	Severe: ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.
281, 282----- Borosaprista	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
347F----- Kalkaska	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
348----- Pickford	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
349B----- Hartwick	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 15.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
13: Tawas-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
Lupton-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
14: Dawson-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
Loxley-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
15A: Crowell-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
Au Gres-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
16B----- Graycalm	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
17A----- Crowell	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
18A----- Au Gres	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
19----- Leafriver	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
20B, 20D: Graycalm-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
Grayling-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
20F: Graycalm-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
20F: Grayling-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
21B, 21D: Graycalm-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
Klacking-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
21F: Graycalm-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
Klacking-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
22B----- Montcalm	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
23: Ausable-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, wetness.
Bowstring-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
24A: Kinross-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
Au Gres-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
31B----- Klacking	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
32B----- Kellogg	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
34B----- Kneff	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
35----- Kinross	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
47D----- Graycalm	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
47F----- Graycalm	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
48B, 48D: Rubicon-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
Graycalm-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
49B----- Kalkaska	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
50B: Au Gres-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
Kinross-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
Croswell-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
51: Tawas-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
Leafriver-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
52B, 52D----- Blue Lake	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
58A: Wakeley-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
Allendale-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
64B----- Feldhauser	Good-----	Probable-----	Improbable: too sandy.	Good.
65F----- Rubicon	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
67A: Bowers-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Deerheart-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
75B, 75D----- Rubicon	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
78. Pits				
81B, 81D----- Grayling	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
81F----- Grayling	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
82B----- Udorthents	Variable-----	Variable-----	Variable-----	Variable.
83B----- Udipsamments	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
86: Histosols-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Aquents-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
115D----- Kalkaska	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
126F: Udipsamments. Haplorthods. Eutroboralfs.				
144B----- Perechenev	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
146F: Rubicon-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
Graycalm-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
210B, 210C----- Grayling	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
210D----- Grayling	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
210E----- Grayling	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
211B, 211C----- Grayling	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
211D----- Grayling	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
211E----- Grayling	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
212B----- Grayling	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
213B----- Graycalm	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
215B, 220B, 220C----- Typic Udipsamments	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
220D----- Typic Udipsamments	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
221B, 221C----- Typic Udipsamments	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
221D----- Typic Udipsamments	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
221E----- Typic Udipsamments	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
222B----- Typic Udipsamments	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
223B, 223C: Graycalm-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
Grayling-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
223D: Graycalm-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
223D: Grayling-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
224B----- Croswell	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
225B----- Entic Haplorthods	Good-----	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
236B----- Arenic Eutroboralfs	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
237B----- Glossic Eutroboralfs	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
239B, 239C: Psammentic Eutroboralfs-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
Typic Udipsamments---	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
239E: Psammentic Eutroboralfs-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
Typic Udipsamments---	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
262A----- Au Gres	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
263A----- Argic Endoaquods	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
264A----- Allendale	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
271: Typic Endoaquods, wet	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Typic Endoaquods-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
275: Wakeley-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
275: Leafriver-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
280: Aquents-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Histosols-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
281, 282----- Borosapristis	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
347F----- Kalkaska	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
348----- Pickford	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
349B----- Hartwick	Good-----	Probable-----	Improbable: thin layer, too sandy.	Poor: too sandy, small stones.

TABLE 16.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
13: Tawas-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Lupton-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
14: Dawson-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, rooting depth.	Wetness, rooting depth.
Loxley-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, too acid.	Wetness.
15A: Croswell-----	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Droughty.
Au Gres-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
16B----- Graycalm	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
17A----- Croswell	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Droughty.
18A----- Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
19----- Leafriver	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
20B: Graycalm-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Grayling-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
20D, 20F: Graycalm-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Grayling-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
21B: Graycalm-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Klacking-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
21D, 21F: Graycalm-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Klacking-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
22B----- Montcalm	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
23: Ausable-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, cutbanks cave.	Ponding, soil blowing, flooding.	Wetness.
Bowstring-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, subsides.	Ponding, flooding.	Wetness.
24A: Kinross-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding-----	Wetness.
Au Gres-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
31B----- Klacking	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
32B----- Kellogg	Severe: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, droughty.	Droughty, percs slowly.
34B----- Kneff	Moderate: slope.	Severe: piping.	Severe: no water.	Frost action, slope.	Slope, wetness, soil blowing.	Erodes easily.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
35----- Kinross	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding-----	Wetness.
47D, 47F----- Graycalm	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
48B: Rubicon-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Graycalm-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
48D: Rubicon-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Graycalm-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
49B----- Kalkaska	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
50B: Au Gres-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
Kinross-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding-----	Wetness.
Croswell-----	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Droughty.
51: Tawas-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
Leafriver-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
52B----- Blue Lake	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
52D----- Blue Lake	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
58A: Wakeley-----	Severe: seepage.	Severe: ponding.	Severe: no water.	Ponding, percs slowly.	Ponding, droughty.	Wetness, droughty, percs slowly.
Allendale-----	Severe: seepage.	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly---	Wetness, droughty.	Wetness, droughty, percs slowly.
64B----- Feldhauser	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Favorable.
65F----- Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
67A: Bowers-----	Slight-----	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness-----	Wetness, erodes easily, percs slowly.
Deerheart-----	Slight-----	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Wetness, erodes easily, percs slowly.
75B----- Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
75D----- Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
78. Pits						
81B----- Grayling	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
81D, 81F----- Grayling	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
82B----- Udorthents	Variable-----	Variable-----	Variable-----	Variable-----	Variable-----	Variable.
83B----- Udipsamments	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
86: Histosols-----	Slight-----	Severe: excess humus, ponding.	Slight-----	Ponding, frost action.	Ponding, soil blowing.	Wetness.
Aquents-----	Slight-----	Severe: ponding.	Slight-----	Ponding, frost action.	Ponding-----	Wetness.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
115D----- Kalkaska	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
126F: Udipsamments----- Haplorthods. Eutroboralfs.	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
144B----- Perecheney	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Slope, cutbanks cave.	Slope, wetness, droughty.	Erodes easily, droughty.
146F: Rubicon----- Graycalm-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
210B----- Grayling	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
210C, 210D, 210E, 211B, 211C, 211D, 211E----- Grayling	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
212B----- Grayling	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
213B----- Graycalm	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
215B, 220B----- Typic Udipsamments	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
220C, 220D----- Typic Udipsamments	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
221B----- Typic Udipsamments	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
221C, 221D, 221E-- Typic Udipsamments	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
222B----- Typic Udipsamments	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
223B: Graycalm-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Grayling-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
223C, 223D: Graycalm-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Grayling-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
224B----- Crowell	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Droughty.
225B----- Entic Haplorthods	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
236B----- Arenic Eutroboralfs	Moderate: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Favorable.
237B----- Glossic Eutroboralfs	Moderate: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Favorable.
239B: Psammentic Eutroboralfs----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Typic Udipsamments----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
239C, 239E: Psammentic Eutroboralfs----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
Typic Udipsamments----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
262A----- Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Grassed waterways
263A----- Argic Endoaquods	Slight-----	Severe: wetness.	Slight-----	Favorable-----	Wetness-----	Wetness.
264A----- Allendale	Severe: seepage.	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly---	Wetness, droughty.	Wetness, droughty, percs slowly.
271: Typic Endoaquods, wet-----	Slight-----	Severe: ponding.	Slight-----	Ponding, frost action.	Ponding-----	Wetness.
Typic Endoaquods-	Slight-----	Severe: wetness.	Slight-----	Favorable-----	Wetness-----	Wetness.
275: Wakeley-----	Severe: seepage.	Severe: ponding.	Severe: no water.	Ponding, percs slowly.	Ponding, droughty.	Wetness, droughty, percs slowly.
Leafriver-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
280: Aquents-----	Slight-----	Severe: ponding.	Slight-----	Ponding, frost action.	Ponding-----	Wetness.
Histosols-----	Slight-----	Severe: excess humus, ponding.	Slight-----	Ponding, frost action.	Ponding, soil blowing.	Wetness.
281, 282----- Borosaprists	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing.	Wetness.
347F----- Kalkaska	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
348----- Pickford	Slight-----	Severe: ponding.	Severe: no water.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
349B----- Hartwick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.

