United States Department of Agriculture

Soil Conservation Service

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

Soil Survey of Presque Isle County, Michigan

How To Use This Soil Survey

General Soil Map

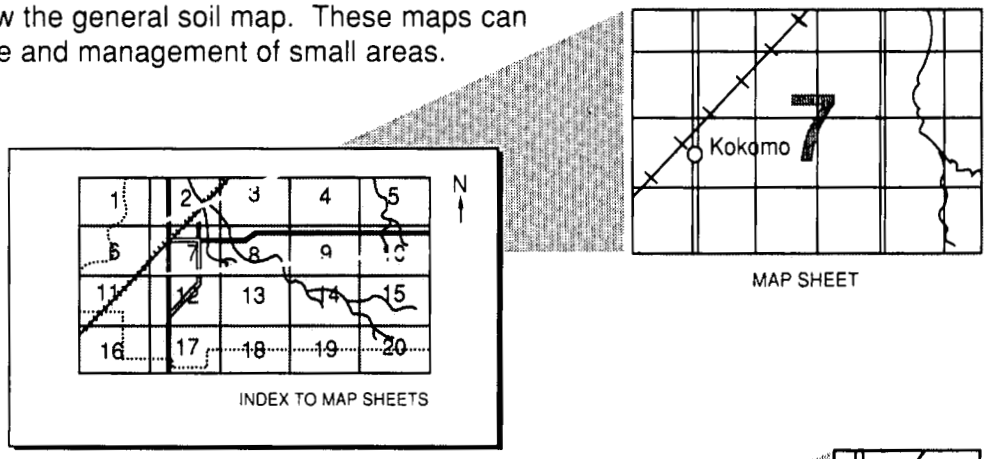
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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.

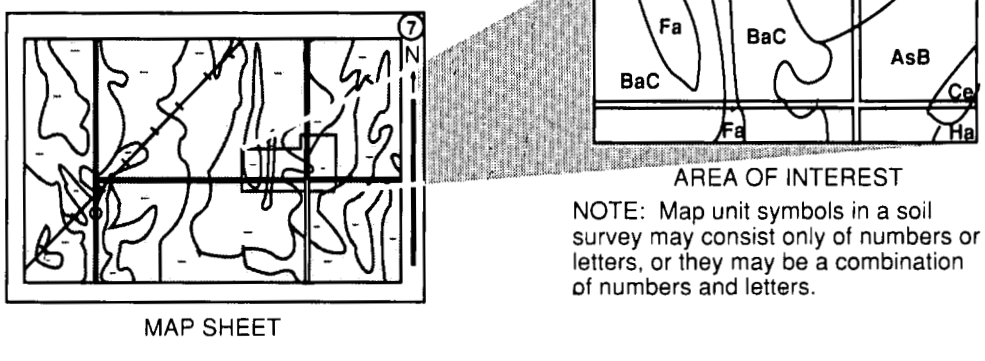
Detailed Soil Maps

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 Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1989. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Soil Conservation Service, the Michigan Department of Agriculture, the Michigan Agricultural Experiment Station, and Michigan Technological University. It is part of the technical assistance furnished to the Presque Isle County Soil Conservation District. Financial assistance was provided by the Presque Isle County Board of Commissioners.

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.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Ocqueoc Falls on the Ocqueoc River flowing through an area of Summerville soils. Limestone bedrock outcrops are in the background.

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Issued February 1993

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Preface

This soil survey contains information that can be used in land-planning programs in Presque Isle County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

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

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

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

Soil Survey of
Presque Isle County, Michigan

By Bruce D. Knapp, Soil Conservation Service

Fieldwork by Bruce Knapp, James Robinson, and John Werlein, Soil Conservation Service, and Craig Outwater, Michigan Department of Agriculture

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Michigan Department of Agriculture, Michigan Agricultural Experiment Station, and
Michigan Technological University

PRESQUE ISLE COUNTY is in the northeastern part of Michigan's lower peninsula (fig. 1). It borders on Lake Huron. It has an area of about 688 square miles, or 440,493 acres. The county seat is Rogers City, which is along Lake Huron in the north-central part of the county. The population of the county in 1980 was 14,267.

About 20 percent of the county is used for farming, primarily for the production of cash crops, dairy products, and beef. Woodland occupies about 68 percent of the county. Most of the woodland is in second-growth stands. The remaining 12 percent of the county is made up of water, urban areas, wildlife habitat, parks, or recreation areas.

About 109 different kinds of soil are in the county. The soils range widely in texture, natural drainage, slope, and other characteristics. Well drained and moderately well drained soils make up about 46 percent of the county, somewhat poorly drained soils make up about 18 percent, and poorly drained or very poorly drained soils make up about 33 percent. Miscellaneous areas, quarries, and water areas less than 40 acres in size make up the remainder.