TABLE 17.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
13: Tawas-----	0-10	Muck-----	PT	A-8	0	---	---	---	---	---	---
	10-24	Muck-----	PT	A-8	0	---	---	---	---	---	---
	24-60	Sand, gravelly sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	80-100	60-100	30-80	0-15	---	NP
Lupton-----	0-9	Muck-----	PT	A-8	0	---	---	---	---	---	---
	9-60	Muck-----	PT	A-8	0	---	---	---	---	---	---
14: Dawson-----	0-4	Peat-----	PT	A-8	0	---	---	---	---	---	---
	4-43	Muck-----	PT	A-8	0	---	---	---	---	---	---
	43-60	Sand-----	SP, SM, SP-SM	A-2, A-3, A-1	0	90-100	75-100	40-70	0-15	---	NP
Loxley-----	0-6	Peat-----	PT	A-8	0	---	---	---	---	---	---
	6-60	Muck-----	PT	A-8	0	---	---	---	---	---	---
15A: Crowell-----	0-5	Sand-----	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	5-15	---	NP
	5-30	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-30	---	NP
	30-80	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-30	---	NP
Au Gres-----	0-8	Sand-----	SM, SP-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
	8-24	Sand-----	SP-SM, SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-75	0-15	---	NP
	24-60	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
16B: Graycalm-----	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, sandy loam.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
17A: Crowell-----	0-5	Sand-----	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	5-15	---	NP
	5-30	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-15	---	NP
	30-80	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-30	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
18A----- Au Gres	0-8	Sand-----	SM, SP-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
	8-24	Sand-----	SP-SM, SM, SC-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-75	0-15	---	NP
	24-60	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
19----- Leafriver	0-9	Muck-----	PT	A-8	0	---	---	---	---	---	---
	9-12	Loamy fine sand, fine sandy loam, fine sand.	SM	A-4, A-2-4	0	100	95-100	55-80	15-50	<20	NP-4
	12-60	Loamy sand, fine sand, sand.	SM, SP-SM, SP	A-3, A-2, A-2-4, A-1	0	95-100	80-100	45-70	3-35	---	NP
20B, 20D, 20F: Graycalm-----	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, sandy loam.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
Grayling-----	0-3	Sand-----	SM, SP-SM, SP	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	3-23	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	23-80	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-70	0-15	---	NP
21B, 21D, 21F: Graycalm-----	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, sandy loam.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
Klackings-----	0-3	Loamy sand-----	SM, SP-SM	A-2, A-1	0-5	90-100	75-100	35-75	10-30	---	NP
	3-21	Sand, loamy sand	SP-SM, SM, SP	A-2, A-1, A-3	0-5	90-100	75-100	35-75	0-30	---	NP
	21-80	Sand, loamy sand, sandy loam.	SP-SM, SM, SP, SC-SM	A-2, A-4, A-1, A-3	0-5	90-100	75-100	35-70	0-40	<25	NP-7
22B----- Montcalm	0-5	Loamy sand-----	SM, SP-SM	A-2, A-1	0-2	90-100	75-100	35-75	10-30	---	NP
	5-19	Loamy sand, sand	SM, SP-SM	A-2, A-1, A-3	0-2	90-100	75-100	35-75	5-30	---	NP
	19-63	Stratified sand to sandy clay loam.	SM, SP-SM, SC-SM, SC	A-2, A-4, A-1, A-3	0-2	90-100	75-100	35-85	5-50	<30	NP-10
	63-70	Sand-----	SP, SP-SM, SM	A-2, A-1, A-3	0-2	90-100	75-100	35-75	0-15	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
23: Ausable-----	0-10	Muck-----	PT	A-8	0	---	---	---	---	---	---
	10-20	Sand, loamy sand	SP-SM, SM	A-3, A-2-4	0-15	95-100	85-100	50-75	5-30	---	NP
	20-60	Sand, loamy sand, gravelly loamy sand.	SP, SM, SP-SM	A-3, A-2-4, A-1	0-15	80-100	70-100	35-75	0-30	---	NP
Bowstring-----	0-34	Muck-----	PT	A-8	0	---	---	---	---	---	---
	34-38	Sand, fine sand	SP-SM, SM	A-2-4, A-3	0	100	100	50-80	5-30	<20	NP-5
	38-60	Muck-----	PT	A-8	0	---	---	---	---	---	---
24A: Kinross-----	0-3	Muck-----	PT	A-8	0	---	---	---	---	---	NP
	3-22	Sand-----	SP-SM, SM	A-3, A-2-4	0	100	90-100	35-70	5-15	---	NP
	22-60	Sand-----	SP-SM, SM	A-3, A-2-4	0	100	90-100	35-70	5-15	---	NP
Au Gres-----	0-10	Sand-----	SM, SP-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
	10-26	Sand-----	SP-SM, SM, SC-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-75	0-15	---	NP
	26-60	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
31B----- Klacking	0-3	Loamy sand-----	SM, SP-SM	A-2, A-1	0-5	90-100	75-100	35-75	10-30	---	NP
	3-21	Sand, loamy sand	SP-SM, SM, SP	A-2, A-1, A-3	0-5	90-100	75-100	35-75	0-30	---	NP
	21-80	Sand, loamy sand, sandy loam.	SP-SM, SM, SP, SC-SM	A-2, A-4, A-1, A-3	0-5	90-100	75-100	35-70	0-40	<25	NP-7
32B----- Kellogg	0-6	Sand-----	SP-SM, SM	A-2-4, A-3, A-1-b	0-5	90-100	85-100	40-70	5-15	---	NP
	6-26	Sand, loamy sand	SP-SM, SM	A-2-4, A-3, A-1-b	0-5	90-100	85-100	40-75	5-30	---	NP
	26-29	Sand, loamy sand, clay.	SC-SM, SC, CL, CL-ML	A-7, A-6, A-2-4, A-4	0	95-100	95-100	45-100	10-95	20-50	4-25
	29-40	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	95-100	95-100	90-100	80-95	40-65	20-40
	40-80	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	95-100	95-100	90-100	80-95	40-65	20-40

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
34B----- Kneff	0-8	Very fine sandy loam.	CL-ML, CL	A-4	0	100	95-100	85-95	50-65	20-30	4-10
	8-14	Silty clay loam, very fine sandy loam, silt loam.	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	50-95	20-40	4-18
	14-29	Silty clay loam, silt loam.	CL	A-4, A-6, A-7	0	100	95-100	90-100	80-95	30-45	9-20
	29-61	Stratified silty clay loam to very fine sandy loam.	CL-ML, CL	A-4, A-6, A-7	0	100	95-100	85-100	75-95	20-45	4-20
	61-80	Stratified sand to silty clay loam.	SM, SC, ML, CL	A-2-4, A-4, A-6	0	100	95-100	50-100	10-95	<40	NP-20
35----- Kinross	0-3	Muck-----	PT	A-8	0	---	---	---	---	---	NP
	3-22	Sand-----	SP-SM, SM	A-3, A-2-4	0	100	90-100	35-70	5-15	---	NP
	22-60	Sand-----	SP-SM, SM	A-3, A-2-4	0	100	90-100	35-70	5-15	---	NP
47D, 47F----- Graycalm	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, sandy loam.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
48B, 48D: Rubicon-----	0-6	Sand-----	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-70	0-15	---	NP
	6-35	Sand-----	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-70	0-15	---	NP
	35-80	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	75-100	30-70	0-15	---	NP
Graycalm-----	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, sandy loam.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
49B----- Kalkaska	0-11	Sand-----	SM, SP-SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-70	5-15	---	NP
	11-22	Sand, loamy sand	SM, SP-SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-75	5-30	---	NP
	22-44	Sand-----	SM, SP-SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-70	5-15	---	NP
	44-80	Sand-----	SP, SP-SM, SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-70	0-15	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
50B: Au Gres-----	0-8	Sand-----	SM, SP-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
	8-24	Sand-----	SP-SM, SM, SC-SM, SP	A-2-4, A-3, A-1-b	0	95-100	75-100	35-75	0-15	---	NP
	24-60	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	95-100	75-100	35-70	0-15	---	NP
Kinross-----	0-3	Muck-----	PT	A-8	0	---	---	---	---	---	NP
	3-22	Sand-----	SP-SM, SM	A-3, A-2-4	0	100	90-100	35-70	5-15	---	NP
	22-60	Sand-----	SP-SM, SM	A-3, A-2-4	0	100	90-100	35-70	5-15	---	NP
Croswell-----	0-5	Sand-----	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	5-15	---	NP
	5-30	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-15	---	NP
	30-80	Sand-----	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-15	---	NP
51: Tawas-----	0-10	Muck-----	PT	A-8	0	---	---	---	---	---	---
	10-24	Muck-----	PT	A-8	0	---	---	---	---	---	---
	24-60	Sand, gravelly sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	80-100	60-100	30-80	0-15	---	NP
Leafriver-----	0-9	Muck-----	PT	A-8	0	---	---	---	---	---	---
	9-12	Loamy fine sand, fine sandy loam, fine sand.	SM	A-4, A-2-4	0	100	95-100	55-80	15-50	<20	NP-4
	12-60	Loamy sand, fine sand, sand.	SM, SP-SM, SP	A-3, A-2, A-2-4, A-1	0	95-100	80-100	45-70	3-35	---	NP
52B, 52D----- Blue Lake	0-6	Loamy sand-----	SM, SP-SM	A-2-4, A-1-b	0-5	95-100	85-100	40-75	10-30	---	NP
	6-21	Loamy sand, sand	SP-SM, SM	A-2-4, A-3, A-1-b	0-5	95-100	85-100	40-75	5-30	---	NP
	21-71	Stratified sand to sandy loam.	SP-SM, SM	A-2-4, A-4, A-3, A-1	0-5	95-100	85-100	40-75	5-40	---	NP
	71-80	Sand-----	SP-SM, SM	A-3, A-2-4, A-1-b	0-5	95-100	85-100	40-75	5-15	---	NP
58A: Wakeley-----	0-4	Muck-----	PT	A-8	0	---	---	---	---	---	---
	4-28	Sand, loamy sand	SP, SP-SM, SM, SC-SM	A-2-4, A-3	0-5	95-100	75-100	35-75	0-30	<25	NP-7
	28-80	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	95-100	90-100	85-100	75-95	40-65	20-40

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
83B----- Udipsamments	0-60	Sand, loamy sand	SP, SP-SM, SM	A-1, A-2, A-3	0	85-100	75-100	30-75	0-25	---	NP
86: Histosols-----	0-51 51-60	Muck----- Variable-----	PT ---	A-8 ---	0 ---	---	---	---	---	---	NP ---
Aquents-----	0-60	Variable-----	---	---	---	---	---	---	---	---	---
115D----- Kalkaska	0-11 11-22 22-44 44-80	Sand----- Sand, loamy sand Sand----- Sand-----	SM, SP-SM SM, SP-SM SM, SP-SM SP, SP-SM, SM	A-1-b, A-2-4, A-3 A-1-b, A-2-4, A-3 A-1-b, A-2-4, A-3 A-1-b, A-2-4, A-3	0-5 0-5 0-5 0-5	95-100 95-100 95-100 95-100	85-100 85-100 85-100 85-100	45-70 45-75 45-70 45-70	5-15 5-30 5-15 0-15	---	NP NP NP NP
126F: Udipsamments----	0-60	Sand, loamy sand	---	---	---	---	---	---	---	---	NP
Haplorthods----	0-60	Sand-----	---	---	---	---	---	---	---	---	---
Eutroboralfs----	0-60	Variable-----	---	---	---	---	---	---	---	---	---
144B----- Perechney	0-3 3-36 36-38 38-52 52-80	Sand----- Sand, loamy sand, loamy fine sand. Sand, loamy fine sand, clay loam. Sandy clay loam, loam, clay loam. Sand, loamy sand	SP-SM, SM SP-SM, SM, SC-SM SM, SC, ML, CL CL, CL-ML, SC SM, SC-SM, SP-SM	A-1-b, A-3, A-2-4 A-1-b, A-2-4, A-3 A-1-b, A-2-4, A-6 A-4, A-6 A-1-b, A-3, A-2-4	0-8 0-8 0-8 0-8 0-8	95-100 95-100 95-100 95-100 95-100	85-100 85-100 85-100 85-100 85-100	40-70 35-95 40-95 55-95 40-75	5-15 5-50 5-75 40-80 5-30	---	NP NP-7 NP-11 7-20 NP-7
146F: Rubicon-----	0-5 5-35 35-80	Sand----- Sand----- Sand, coarse sand	SM, SP-SM, SP SM, SP-SM, SP SP, SP-SM, SM	A-2, A-3, A-1 A-2, A-3, A-1 A-1, A-2, A-3	0 0 0	95-100 95-100 95-100	75-100 75-100 75-100	35-70 35-70 30-70	0-15 0-15 0-15	---	NP NP NP
Graycalm-----	0-5 5-27 27-80	Sand----- Sand, loamy sand Sand, loamy sand, sandy loam.	SM, SP-SM, SP SP-SM, SM, SP SM, SP-SM, SP	A-2, A-1, A-3 A-3, A-2, A-1 A-2, A-1, A-3	0-5 0-5 0-5	95-100 95-100 95-100	75-100 75-100 75-100	35-55 30-75 30-75	0-15 0-30 0-30	---	NP NP NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
210B, 210C, 210D, 210E----- Grayling	0-3	Sand-----	SM, SP-SM, SP	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	3-23	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	23-99	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-70	0-15	---	NP
211B, 211C, 211D, 211E----- Grayling	0-3	Sand-----	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	3-35	Sand-----	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	35-60	Sand, coarse sand	SM, SP-SM, SP	A-3, A-1, A-2	0	90-100	85-100	40-70	0-15	---	NP
	60-99	Stratified sand to sandy loam.	SM, SC-SM, SC, SP-SM	A-3, A-1, A-2, A-4	0	90-100	85-100	40-70	5-40	<30	NP-10
212B----- Grayling	0-3	Sand-----	SM, SP-SM	A-1, A-2, A-3	0	90-100	85-100	45-70	5-15	---	NP
	3-30	Sand-----	SP-SM, SM	A-1, A-2, A-3	0	90-100	85-100	45-70	5-15	---	NP
	30-99	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	85-100	40-70	0-15	---	NP
213B----- Graycalm	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
	80-99	Sand, coarse sand	SP, SP-SM, SM	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
215B----- Typic Udipsamments	0-2	Sand-----	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	2-25	Sand-----	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	25-75	Sand, coarse sand	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	75-90	Stratified sand to sandy loam.	SM, SC-SM, SC, SP-SM	A-3, A-1, A-2, A-4	0	90-100	85-100	40-70	5-40	<30	NP-10
220B, 220C, 220D- Typic Udipsamments	0-2	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	3-15	---	NP
	2-40	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	3-15	---	NP
	40-99	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	35-70	0-15	---	NP
221B, 221C, 221D, 221E----- Typic Udipsamments	0-3	Sand-----	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	3-30	Sand-----	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	30-60	Sand, coarse sand	SM, SP-SM	A-3, A-1, A-2	0	90-100	85-100	40-70	5-15	---	NP
	60-99	Stratified sand to sandy loam.	SM, SC-SM, SC, SP-SM	A-3, A-1, A-2, A-4	0	90-100	85-100	40-70	5-40	<30	NP-10