This soil survey updates an earlier survey of Presque Isle County published in 1954 *(13)* and a Land Type Map published in 1940. It provides additional

Figure 1.—Location of Presque Isle County in Michigan.

information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section gives general information about the survey area. It describes history and development, climate, physiography, lakes and streams, farming, and industry and transportation facilities.

History and Development

Carla Gregory, district conservationist, Soil Conservation Service, prepared this section.

The survey area was originally inhabited by Chippewa and Ottawa Indians, who were attracted by the abundance of fish. It was claimed by the French in 1612 and remained under French rule until 1760, when it fell to the British. In 1796, the area became an American possession, and on March 28, 1836, it was officially ceded to the United States.

The term "Presque Isle" means "almost an island" in French. This name was applied to the area because of the island-like peninsula jutting into Lake Huron north of Grand Lake. Missionaries and trappers had to portage this peninsula in their travels. The area was a summer headquarters for trappers, Indians, and fishermen. Later, the advent of steamers made the area a fuelwood and supply station for residents.

The county was first surveyed in 1840. It was originally part of Mackinac County. In 1853, it was transferred to Cheboygan County and in 1858 to Alpena County. Presque Isle County was legally established in 1875.

The Presque Isle Lighthouse was built in 1840, and a second lighthouse was built a mile north of the original one in 1870. The newer lighthouse, which is 120 feet tall, is the oldest and tallest operating lighthouse on the Great Lakes. The original lighthouse is a privately owned museum. Both sites draw thousands of visitors every year.

Lumbering was the earliest industry in the survey area. In 1837, the county was inhabited by only four residents, all woodcutters. The first settlement in Presque Isle County, Burnham's Landing, was established in 1860 at Presque Isle Harbor as the base of a cordwood business. In 1869, a group of German and Polish immigrants began lumbering in the Rogers City area, and French Canadians came to the area in 1870. The first trees to be cut were pines, but the supply was exhausted around 1900. During the subsequent 30 years, the hardwood areas and swamps were lumbered.

Homesteaders, mostly German and Polish immigrants, followed the timbermen and established agricultural settlements on the former hardwood lands. The earliest crops grown were hay, oats, potatoes, wheat, and corn. The farmers also raised livestock.

In the 1870's, the settlers lived on fish in the winter because water routes from the south were cut off. As a result, the fishing industry grew. Between 1870 and 1875, fish nets set in Hammond Bay caught great sturgeon. The sturgeon were chopped up and boiled, and the oil was collected and sold. Lake trout were caught at the outlets of the Ocqueoc and Swan Rivers in the fall and salted for use in the winter. The trout industry was most productive from 1926, when the first diesel-powered boat was built, until about 1930. It declined because of the introduction of the sea lamprey, which apparently migrated to the Great Lakes on the bottom of boats passing through the St. Lawrence River. Fish planting was begun in the 1960's, and millions of salmon and trout are planted in the Ocqueoc River each year.

During the first years of the county's settlement, transportation was by water. In 1871, the railroad ended at Bay City and supplies were taken north from there by boat. In the winter, mail came by dogsled and transportation was limited to snowshoes. In the early 1900's, vessels of the Detroit and Cleveland lines carried settlers to the area. Because of the dependence on water for transportation, the early settlements were along the shore. The first road in the county was the state road from Cheboygan to Alpena. In 1881, the first settlers came to Onaway and a road was built from there to Petosky. In 1893, the railroad was extended into the county from Alpena, thus encouraging the development of outlying areas.

In 1910, the railroad was extended to the village of Crawford's Quarry, a limestone quarry operated by Michigan Limestone and Chemical Company. This village was originally founded around 1860 as a fueling station for woodburning tugs and was a port for forest products until the timber was exhausted. When the timber industry declined, the town was abandoned until Michigan Limestone and Chemical Company established the Calcite limestone quarry there. The quarry was sold to U.S. Steel in 1920. In 1953, at the height of its production, Calcite produced 162 million tons of limestone and employed 470 men. Another 280 men worked the eight boats owned by Bradley Transportation Company, delivering the product to 30 ports to be used for making steel, pulp and paper, cement, and chemicals. Today, the quarry employs around 220 men and produces 9 million tons of limestone; only a few of the ships are currently used.

No history of Presque Isle County would be complete without an account of the forest fire of 1908, which is

claimed to be the most destructive in Michigan's recent history. A drought in the summer and fall of 1908 followed a warm, moist spring that had produced an abundance of vegetative growth. These conditions led to a forest fire, which started south of Presque Isle County on October 15. The 5-mile-wide fire was driven by gale force winds until it stopped at Lake Huron. It resulted in the destruction of 2.5 million acres. Farms, mills, and homes were destroyed, and many people were killed or injured. The community that was most seriously affected by the fire was the village of Metz, which was virtually destroyed.