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
222B----- Typic Udipsamments	0-2	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	3-15	---	NP
	2-30	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	3-15	---	NP
	30-99	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	0-15	---	NP
223B, 223C, 223D: Graycalm-----	0-5	Sand-----	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0-5	95-100	75-100	30-75	0-30	---	NP
	27-80	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-2, A-1, A-3	0-5	95-100	75-100	30-75	0-30	---	NP
	80-99	Sand, coarse sand	SP, SP-SM, SM	A-2, A-1, A-3	0-5	95-100	75-100	35-55	0-15	---	NP
Grayling-----	0-3	Sand-----	SM, SP-SM, SP	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	3-23	Sand-----	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	23-99	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-70	0-15	---	NP
224B----- Crowell	0-5	Sand-----	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	5-15	---	NP
	5-30	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-30	---	NP
	30-80	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-75	3-30	---	NP
225B----- Entic Haplorthods	0-3	Sand-----	SP-SM, SM	A-2, A-1, A-3	0	95-100	90-100	45-70	5-15	---	NP
	3-35	Sand-----	SP, SP-SM, SM	A-2, A-1, A-3	0	95-100	90-100	45-70	3-15	---	NP
	35-60	Sand-----	SP, SP-SM, SM	A-2, A-1, A-3	0	95-100	90-100	45-70	0-15	---	NP
	60-90	Sandy clay loam, clay loam.	SC, CL	A-6, A-7, A-2-7	0	95-100	85-100	65-95	30-80	30-50	10-25
236B----- Arenic Eutroboralfs	0-99	Variable-----	---	---	---	---	---	---	---	---	
237B----- Glossic Eutroboralfs	0-99	Variable-----	---	---	---	---	---	---	---	---	
239B, 239C, 239E: Psammentic Eutroboralfs---	0-2	Sand-----	SP-SM, SM, SP	A-2-4, A-1-b, A-3	0-5	90-100	75-100	35-75	0-15	---	NP
	2-75	Sand, loamy sand	SP-SM, SM, SP	A-2-4, A-1-b, A-3	0-5	90-100	75-100	35-75	0-30	---	NP
	75-99	Sand, loamy sand, sandy loam.	SP-SM, SM, SP	A-2-4, A-1-b, A-3	0-5	90-100	75-100	35-75	0-35	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
347F----- Kalkaska	0-11	Sand-----	SM, SP-SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-70	5-15	---	NP
	11-22	Sand, loamy sand	SM, SP-SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-75	5-30	---	NP
	22-44	Sand-----	SM, SP-SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-70	5-15	---	NP
	44-80	Sand-----	SP, SP-SM, SM	A-1-b, A-2-4, A-3	0-5	95-100	85-100	45-70	0-15	---	NP
348----- Pickford	0-3	Muck-----	PT	A-8	0	---	---	---	---	---	---
	3-6	Silty clay, clay	CH, CL	A-7	0	100	100	80-100	80-95	40-60	20-35
	6-32	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	40-70	20-40
	32-80	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	45-70	25-40
349B----- Hartwick	0-2	Sand-----	SP, SM, SP-SM	A-1-b, A-2-4, A-3	0-5	90-100	75-100	35-70	0-15	---	NP
	2-4	Sand, loamy sand	SP, SM, SP-SM	A-1-b, A-2-4, A-3	0-5	90-100	75-100	35-70	0-20	---	NP
	4-8	Sand, gravelly loamy sand, very gravelly sand.	SP, SM, GP, GM	A-1-b, A-2-4, A-3	0-5	45-100	35-100	30-70	0-15	---	NP
	8-30	Sand, gravelly loamy sand, very gravelly sand.	SP, SM, GP, GM	A-1-b, A-2-4, A-3	0-5	45-100	35-100	30-70	0-15	---	NP
	30-80	Sand, gravelly sand.	SP, SM, SP-SM	A-1-b, A-2-4, A-3	0-5	75-100	60-100	30-100	0-15	---	NP

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
13: Tawas-----	0-10	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	-----	---	4	2	40-60
	10-24	---	0.30-0.55	0.2-6.0	0.24-0.45	4.5-7.8	-----	---			
	24-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low-----	0.15			
Lupton-----	0-9	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	-----	---	5	2	70-90
	9-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8	-----	---			
14: Dawson-----	0-4	---	0.15-0.30	>6.0	0.55-0.65	3.6-4.4	-----	---	4	7	65-85
	4-43	---	0.15-0.40	0.2-6.0	0.35-0.45	3.6-4.4	-----	---			
	43-60	0-10	1.55-1.75	6.0-20	0.03-0.10	4.5-6.5	Low-----	0.10			
Loxley-----	0-6	---	0.30-0.40	>6.0	0.35-0.65	<4.5	-----	---	5	7	70-90
	6-60	---	0.10-0.35	0.2-6.0	0.35-0.45	<4.5	-----	---			
15A: Croswell-----	0-5	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low-----	0.10	5	1	.5-2
	5-30	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low-----	0.10			
	30-80	0-10	1.40-1.60	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
Au Gres-----	0-8	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low-----	0.10	5	1	2-4
	8-24	0-8	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
	24-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.10			
16B----- Graycalm	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
17A----- Croswell	0-5	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low-----	0.10	5	1	.5-2
	5-30	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low-----	0.10			
	30-80	0-10	1.40-1.60	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
18A----- Au Gres	0-8	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low-----	0.10	5	1	2-4
	8-24	0-8	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
	24-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.10			
19----- Leafriver	0-9	---	0.10-0.25	0.6-6.0	0.35-0.50	5.6-7.3	-----	---	2	2	50-90
	9-12	3-18	1.40-1.65	2.0-20	0.08-0.14	5.6-7.3	Low-----	0.20			
	12-60	0-10	1.50-1.65	6.0-20	0.03-0.08	5.6-7.3	Low-----	0.15			
20B, 20D, 20F: Graycalm-----	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
Grayling-----	0-3	0-10	1.30-1.65	6.0-20	0.07-0.09	3.6-5.5	Low-----	0.15	5	1	1-6
	3-23	0-10	1.30-1.65	6.0-20	0.06-0.08	3.6-5.5	Low-----	0.15			
	23-80	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
21B, 21D, 21F: Graycalm-----	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
21B, 21D, 21F: Klacking-----	0-3	2-12	1.35-1.65	6.0-20	0.08-0.11	4.5-6.0	Low-----	0.15	5	2	1-2
	3-21	0-10	1.35-1.65	6.0-20	0.05-0.08	4.5-7.3	Low-----	0.10			
	21-80	2-15	1.55-1.70	2.0-6.0	0.05-0.11	4.5-7.3	Low-----	0.15			
22B----- Montcalm	0-5	2-10	1.35-1.60	2.0-6.0	0.09-0.12	5.1-6.5	Low-----	0.15	5	2	.5-3
	5-19	8-15	1.30-1.60	2.0-6.0	0.05-0.10	5.1-6.5	Low-----	0.15			
	19-63	2-22	1.45-1.65	2.0-6.0	0.04-0.16	5.1-6.5	Low-----	0.15			
	63-70	2-10	1.45-1.65	6.0-20	0.04-0.10	5.6-8.4	Low-----	0.15			
23: Ausable-----	0-10	---	0.20-0.30	0.6-6.0	0.35-0.45	6.1-7.3	-----	---	5	2	70-90
	10-20	0-10	1.40-1.65	6.0-20	0.06-0.10	6.1-7.8	Low-----	0.15			
	20-60	0-10	1.30-1.60	6.0-20	0.04-0.08	6.1-7.8	Low-----	0.10			
Bowstring-----	0-34	0-5	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	-----	---	4	8	40-90
	34-38	0-5	1.40-1.60	6.0-20	0.08-0.14	5.6-8.4	Low-----	---			
	38-60	0-5	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	-----	---			
24A: Kinross-----	0-3	---	0.10-0.35	2.0-20	0.35-0.45	3.6-5.0	-----	---	5	2	20-70
	3-22	0-10	1.40-1.70	6.0-20	0.04-0.09	3.6-6.0	Low-----	0.15			
	22-60	0-10	1.40-1.70	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
Au Gres-----	0-10	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low-----	0.10	5	1	2-4
	10-26	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
	26-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.10			
31B----- Klacking	0-3	2-12	1.35-1.65	6.0-20	0.08-0.11	4.5-6.0	Low-----	0.15	5	2	1-2
	3-21	0-10	1.35-1.65	6.0-20	0.05-0.08	4.5-7.3	Low-----	0.10			
	21-80	2-15	1.55-1.70	2.0-6.0	0.05-0.11	4.5-7.3	Low-----	0.15			
32B----- Kellogg	0-6	0-10	1.35-1.60	6.0-20	0.07-0.09	4.5-6.0	Low-----	0.15	4	1	2-4
	6-26	2-12	1.35-1.60	6.0-20	0.06-0.10	4.5-6.0	Low-----	0.15			
	26-29	10-40	1.45-1.60	0.2-0.6	0.12-0.15	6.1-7.8	Moderate----	0.32			
	29-40	35-60	1.50-1.70	<0.2	0.09-0.17	6.1-7.8	High-----	0.32			
34B----- Kneff	40-80	35-60	1.60-1.70	<0.2	0.08-0.15	7.4-8.4	High-----	0.32			
	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	4.5-6.5	Low-----	0.37	5	3	1-3
	8-14	10-30	1.35-1.55	0.2-2.0	0.17-0.22	4.5-6.5	Low-----	0.43			
	14-29	18-35	1.35-1.55	0.2-0.6	0.18-0.22	5.1-6.5	Low-----	0.43			
	29-61	10-35	1.30-1.65	0.2-0.6	0.17-0.20	7.4-8.4	Low-----	0.43			
35----- Kinross	61-80	5-35	1.30-1.65	0.2-2.0	0.05-0.20	7.4-8.4	Low-----	0.17			
	0-3	---	0.10-0.35	2.0-20	0.35-0.45	3.6-5.0	-----	---	5	2	20-70
	3-22	0-10	1.40-1.70	6.0-20	0.04-0.09	3.6-6.0	Low-----	0.15			
47D, 47F----- Graycalm	22-60	0-10	1.40-1.70	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
48B, 48D: Rubicon-----	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
	0-6	0-5	1.25-1.45	6.0-20	0.05-0.09	4.5-6.0	Low-----	0.10	5	1	.5-2
	6-35	0-5	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low-----	0.10			
Graycalm-----	35-80	0-5	1.40-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.10			
	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter Pct
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					
49B----- Kalkaska	0-11	0-10	1.25-1.45	6.0-20	0.05-0.09	3.6-6.0	Low-----	0.15	5	1	1-4
	11-22	0-15	1.35-1.45	6.0-20	0.06-0.08	3.6-6.0	Low-----	0.15			
	22-44	0-10	1.35-1.45	6.0-20	0.06-0.08	4.5-6.0	Low-----	0.15			
	44-80	0-10	1.35-1.50	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
50B:											
Au Gres-----	0-8	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low-----	0.10	5	1	2-4
	8-24	0-8	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
	24-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.10			
Kinross-----	0-3	---	0.10-0.35	2.0-20	0.35-0.45	3.6-5.0	-----	---	5	2	20-70
	3-22	0-10	1.40-1.70	6.0-20	0.04-0.09	3.6-6.0	Low-----	0.15			
	22-60	0-10	1.40-1.70	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
Crowell-----	0-5	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low-----	0.10	5	1	.5-2
	5-30	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low-----	0.10			
	30-80	0-10	1.40-1.60	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
51:											
Tawas-----	0-10	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	-----	---	4	2	40-60
	10-24	---	0.30-0.55	0.2-6.0	0.24-0.45	4.5-7.8	-----	---			
	24-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low-----	0.15			
Leafriver-----	0-9	---	0.10-0.25	0.6-6.0	0.35-0.50	5.6-7.3	-----	---	2	2	50-90
	9-12	3-18	1.40-1.65	2.0-20	0.08-0.14	5.6-7.3	Low-----	0.20			
	12-60	0-10	1.50-1.65	6.0-20	0.03-0.08	5.6-7.3	Low-----	0.20			
52B, 52D-----											
Blue Lake	0-6	3-12	1.35-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17	5	2	.5-2
	6-21	5-12	1.30-1.60	6.0-20	0.06-0.11	5.1-6.5	Low-----	0.17			
	21-71	8-15	1.30-1.60	2.0-6.0	0.06-0.12	5.1-6.5	Low-----	0.17			
	71-80	0-5	1.45-1.70	6.0-20	0.05-0.07	5.6-7.8	Low-----	0.17			
58A:											
Wakeley-----	0-4	---	0.30-0.40	6.0-20	0.35-0.45	5.6-7.8	-----	---	4	2	40-60
	4-28	0-15	1.45-1.60	6.0-20	0.05-0.10	5.6-7.8	Low-----	0.10			
	28-80	35-60	1.50-1.70	<0.2	0.08-0.12	7.4-8.4	High-----	0.32			
Allendale-----	0-7	0-10	1.25-1.40	6.0-20	0.07-0.09	4.5-7.3	Low-----	0.15	4	1	2-4
	7-21	0-15	1.35-1.45	6.0-20	0.06-0.10	4.5-7.3	Low-----	0.17			
	21-80	40-60	1.45-1.70	<0.06	0.08-0.12	6.1-8.4	High-----	0.32			
64B-----											
Feldhauser	0-10	2-12	1.30-1.60	0.6-2.0	0.13-0.18	5.1-6.5	Low-----	0.24	5	3	.5-2
	10-39	8-18	1.35-1.60	0.6-2.0	0.12-0.19	4.5-6.5	Low-----	0.24			
	39-80	0-10	1.55-1.75	6.0-20	0.04-0.10	4.5-7.3	Low-----	0.17			
65F-----											
Rubicon	0-6	0-5	1.25-1.45	6.0-20	0.05-0.09	4.5-6.0	Low-----	0.10	5	1	.5-2
	6-35	0-5	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low-----	0.10			
	35-80	0-5	1.40-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.10			
67A:											
Bowers-----	0-8	15-27	1.40-1.70	0.6-2.0	0.20-0.22	5.6-7.3	Low-----	0.32	5	6	1-3
	8-11	30-40	1.45-1.60	0.2-0.6	0.12-0.17	5.6-7.3	Moderate----	0.37			
	11-45	35-40	1.45-1.60	0.06-0.2	0.18-0.20	6.1-7.3	Moderate----	0.43			
	45-80	30-40	1.50-1.65	0.06-0.6	0.18-0.22	7.4-7.8	Moderate----	0.43			
Deerheart-----											
Deerheart	0-6	12-27	1.10-1.60	0.6-2.0	0.22-0.24	6.1-7.3	Low-----	0.37	5	6	2-5
	6-27	27-35	1.40-1.70	0.06-0.2	0.15-0.20	6.1-7.8	Moderate----	0.43			
	27-43	27-35	1.40-1.70	0.06-0.2	0.15-0.20	7.4-8.4	Moderate----	0.43			
	43-80	18-40	1.50-1.75	0.06-0.2	0.08-0.22	7.4-8.4	Moderate----	0.43			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
75B, 75D----- Rubicon	0-6	0-5	1.25-1.45	6.0-20	0.05-0.09	4.5-6.0	Low-----	0.10	5	1	.5-2
	6-35	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low-----	0.10			
	35-80	0-5	1.40-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.10			
78. Pits											
81B, 81D, 81F---- Grayling	0-3	0-10	1.30-1.65	6.0-20	0.07-0.09	3.6-5.5	Low-----	0.15	5	1	1-6
	3-23	0-10	1.30-1.65	6.0-20	0.06-0.08	3.6-5.5	Low-----	0.15			
	23-80	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
82B----- Udorthents	0-60	2-18	1.50-1.70	0.6-2.0	0.11-0.18	---	Low-----	0.32	5	3	---
	60-80	---	---	---	---	---	---	---			
83B----- Udipsamments	0-60	0-10	1.35-1.65	>6.0	0.05-0.09	5.1-6.5	Low-----	0.12	5	1	<1
86: Histosols-----	0-51	---	---	0.2-6.0	---	---	---	---	---	2	50-70
	51-60	---	---	---	---	---	---	---	---		
Aquents-----	0-60	---	---	---	---	---	---	---	---	---	---
115D----- Kalkaska	0-11	0-10	1.25-1.45	6.0-20	0.05-0.09	3.6-6.0	Low-----	0.15	5	1	1-4
	11-22	0-15	1.35-1.45	6.0-20	0.06-0.08	3.6-6.0	Low-----	0.15			
	22-44	0-10	1.35-1.45	6.0-20	0.06-0.08	4.5-6.0	Low-----	0.15			
	44-80	0-10	1.35-1.50	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
126F: Udipsamments----	0-60	0-10	---	---	---	---	---	---	---	---	---
Haplorthods----	0-60	---	---	---	---	---	---	---	---	---	---
Eutroboralfs----	0-60	---	---	---	---	---	---	---	---	---	---
144B----- Perecheney	0-3	0-10	1.30-1.55	6.0-20	0.07-0.09	4.5-6.0	Low-----	0.15	5	1	.5-2
	3-36	0-15	1.30-1.65	6.0-20	0.06-0.11	4.5-6.5	Low-----	0.17			
	36-38	5-20	1.40-1.65	6.0-20	0.06-0.18	4.5-6.5	Low-----	0.37			
	38-52	18-35	1.35-1.55	0.2-2.0	0.15-0.20	5.6-8.4	Low-----	0.32			
	52-80	0-15	1.40-1.65	6.0-20	0.05-0.10	5.6-8.4	Low-----	0.17			
146F: Rubicon-----	0-5	0-5	1.25-1.45	6.0-20	0.05-0.09	4.5-6.0	Low-----	0.10	5	1	.5-2
	5-35	0-5	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low-----	0.10			
	35-80	0-5	1.40-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.10			
Graycalm-----	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
210B, 210C, 210D, 210E----- Grayling	0-3	0-10	1.30-1.65	6.0-20	0.07-0.09	3.6-5.5	Low-----	0.15	5	1	1-6
	3-23	0-10	1.30-1.65	6.0-20	0.06-0.08	3.6-5.5	Low-----	0.15			
	23-99	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
211B, 211C, 211D, 211E----- Grayling	0-3	0-4	1.30-1.55	6.0-20	0.06-0.08	4.5-6.5	Low-----	0.15	5	1	1-5
	3-35	0-4	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	35-60	0-4	1.50-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
	60-99	0-20	1.55-1.70	0.6-20	0.04-0.12	4.5-6.5	Low-----	0.20			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
212B----- Grayling	0-3	0-4	1.30-1.55	6.0-20	0.07-0.09	3.6-5.5	Low-----	0.15	5	1	1-5
	3-30	0-4	1.40-1.60	6.0-20	0.06-0.08	4.5-6.5	Low-----	0.15			
	30-99	0-4	1.50-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
213B----- Graycalm	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
	80-99	0-10	1.50-1.65	6.0-20	0.04-0.06	5.6-8.4	Low-----	0.10			
215B----- Typic Udipsamments	0-2	0-4	1.30-1.55	6.0-20	0.06-0.08	4.5-6.5	Low-----	0.15	5	1	1-5
	2-25	0-4	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	25-75	0-4	1.50-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
	75-90	0-20	1.55-1.70	0.6-20	0.04-0.12	4.5-6.5	Low-----	0.20			
220B, 220C, 220D- Typic Udipsamments	0-2	0-5	1.30-1.55	6.0-20	0.07-0.09	4.5-6.0	Low-----	0.15	5	1	1-5
	2-40	0-5	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	40-99	0-5	1.50-1.65	6.0-20	0.04-0.06	5.6-7.3	Low-----	0.15			
221B, 221C, 221D, 221E----- Typic Udipsamments	0-3	0-4	1.30-1.55	6.0-20	0.06-0.08	4.5-6.5	Low-----	0.15	5	1	1-5
	3-30	0-4	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	30-60	0-4	1.50-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
	60-99	0-20	1.55-1.70	0.6-20	0.04-0.12	4.5-6.5	Low-----	0.20			
222B----- Typic Udipsamments	0-2	0-5	1.30-1.55	6.0-20	0.07-0.09	4.5-6.0	Low-----	0.15	5	1	1-5
	2-30	0-5	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	30-99	0-5	1.50-1.65	6.0-20	0.04-0.06	5.6-7.3	Low-----	0.15			
223B, 223C, 223D: Graycalm-----	0-5	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low-----	0.10	5	1	.5-2
	5-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-80	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
	80-99	0-10	1.50-1.65	6.0-20	0.04-0.06	5.6-8.4	Low-----	0.10			
Grayling-----	0-3	0-10	1.30-1.65	6.0-20	0.07-0.09	3.6-5.5	Low-----	0.15	5	1	1-6
	3-23	0-10	1.30-1.65	6.0-20	0.06-0.08	3.6-5.5	Low-----	0.15			
	23-99	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
224B----- Crowell	0-5	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low-----	0.10	5	1	.5-2
	5-30	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low-----	0.10			
	30-80	0-10	1.40-1.60	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
225B----- Entic Haplorthods	0-3	0-5	1.30-1.55	6.0-20	0.07-0.09	4.5-6.5	Low-----	0.15	5	1	1-5
	3-35	0-5	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	35-60	0-5	1.50-1.65	6.0-20	0.04-0.06	5.6-7.3	Low-----	0.15			
	60-90	20-40	1.30-1.65	0.2-0.6	0.14-0.16	5.6-8.4	Moderate----	0.37			
236B----- Arenic Eutroboralfs	0-99	---	---	---	---	---	---	---	---	---	
237B----- Glossic Eutroboralfs	0-99	---	---	---	---	---	---	---	---	---	
239B, 239C, 239E: Psammentic Eutroboralfs---	0-2	0-10	1.35-1.65	6.0-20	0.05-0.09	4.5-6.0	Low-----	0.10	5	1	1-5
	2-75	0-10	1.35-1.65	6.0-20	0.05-0.08	4.5-7.3	Low-----	0.10			
	75-99	0-10	1.55-1.70	6.0-20	0.05-0.09	4.5-7.3	Low-----	0.15			