Climate

Prepared by the Michigan Department of Agriculture, Climatology Division, East Lansing, Michigan.

The climate in the county is highly varied because of topographical variations and the proximity to Lake Huron. The county has reporting stations in Onaway and Rogers City. The Rogers City data were not used for this survey because of frequent incompatible relocations. In addition to the data recorded at Onaway, however, data from adjacent Alpena County are given.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Onaway, at Phelps Collins Airport, and at Alpena 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 20.4 degrees F at Onaway, 20.1 degrees at Phelps Collins Airport, and 21.8 degrees at Alpena. The average daily minimum temperature is 11.7 degrees at Onaway, 11.4 degrees at Phelps Collins Airport, and 14.8 degrees at Alpena. The lowest temperature on record is -35 degrees at Onaway, -37 degrees at Phelps Collins Airport, and -28 degrees at Alpena. In summer the average daily maximum temperature is 78.8 degrees at Onaway, 77.2 degrees at Phelps Collins Airport, and 74.1 degrees at Alpena. The highest recorded temperature is 106 degrees at Onaway and Phelps Collins Airport and 104 degrees at Alpena.

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

The total annual precipitation is 30.98 inches at Onaway, 28.92 inches at Phelps Collins Airport, and 27.60 inches at Alpena. Of these totals, 18.84 inches at Onaway, 17.86 inches at Phelps Collins Airport, and 17.28 inches at Alpena usually fall 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 15.5 inches at Onaway, 14.8 inches at Phelps Collins Airport, and 14.4 inches at Alpena. The heaviest 1-day rainfall ever recorded was on September 3, 1937, when 6.00 inches fell at Onaway, 5.14 inches fell at Phelps Collins Airport, and 4.40 inches fell at Alpena. Thunderstorms occur on about 24 days each year.

Average seasonal snowfall is 89.0 inches at Onaway, 79.7 inches at Phelps Collins Airport, and 67.3 inches at Alpena. The greatest snow depth at any one time was 38 inches at Onaway, 30 inches at Phelps Collins Airport, and 30 inches at Alpena. On the average, 119 days at Onaway, 106 days at Phelps Collins Airport, and 100 days at Alpena have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

At Phelps Collins Airport, the average relative humidity in midafternoon is about 61 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 63 percent of the time possible in summer and 36 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 9.2 miles per hour, in April. Humidity, sunshine, and windspeed data are not available from the Onaway and Alpena stations.

Physiography

The survey area is part of a plain built up of variable thicknesses of glacial drift. This plain lies on an old, dissected preglacial limestone bedrock plateau. From Rogers City through the southeastern part of the county and from south of Black Lake east to the Ocqueoc River, the bedrock is close to the surface and outcrops are common. The flat and undulating areas of glacial material were formed as outwash plains, till plains, lake plains, and ground moraines. The hilly to steep areas, although largely morainic in origin, are associated in some areas with eskers, drumlins, sinkholes, postglacial beach escarpments, and bedrock escarpments.

Variations in elevation are not extreme in the county. The average elevation of Lake Huron is about 580 feet above sea level, and the highest points in the county are at about 950 feet. These high points are in the townships of Moltke, South Allis, and South Case. The greatest local variations in relief occur between the Moltke highlands and the lake plain west of Rogers City and in the sinkholes that run from east to west across the southern tier of townships.

Lakes and Streams

Presque Isle County has approximately 72 miles of Lake Huron shoreline. There are about 89 inland lakes and reservoirs in the county, 13 of which are at least 100 acres in size and 65 of which are at least 25 acres. Among the larger lakes are Grand Lake, Long Lake, and Black Lake with surface areas of over 2,000 acres each. Other large lakes include Lake Augusta, Lake Esau, Big Trout Lake, Lake Nettie, and the Tomahawk Creek Flooding, each with a surface area of more than 250 acres.

There are seven major rivers in Presque Isle County. The western part of the county is drained by the Rainey, Ocqueoc, and Black Mallard Rivers. The Rainey River flows northwest through Case, Allis, and North Allis Townships into Black Lake on the west county line. The Ocqueoc River flows north through Bismark, Case, and Ocqueoc Townships to Lake Huron at Hammond Bay. The Black Mallard River flows east through Bearinger Township and into Lake Huron. The Trout, Swan, and Little Trout Rivers drain the north-central part of the county. The Trout River originates in Belknap Township and flows through Rogers Township to Lake Huron. The Swan River flows through Belknap and Pulawski Townships and into Lake Huron. The Little Trout River flows from Posen through Pulawski Township to Lake Huron. The south-central part of the county is drained by the North Branch of the Thunder Bay River. This river flows southeast through Metz and Posen Townships into Alpena County.