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
239B, 239C, 239E: Typic Udipsamments---	0-3	0-4	1.30-1.55	6.0-20	0.06-0.08	4.5-6.5	Low-----	0.15	5	1	1-5
	3-30	0-4	1.40-1.60	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	30-60	0-4	1.50-1.65	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
	60-99	0-20	1.55-1.70	0.6-20	0.04-0.12	4.5-6.5	Low-----	0.20			
262A----- Au Gres	0-8	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low-----	0.10	5	1	2-4
	8-24	0-8	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low-----	0.10			
	24-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.10			
263A----- Argic Endoaquods	0-99	---	---	---	---	---	-----	---	---	---	---
264A----- Allendale	0-3	0-10	1.25-1.40	6.0-20	0.07-0.09	4.5-7.3	Low-----	0.15	4	1	2-4
	3-21	0-15	1.35-1.45	6.0-20	0.06-0.10	4.5-7.3	Low-----	0.17			
	21-80	40-60	1.45-1.70	<0.06	0.08-0.12	6.1-8.4	High-----	0.32			
271: Typic Endoaquods, wet	0-99	---	---	---	---	---	-----	---	---	---	---
Typic Endoaquods	0-99	---	---	---	---	---	-----	---	---	---	---
275: Wakeley-----	0-4	---	0.30-0.40	6.0-20	0.35-0.45	5.6-7.8	-----	---	4	2	40-60
	4-28	0-15	1.45-1.60	6.0-20	0.05-0.10	5.6-7.8	Low-----	0.10			
	28-80	35-60	1.50-1.70	<0.2	0.08-0.12	7.4-8.4	High-----	0.32			
Leafriver-----	0-9	---	0.10-0.25	0.6-6.0	0.35-0.50	5.6-7.3	-----	---	2	2	50-90
	9-12	3-18	1.40-1.65	2.0-20	0.08-0.14	5.6-7.3	Low-----	0.17			
	12-60	0-10	1.50-1.65	6.0-20	0.03-0.08	5.6-7.3	Low-----	0.17			
280: Aquents-----	0-60	---	---	---	---	---	-----	---	---	---	---
Histosols-----	0-51	---	---	0.2-6.0	---	---	-----	---	---	2	50-70
	51-60	---	---	---	---	---	-----	---			
281----- Borosaprists	0-51	---	0.15-0.25	0.2-6.0	0.35-0.45	3.6-4.4	-----	---	5	2	>20
	51-60	---	---	---	---	---	-----	---			
282----- Borosaprists	0-51	---	0.15-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	---	2	2	>70
	51-60	---	---	---	---	---	-----	---			
347F----- Kalkaska	0-11	0-10	1.25-1.45	6.0-20	0.05-0.09	3.6-6.0	Low-----	0.15	5	1	1-4
	11-22	0-15	1.35-1.45	6.0-20	0.06-0.08	3.6-6.0	Low-----	0.15			
	22-44	0-10	1.35-1.45	6.0-20	0.06-0.08	4.5-6.0	Low-----	0.15			
	44-80	0-10	1.35-1.50	6.0-20	0.04-0.06	4.5-6.5	Low-----	0.15			
348----- Pickford	0-3	---	0.20-0.30	6.0-20	0.35-0.45	5.1-7.8	-----	---	4	2	40-60
	3-6	35-50	1.10-1.35	0.2-0.6	0.12-0.14	5.1-7.8	High-----	0.32			
	6-32	35-60	1.40-1.65	0.00-0.06	0.09-0.13	5.1-7.8	High-----	0.32			
	32-80	40-60	1.50-1.70	0.00-0.06	0.08-0.12	7.4-8.4	High-----	0.32			
349B----- Hartwick	0-2	0-5	1.35-1.55	6.0-20	0.07-0.09	4.5-6.0	Low-----	0.15	5	1	1-5
	2-4	0-10	1.35-1.70	6.0-20	0.07-0.09	4.5-6.0	Low-----	0.15			
	4-8	0-10	1.35-1.70	6.0-20	0.03-0.09	4.5-6.0	Low-----	0.17			
	8-30	0-10	1.35-1.70	6.0-20	0.03-0.09	4.5-6.0	Low-----	0.10			
	30-80	0-5	1.55-1.65	>6.0	0.02-0.06	7.4-8.4	Low-----	0.10			