Canada and Tomahawk Creeks drain South Allis Township and flow into Cheboygan County's Black River at the west county line. Stony Creek flows from near Onaway through North Allis Township to Black Lake. Fox Creek flows out of the northern part of Bismark Township into the Little Ocqueoc River, through southwest Moltke Township, and into the Ocqueoc River in Ocqueoc Township. Schmit Creek drains the northwestern part of Rogers Township and flows into Lake Huron. Quinn Creek drains the eastern part of Bismark Township and flows to the North Branch of the Thunder Bay River through Metz Township. Monaghan Creek drains central Krakow Township and empties into Long Lake. Grand Lake outlet drains Grand Lake and the northern part of Krakow and Presque Isle Townships and empties into Lake Huron.

Farming

Carla Gregory, district conservationist, Soil Conservation Service, prepared this section.

In 1959, about 31 percent of the county was used for agriculture. Presently about 88,000 acres, or 20 percent of the county, is farmed. The majority of land removed from agriculture was woodland; between 1959 and 1982, agriculture experienced a 59 percent decline in wooded areas. The number of farms in the county decreased by 48 percent between 1959 and 1982. Average farm size, however, increased by about 19 percent during the same period to 263 acres.

About 55,300 acres in Presque Isle County is used for the production of crops. Pasture and idle grassland account for another 24,000 acres. The major crops grown are potatoes, dry beans, corn, small grains, and hay *(5)*. Roughly 5,000 acres each of potatoes, dry beans, and corn is produced *(5)*. Presque Isle County is the third largest producer of potatoes in Michigan. It is also an important producer of certified seed.

Irrigation has increased dramatically in the county. Since 1964, when only 162 acres was irrigated, center pivot and traveling sprinkler systems have been installed on about 5,100 acres. Potatoes are grown on most of the irrigated acreage.

In addition to crops, milk cows and beef cattle are raised in the county. Livestock and related uses account for about 32 percent of the agricultural land. Specialty crops, such as strawberries and raspberries, are grown on a few small farms.

Agricultural areas are located away from Lake Huron and the many inland lakes, in areas dominated by well drained to somewhat poorly drained, sandy, loamy, and silty soils. Posen Township contains the highest percentage of cropland, 96 percent, followed by Belknap, Pulawski, Moltke, North Case, Allis, North Allis, Metz, and Ocqueoc Townships.

In 1949, the Presque Isle Soil Conservation District was formed to assist landowners in the prevention of erosion and water pollution and to help in the planning of resource management systems.

Industry and Transportation Facilities

Carla Gregory, district conservationist, Soil Conservation Service, prepared this section.

The primary industry in the county is the limestone mining at USX Calcite quarry (the world's largest) and at Presque Isle Corporation's Stoneport quarry. The land holdings of these two companies comprise 5 percent of the county. The land is along Lake Huron from Rogers City to the south end of Grand Lake.

Another 5 percent of the land in the county is owned by Abitibi-Price Corporation and is used to supply pulp for the plant in Alpena. Some 20 small forest product industries, including small logging companies, sawmills, pallet- and fence-making firms, and cedar post producers, are scattered throughout the county.

Plastics manufacturing is another important industry

in the county. Rogers City Industries, a division of Cadillac Products, operates a plastics factory just outside Rogers City.

Oil and gas exploration and production have grown tremendously since the first well was drilled in the 1950's. More than 300 wells have been drilled, about 40 of which represent actual discoveries of oil, gas, or both. In 1984, a 32-mile natural gas pipeline was built across the county from the southwest corner to near Lake Huron east of Rogers City. This pipeline connects gas-producing wells with a Michigan Consolidated Gas refining plant in Kalkaska. In 1986, 26 wells were drilled and 6 discoveries made, making Presque Isle County the state's leader in oil discoveries.

Four major highways link Presque Isle County to other areas. These include U.S. Highway 23, which extends from Mackinac City south along Lake Huron to Standish; Michigan Highway 68, from Alanson to Rogers City; Michigan Highway 65, from north of Posen to Au Gres; and Michigan Highway 33, from Onaway to Alger. The roads are all two-lane, undivided highways. There are 52 miles of rail lines in the county, serving all six major communities. Airports are located in Rogers City and Onaway; they accommodate only general aviation. Two commercial shipping ports are in Presque Isle County. Located at the Calcite and Stoneport quarries, they are used exclusively for the shipment of limestone. Small boat harbors located at Rogers City and Hammond Bay serve as ports or harbors of refuge for recreational boaters. A third small boat harbor is planned for Presque Isle Harbor.