TABLE 19.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
13:					Ft					
Tawas-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	Moderate.
Lupton-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	Low.
14:										
Dawson-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	High.
Loxley-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	High.
15A:										
Croswell-----	A	None-----	---	---	2.0-3.5	Apparent	Oct-May	Low-----	Low-----	Moderate.
Au Gres-----	B	None-----	---	---	0.5-1.5	Apparent	Oct-May	Moderate	Low-----	Moderate.
16B:										
Graycalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
17A:										
Croswell-----	A	None-----	---	---	2.0-3.5	Apparent	Oct-May	Low-----	Low-----	Moderate.
18A:										
Au Gres-----	B	None-----	---	---	0.5-1.5	Apparent	Oct-May	Moderate	Low-----	Moderate.
19:										
Leafriver-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	High.
20B, 20D, 20F:										
Graycalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
Grayling-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
21B, 21D, 21F:										
Graycalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
Klacking-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
22B:										
Montcalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
23:										
Ausable-----	D	Frequent-----	Brief or long.	Nov-May	+1.-1.0	Apparent	Oct-May	Moderate	High-----	Low.
Bowstring-----	A/D	Frequent-----	Brief or long.	Nov-May	+1-1.0	Apparent	Oct-May	High-----	High-----	Low.
24A:										
Kinross-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	Moderate	High-----	Moderate.
Au Gres-----	B	None-----	---	---	0.5-1.5	Apparent	Oct-May	Moderate	Low-----	Moderate.
31B:										
Klacking-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
32B:										
Kellogg-----	A/B	None-----	---	---	2.0-3.5	Perched	Oct-May	Low-----	High-----	Low.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
34B----- Kneff	C	None-----	---	---	2.0-3.5	Perched	Oct-May	High-----	High-----	Low.
35----- Kinross	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	Moderate	High-----	Moderate.
47D, 47F----- Graycalm	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
48B, 48D: Rubicon-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
Graycalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
49B----- Kalkaska	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
50B: Au Gres-----	B	None-----	---	---	0.5-1.5	Apparent	Oct-May	Moderate	Low-----	Moderate.
Kinross-----	A/D	None-----	---	---	+1-1.0	Apparent	Oct-May	Moderate	High-----	Moderate.
Croswell-----	A	None-----	---	---	2.0-3.5	Apparent	Oct-May	Low-----	Low-----	Moderate.
51: Tawas-----	A/D	None-----	---	---	+1-1.0	Apparent	Nov-May	High-----	High-----	Moderate.
Leafriver-----	A/D	None-----	---	---	+1-1.0	Apparent	Nov-Jul	High-----	High-----	High.
52B, 52D----- Blue Lake	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
58A: Wakeley-----	D	None-----	---	---	+1-1.0	Perched	Oct-May	Moderate	High-----	Moderate.
Allendale-----	C	None-----	---	---	0.5-1.5	Perched	Oct-May	Moderate	High-----	Moderate.
64B----- Feldhauser	B	None-----	---	---	>6.0	---	---	Moderate	Low-----	Moderate.
65F----- Rubicon	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
67A: Bowers-----	C	None-----	---	---	1.0-2.0	Apparent	Oct-Apr	High-----	High-----	Low.
Deerheart-----	C	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	Low.
75B, 75D----- Rubicon	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
78. Pits										
81B, 81D, 81F----- Grayling	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
82B----- Udorthents	---	None-----	---	---	>6.0	---	---	---	---	---
83B----- Udipsamments	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
86:					Ft					
Histosols-----	D	None-----	---	---	+1-1.0	Apparent	Jan-Dec	High-----	---	---
Aquents-----	D	None-----	---	---	+1-1.0	Apparent	Jan-Dec	High-----	---	---
115D----- Kalkaska	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
126F:										
Udipsamments-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
Haplorthods-----	---	None-----	---	---	>6.0	---	---	---	---	---
Eutroboralfs-----	---	None-----	---	---	>6.0	---	---	---	---	---
144B----- Perechenev	B	None-----	---	---	2.0-3.5	Perched	Nov-May	Low-----	Moderate	Moderate.
146F:										
Rubicon-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
Graycalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
210B, 210C, 210D, 210E----- Grayling	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
211B, 211C, 211D, 211E----- Grayling	A	None-----	---	---	>15	---	---	Low-----	Low-----	High.
212B----- Grayling	A	None-----	---	---	6.0-15	---	---	Low-----	Low-----	Moderate.
213B----- Graycalm	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
215B, 220B, 220C, 220D, 221B, 221C, 221D, 221E----- Typic Udipsamments	A	None-----	---	---	>15	---	---	Low-----	Low-----	High.
222B----- Typic Udipsamments	A	None-----	---	---	5.0-15	Apparent	Jan-Dec	Low-----	Low-----	High.
223B, 223C, 223D: Graycalm-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
Grayling-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
224B----- Crowell	A	None-----	---	---	2.0-3.5	Apparent	Oct-May	Low-----	Low-----	Moderate.
225B----- Entic Haplorthods	A	None-----	---	---	>15	---	---	Low-----	Low-----	High.
236B----- Arenic Eutroboralfs	---	None-----	---	---	>6.0	---	---	---	---	---

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
237B----- Glossic Eutroboralfs	---	None-----	---	---	Ft >6.0	---	---	---	---	---
239B, 239C, 239E: Psammentic Eutroboralfs----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.
Typic Udipsamments-----	A	None-----	---	---	>15	---	---	Low-----	Low-----	High.
262A----- Au Gres	B	None-----	---	---	0.5-1.5	Apparent	Oct-May	Moderate	Low-----	Moderate.
263A----- Argic Endoaquods	A	None-----	---	---	1.0-2.0	Apparent	Oct-May	Moderate	---	---
264A----- Allendale	C	None-----	---	---	0.5-1.5	Perched	Oct-May	Moderate	High-----	Moderate.
271: Typic Endoaquods, wet-----	D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	---	---
Typic Endoaquods-	---	None-----	---	---	0.5-1.5	Apparent	Oct-May	Moderate	---	---
275: Wakeley-----	D	None-----	---	---	+1-1.0	Perched	Oct-May	Moderate	High-----	Moderate.
Leafriver-----	A/D	None-----	---	---	+1-1.0	Apparent	Nov-Jul	High-----	High-----	High.
280: Aquents-----	D	None-----	---	---	+1-1.0	Apparent	Jan-Dec	High-----	---	---
Histosols-----	D	None-----	---	---	+1-1.0	Apparent	Jan-Dec	High-----	---	---
281----- Borosaprists	D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	High.
282----- Borosaprists	D	None-----	---	---	+1-1.0	Apparent	Oct-May	High-----	High-----	Moderate.
347F----- Kalkaska	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	High.
348----- Pickford	D	None-----	---	---	+1-1.0	Perched	Oct-Jun	High-----	High-----	Low.
349B----- Hartwick	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Moderate.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Allendale-----	Sandy over clayey, mixed, frigid Alfic Epiaquods
Aquents-----	Aquents
Arenic Eutroboralfs-----	Arenic Eutroboralfs
Argic Endoaquods-----	Argic Haplaquods
Au Gres-----	Sandy, mixed, frigid Typic Endoaquods
Ausable-----	Sandy, mixed, frigid Histic Humaquepts
Blue Lake-----	Sandy, mixed, frigid Alfic Haplorthods
Borosaprists-----	Borosaprists
Bowers-----	Fine, mixed Glossaquic Eutroboralfs
Bowstring-----	Euic Fluvaquentic Borosaprists
Croswell-----	Sandy, mixed, frigid Oxyaquic Haplorthods
Dawson-----	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
Deerheart-----	Fine-loamy, mixed, nonacid, frigid Aeric Endoaquepts
Entic Haplorthods-----	Sandy, mixed, frigid Entic Haplorthods
Eutroboralfs-----	Eutroboralfs
Feldhauser-----	Coarse-loamy, mixed Oxyaquic Glossoboralfs
Glossic Eutroboralfs-----	Glossic Eutroboralfs
Graycalm-----	Mixed, frigid Argic Udipsamments
Grayling-----	Mixed, frigid Typic Udipsamments
Haplorthods-----	Haplorthods
Hartwick-----	Sandy, mixed, frigid Entic Haplorthods
Histosols-----	Histosols
Kalkaska-----	Sandy, mixed, frigid Typic Haplorthods
Kellogg-----	Sandy over clayey, mixed, frigid Oxyaquic Haplorthods
Kinross-----	Sandy, mixed, frigid Typic Endoaquods
Klacking-----	Coarse-loamy, mixed Psammentic Eutroboralfs
Kneff-----	Fine-silty, mixed Oxyaquic Glossoboralfs
Leafriver-----	Sandy, mixed, frigid Histic Humaquepts
Loxley-----	Dysic Typic Borosaprists
Lupton-----	Euic Typic Borosaprists
Montcalm-----	Coarse-loamy, mixed, frigid Alfic Haplorthods
Perecheney-----	Fine-loamy, mixed Oxyaquic Eutroboralfs
Pickford-----	Fine, mixed, nonacid, frigid Aeric Epiaquepts
Psammentic Eutroboralfs-----	Sandy, mixed Psammentic Eutroboralfs
Rubicon-----	Sandy, mixed, frigid Entic Haplorthods
Tawas-----	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Typic Endoaquods-----	Typic Endoaquods
Typic Udipsamments-----	Mixed, frigid Typic Udipsamments
Udipsamments-----	Udipsamments
Udorthents-----	Udorthents
Wakeley-----	Sandy over clayey, mixed, nonacid, frigid Aeric Epiaquents