How This Survey Was Made

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

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

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

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

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

Predictions about soil behavior are based not only on

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

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

Map Unit Composition

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

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

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

General Soil Map Units

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

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

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

Some of the boundaries of the general soil map of Presque Isle County do not match those of the maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences are the result of improvements in the classification of soils, particularly modifications or refinements in soil series concepts, and variations in the intensity of mapping or in the extent of the soils within the survey areas.

Soil Descriptions

1. Hessel-Detour-Brevort Association

Nearly level and very gently sloping, poorly drained and somewhat poorly drained, loamy and sandy soils on glacial lake benches, ground moraines, and outwash plains

The slope of the major soils in this association ranges from 0 to 3 percent. The Hessel and Brevort soils are on broad, nearly level plains and in depressions and drainageways. The Detour soils are in the slightly higher landscape positions and on low rises.

This association makes up about 13 percent of the county. It is about 40 percent Hessel soils, 20 percent Detour soils, 15 percent Brevort soils, and 25 percent soils of minor extent.

The Hessel soils are poorly drained. Typically, they have a surface layer of black mucky flaggy loam about 6 inches thick. The subsoil is light olive brown, mottled, friable flaggy loam about 10 inches thick. The upper part of the substratum is brown, mottled flaggy loam. The lower part to a depth of about 60 inches is grayish brown gravelly sandy loam. Limestone bedrock is at a depth of about 50 inches.

The Detour soils are somewhat poorly drained. Typically, they have a surface layer of very dark grayish brown flaggy loam about 5 inches thick. The subsoil is about 21 inches thick. It is mottled. The upper part is brown and yellowish brown, friable flaggy very fine sandy loam. The lower part is brown, friable flaggy sandy loam. The substratum to a depth of about 60 inches is dark grayish brown flaggy sandy loam.

The Brevort soils are poorly drained. Typically, they have a surface layer of black mucky loamy sand about 6 inches thick. The upper part of the substratum is grayish brown, light olive brown, and light brownish gray, mottled loamy sand. The lower part to a depth of about 60 inches is grayish brown sandy loam and loam.

Minor in this association are the excessively drained Alpena soils; the well drained Kiva, Summerville, and Cunard soils; the somewhat poorly drained Esau soils; and the very poorly drained Cathro soils. Alpena and Kiva soils are gravelly. They are on uplands and old beach ridges. Esau soils are in swales. Summerville and Cunard soils are on uplands. They are underlain by limestone bedrock. Cathro soils are on the lowest part of the landscape.

Most areas of this association are used as woodland. Some of the acreage is used as pasture or cropland or is idle land. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns in the wooded areas.

The soils in this association are generally unsuited to cropland and pasture, but drained areas of the Detour soils are moderately well suited to pasture. Wetness and stoniness are the major management concerns.

The soils in this association are unsuited or poorly suited to building site development and septic tank absorption fields. Ponding is a severe hazard on the Hessel and Brevort soils. Excess water and slow permeability in the Detour soils are management concerns.

2. East Lake-Deer Park Association

Nearly level to very steep, somewhat excessively drained and excessively drained, sandy soils on outwash plains, eskers, beach ridges, and sand dunes

The slope of the major soils in this association ranges from 0 to 45 percent. The East Lake soils are on broad, nearly level upland plains and side slopes. The Deer Park soils are on gently rolling beach ridges and steep sand dunes.

This association makes up about 4 percent of the county. It is about 45 percent East Lake soils, 30 percent Deer Park soils, and 25 percent soils of minor extent.

The East Lake soils are somewhat excessively drained. Typically, they have a surface layer of very dark grayish brown sand about 2 inches thick. The subsurface layer is brown sand about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, very friable loamy sand. The next part is strong brown, loose sand. The lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is pale brown, stratified sand and gravel.

The Deer Park soils are excessively drained. Typically, they have a surface layer of black sand about 2 inches thick. The subsurface layer is pale brown sand about 6 inches thick. The subsoil is yellowish brown, loose sand about 20 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Minor in this association are the Eastport, Au Gres, Croswell, Roscommon, and Tawas soils. The excessively drained Eastport soils are in landscape positions similar to those of the major soils. The somewhat poorly drained Au Gres soils are on low plains and in depressions between beach ridges. The moderately well drained Croswell soils are on the slightly lower plains and in slight depressions between beach ridges. The poorly drained Roscommon and very poorly drained Tawas soils are in depressions and along drainageways.

Most areas of this association are used as woodland. Some of the acreage is used for building site development or recreational development or is idle land. The equipment limitation and seedling mortality are the major management concerns in the wooded areas.

The soils in this association are poorly suited or generally unsuited to cropland and pasture. Droughtiness and soil blowing are major management concerns.

The soils in this association are well suited, moderately well suited, poorly suited, or generally unsuited to building site development and septic tank absorption fields, depending on the slope. A poor filtering capacity and the slope are the major management concerns.

3. Summerville-Alpena-Quarries Association

Quarries and nearly level to rolling, well drained and excessively drained, loamy soils on till plains, bedrock benches, beach ridges, and eskers

The slope of the major soils in this association ranges from 0 to 18 percent. The Summerville soils are on nearly level to rolling plains, on benches, and along bedrock escarpments. The Alpena soils are on beach ridges, on old glacial shoals near Lake Huron, and along abandoned beach terraces.

This association makes up about 9 percent of the county. It is about 40 percent Summerville and similar soils, 20 percent Alpena and similar soils, 15 percent Quarries, and 25 percent soils of minor extent.

The Summerville soils are well drained. Typically, they have a surface layer of dark reddish brown flaggy fine sandy loam about 4 inches thick. The subsurface layer is reddish gray flaggy fine sandy loam about 2 inches thick. The subsoil is about 11 inches thick. The upper part is mixed reddish brown, firm flaggy clay loam and pinkish gray, friable flaggy fine sandy loam. The lower part is dark reddish brown, firm flaggy clay loam. Limestone bedrock is at a depth of about 17 inches.

The Alpena soils are excessively drained. Typically, they have a surface layer of dark brown very gravelly sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is brown and pale brown very gravelly sand. In some places the soils are underlain by limestone bedrock below a depth of 40 inches.

The Quarries are large, deep excavations of exposed limestone bedrock. Limestone has been removed for commercial and industrial uses.

Minor in this association are the Cunard, Bonduel, Detour, Ensign, Ruse, Hessel, and Cathro soils. The well drained Cunard soils are on uplands. The somewhat poorly drained Bonduel, Detour, and Ensign soils are on low plains, in slight depressions, and in drainageways. The poorly drained Ruse and Hessel soils are on low plains, in depressions, and along drainageways. The very poorly drained, organic Cathro soils are in depressions and drainageways.

Most areas of this association are used as woodland. Some of the acreage is used as pasture or cropland or is idle land. The soils in this association are generally

suited to woodland. The windthrow hazard, the equipment limitation, and seedling mortality are the major management concerns in the wooded areas.

The soils in this association are unsuited, poorly suited, or moderately well suited to pasture and cropland. The depth to bedrock in the Summerville soils, the droughtiness of the Alpena soils, and the content of coarse fragments in both soils are the major management concerns.

The soils in this association are unsuited, poorly suited, or moderately well suited to building site development and septic tank absorption fields. A poor filtering capacity in both soils and the depth to bedrock in the Summerville soils are major management concerns.

4. Rubicon-Cheboygan-Graycalm Association

Nearly level to steep, excessively drained to well drained, sandy soils on moraines, drumlins, outwash plains, and till plains

The slope of the major soils in this association ranges from 0 to 35 percent. These soils are on flats, knolls, ridges, hills, and rolling uplands.

This association makes up about 17 percent of the county. It is about 30 percent Rubicon and similar soils, 25 percent Cheboygan and similar soils, 20 percent Graycalm and similar soils, and 25 percent soils of minor extent.

The Rubicon soils are excessively drained. Typically, they have a surface layer of black sand about 2 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is brown, strong brown, and brownish yellow, very friable sand about 22 inches thick. The substratum to a depth of about 60 inches is very pale brown sand.

The Cheboygan soils are well drained. Typically, they have a surface layer of black loamy sand about 5 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown and strong brown, very friable loamy sand that has a few chunks of cemented material. The lower part is reddish brown, friable sandy loam and brown, friable loamy sand. The substratum to a depth of about 60 inches is light brown sandy loam.

The Graycalm soils are somewhat excessively drained. Typically, they have a surface layer of very dark grayish brown sand about 3 inches thick. The upper part of the subsoil is brownish yellow and yellowish brown, very friable sand about 19 inches thick. The next part is light yellowish brown, very friable sand about 19 inches thick. The lower part to a depth of about 60 inches is light yellowish brown, very friable sand that has very thin bands of strong brown, very friable loamy sand.

Minor in this association are the well drained Klacking and Ocqueoc soils; the somewhat excessively drained Kalkaska, Mancelona, and Melita soils; and the moderately well drained Croswell soils that have a loamy substratum. Mancelona, Kalkaska, and Klacking soils are in landscape positions similar to those of the Rubicon and Graycalm soils. Ocqueoc and Melita soils are in landscape positions similar to those of the Cheboygan soils. Croswell soils are on low flats and in slight depressions.

The soils in this association are generally suited to woodland. Seedling mortality and the equipment limitation are the major management concerns.