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the interpretive group is not assigned)

Soil name and map symbol	Land capability	Prime farmland	Woodland ordination symbol	Michigan soil management group	Primary and secondary plant associations*
13----- Tawas----- Lupton-----	VIw	No	5W 2W	M/4c Mc	---
14----- Dawson----- Loxley-----	VIIw	No	2W 2W	M/4c-a Mc-a	---
15A----- Croswell----- Au Gres-----	IVs	No	5S 6W	5a 5b	---
16B----- Graycalm	IVs	No	6S	5a	---
17A----- Croswell	IVs	No	5S	5a	---
18A----- Au Gres	IVw	No	6W	5b	---
19----- Leafriver	VIw	No	2W	5c	---
20B----- Graycalm----- Grayling-----	IVs	No	6S 4S	5a 5.7a	---
20D----- Graycalm----- Grayling-----	VIIs	No	6S 4S	5a 5.7a	---
20F----- Graycalm----- Grayling-----	VIIIs	No	6R 4R	5a 5.7a	---
21B----- Graycalm----- Klacking-----	IVs	No	6S 6S	5a 4a	---
21D----- Graycalm----- Klacking-----	VIIs	No	6S 6S	5a 4a	---
21F----- Graycalm----- Klacking-----	VIIIs	No	6R 6R	5a 4a	---
22E----- Montcalm	IIIIs	No	3A	4a	---

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Woodland ordination symbol	Michigan soil management group	Primary and secondary plant associations*
23----- Ausable----- Bowstring-----	VIIw	No	2W 3W	L-4c L-Mc	---
24A----- Kinross----- Au Gres-----	VIw	No	2W 6W	5c-a 5b	---
31B----- Klacking	IIIIs	No	6S	4a	---
32B----- Kellogg	IIIIs	No	3S	4/1a	---
34B----- Kneff	IIe	Yes	3L	1.5a	---
35----- Kinross	VIw	No	2W	5c-a	---
47D----- Graycalm	VIIs	No	6S	5a	---
47F----- Graycalm	VIIIs	No	6R	5a	---
48B----- Rubicon----- Graycalm-----	VIIs	No	4S 6S	5.3a 5a	---
48D----- Rubicon----- Graycalm-----	VIIIs	No	4S 6S	5.3a 5a	---
49B----- Kalkaska	IVs	No	3S	5a	---
50B----- Au Gres----- Kinross----- Croswell-----	IVw	No	6W 2W 5S	5b 5c-a 5a	---
51----- Tawas----- Leafriver-----	VIw	No	5W 2W	M/4c 5c	---
52B----- Blue Lake	IIIIs	No	3A	4a	---
52D----- Blue Lake	IVe	No	3A	4a	---
58A----- Wakeley----- Allendale-----	Vw	No	3W 4W	4/1c 4/1b	---

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Woodland ordination symbol	Michigan soil management group	Primary and secondary plant associations*
64B----- Feldhauser	IIe	Yes	3L	3/5a	---
65F----- Rubicon	VIIIs	No	4R	5.3a	---
67A----- Bowers----- Deerheart-----	IIw	Yes	7W 7W	1.5b 1.5c	---
75B----- Rubicon	VIIs	No	4S	5.3a	---
75D----- Rubicon	VIIIs	No	4S	5.3a	---
78. Pits					
81B----- Grayling	VIIs	No	4S	5.7a	---
81D----- Grayling	VIIIs	No	4S	5.7a	---
81F----- Grayling	VIIIs	No	4R	5.7a	---
82B. Udorthents					
83B. Udipsamments					
86. Histosols and Aquents					
115D----- Kalkaska	VIIs	No	3S	5a	---
126F. Udipsamments- Haplorthods- Eutroboralfs					
144B----- Perecheney	IVs	No	6S	4/2a	---
146F----- Rubicon----- Graycalm-----	VIIIs	No	4R 6R	5.3a 5a	---
210B----- Grayling	VIIs	No	4S	5.7a	1, 2
210C----- Grayling	VIIIs	No	4S	5.7a	1, 2
210D, 210E----- Grayling	VIIIs	No	4R	5.7a	1, 2

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Woodland ordination symbol	Michigan soil management group	Primary and secondary plant associations*
211B, 211C----- Grayling	VI _s	No	4S	5.7a	1, 2
211D, 211E----- Grayling	VII _s	No	4R	5.7a	1, 2
212B----- Grayling	VI _s	No	4S	5.7a	1, 2
213B----- Graycalm	IV _s	No	6S	5a	1, 2
215B----- Typic Udipsamments	---	No	---	---	1, 2
220B, 220C, 220D----- Typic Udipsamments	---	No	---	---	2, 1
221B, 221C, 221D, 221E--- Typic Udipsamments	---	No	---	---	2, 1
222B----- Typic Udipsamments	---	No	---	---	2, 1
223B----- Graycalm----- Grayling-----	IV _s	No	6S 4S	5a 5.7a	2, 1
223C----- Graycalm----- Grayling-----	VI _s	No	6S 4S	5a 5.7a	2, 1
223D----- Graycalm----- Grayling-----	VI _s	No	6R 4R	5a 5.7a	2, 1
224B----- Crowell	IV _s	No	5S	5a	2, 1
225B----- Entic Haplorthods	---	No	---	---	2, 3
236B----- Arenic Eutroboralfs	---	No	---	---	3, 4
237B----- Glossic Eutroboralfs	---	No	---	---	4, 3
239B, 239C, 239E----- Psammentic Eutroboralfs-Typic Udipsamments	---	No	---	---	2, 3
262A----- Au Gres	IV _w	No	6W	5b	7, 8
263A----- Argic Endoaquods	---	No	---	---	8, 7

See footnote at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Woodland ordination symbol	Michigan soil management group	Primary and secondary plant associations*
264A----- Allendale	IIIw	No	4W	4/1b	9, 8
271----- Typic Endoaquods, wet- Typic Endoaquods	---	No	---	---	7
275----- Wakeley-----	Vw	No	3W	4/1c	8, 7
Leafriver-----			2W	5c	
280. Aquents and Histosols					
281----- Borosaprists	---	No	---	---	10
282----- Borosaprists	---	No	---	---	11, 9
347F----- Kalkaska	VIIIs	No	3R	5a	---
348----- Pickford	Vw	No	6W	1c	---
349B----- Hartwick	VIIs	No	4S	5.3a	---

* See text for descriptions of these plant associations.

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