The soils in this association are well suited, moderately well suited, poorly suited, or unsuited to pasture and cropland. Droughtiness, soil blowing, and the slope are the main management concerns in areas of the Rubicon and Graycalm soils. The nearly level to gently rolling areas of Cheboygan soils are generally suited to cropland, but soil blowing is a hazard in the steeper areas.

The soils in this association are well suited, moderately well suited, poorly suited, or unsuited to building site development and septic tank absorption fields. A poor filtering capacity is a major management concern in areas of the Rubicon and Graycalm soils. The slope is an additional concern in the steeper areas of the association.

5. Emmet-Onaway-Omena Association

Nearly level to hilly, well drained and moderately well drained, loamy soils on drumlins and ground moraines

The slope of the major soils in this association ranges from 0 to 25 percent. These soils are on elongated or oval hills, ridges, and gently rolling plains.

This association makes up about 12 percent of the county. It is about 30 percent Emmet and similar soils, 25 percent Onaway soils, 25 percent Omena soils, and 20 percent soils of minor extent (fig. 2).

The Emmet soils are well drained and moderately well drained. Typically, they have a surface layer of dark brown sandy loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of about 60 inches is light reddish brown sandy loam.

The Onaway soils are well drained and moderately well drained. Typically, they have a surface layer of

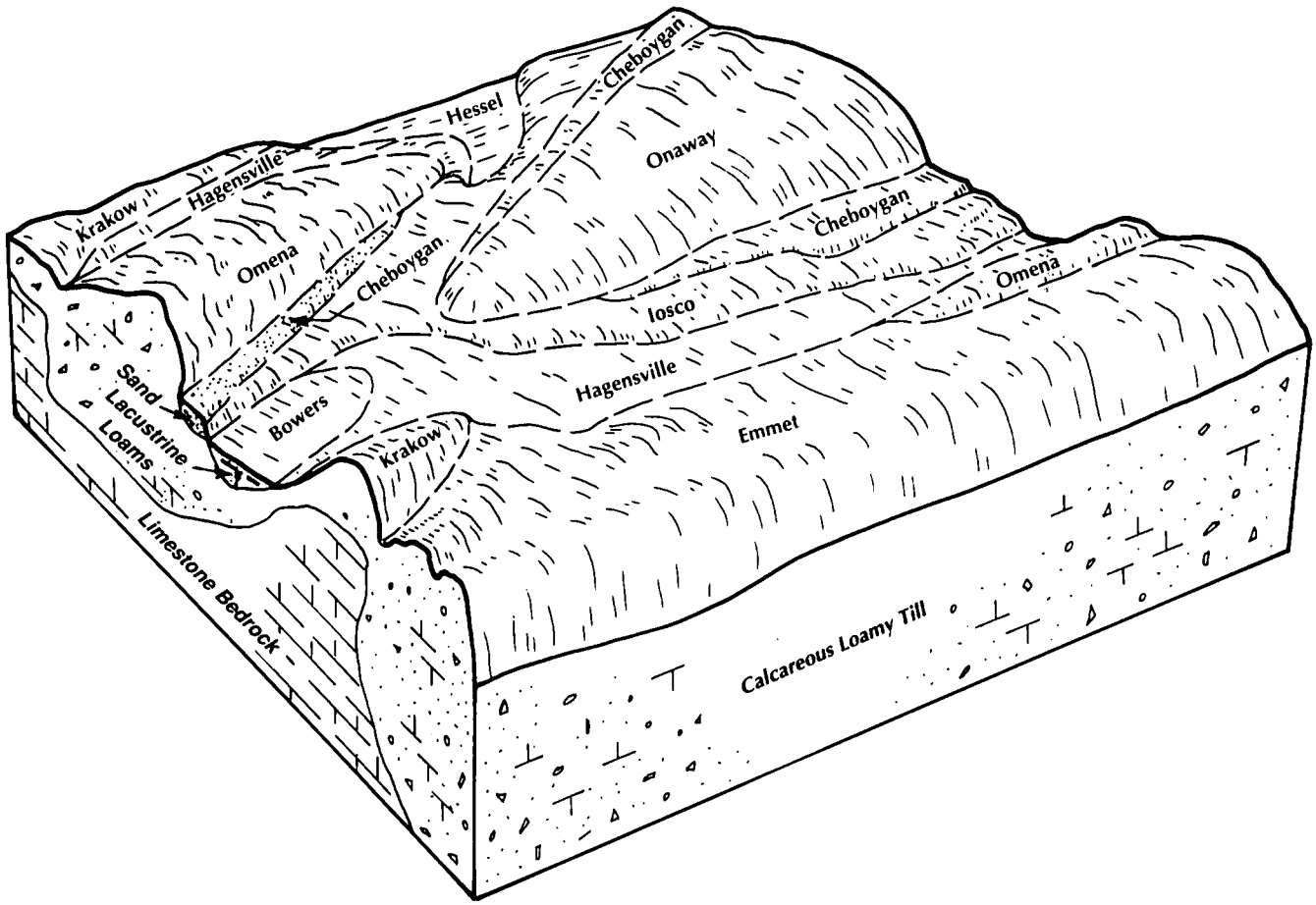

Figure 2.—Typical pattern of soils and parent material in the Emmet-Onaway-Omena association.

very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam.

The Omena soils are well drained. Typically, they have a surface layer of dark brown fine sandy loam about 8 inches thick. The subsoil is sandy loam about 5 inches thick. The upper part is strong brown and firm. The lower part is dark yellowish brown and friable. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam.

Minor in this association are the Hagensville, Iosco, Alstad, Bowers, Cheboygan, Krakow, and Hessel soils. The somewhat poorly drained Hagensville, Iosco, Alstad, and Bowers soils are between the drumlins and on foot slopes in the sloping to hilly areas. The well drained Cheboygan and Krakow soils are on knolls and ridges. The poorly drained Hessel soils are in swales and low areas.

Most areas of this association are used as cropland or pasture. Some of the acreage is used as woodland or is idle land.

The soils in this association are generally well suited to woodland, depending on the slope. The equipment limitation and the erosion hazard are the major management concerns.

The soils in this association are well suited, moderately well suited, poorly suited, or unsuited to pasture and cropland, depending on the slope. Water erosion is a major management concern in the cropped areas.

The soils in this association are well suited, moderately well suited, poorly suited, or unsuited to building site development and septic tank absorption fields, depending on the slope. The moderately well drained areas of Emmet and Onaway soils have additional limitations for septic tank absorption fields.

6. Krakow-Cunard Association

Nearly level to rolling, well drained, loamy soils on ground moraines, drumlins, glacial lake benches, and terraces

The slope of the major soils in this association ranges from 0 to 18 percent. The Krakow soils are on nearly level to rolling plains, knolls, and ridges. The Cunard soils are on knolls, ridges, and plains underlain by limestone bedrock. The Detour soils are in depressions, in drainageways, and on low flats.

This association makes up 8 percent of the county. It is 55 percent Krakow and similar soils, 20 percent Cunard and similar soils, and 25 percent soils of minor extent.

Typically, the Krakow soils have a surface layer of dark grayish brown flaggy fine sandy loam about 2 inches thick. The subsurface layer is yellowish brown flaggy fine sandy loam about 9 inches thick. The subsoil is dark reddish brown, firm very flaggy clay loam about 5 inches thick. The substratum to a depth of about 60 inches is dark brown and brown very flaggy loam. In places limestone bedrock is below a depth of 40 inches.

Typically, the Cunard soils have a surface layer of very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is pale brown and yellowish brown, friable sandy loam. The next part is yellowish brown and brown, friable sandy loam. The lower part is dark brown, friable loam. The substratum is pale brown fine sandy loam. Limestone bedrock is at a depth of about 25 inches.

Minor in this association are the Hessel, Omena, Onaway, Cathro, and Hagensville soils. The poorly drained, flaggy Hessel soils are in swales, depressions, and drainageways. The well drained Omena and Onaway soils are in landscape positions similar to those of the Krakow soils. The very poorly drained Cathro soils are in depression and swales. The somewhat poorly drained Hagensville soils are in slight depressions and on flats.

Most areas of this association are used as cropland or pasture. Some of the acreage is used as woodland or is idle land.

The soils in this association are generally suited to woodland. The equipment limitation and the windthrow hazard are the major management concerns.

The soils in this association are moderately well suited, poorly suited, or unsuited to cropland and pasture. Flagginess and the hazard of water erosion are the major management concerns.

The soils in this association are moderately well suited or poorly suited to building site development. Flagginess and the slope are management concerns in areas of the Krakow soils. The depth to bedrock and the slope are management concerns in areas of the Cunard soils.

7. Moltke-Grace-Glawe Association

Nearly level to undulating, well drained to poorly drained, loamy soils on lake plains, outwash plains, and deltas

The slope of the major soils in this association ranges from 0 to 6 percent. The Moltke soils are on low flats, on stream terraces, and in slight depressions and drainageways. The Grace soils are on nearly level to undulating upland plains. The Glawe soils are in swales, depressions, and drainageways.

This association makes up about 2 percent of the county. It is about 40 percent Moltke and similar soils, 30 percent Grace and similar soils, 20 percent Glawe soils, and 10 percent soils of minor extent.

The Moltke soils are somewhat poorly drained. Typically, they have a surface layer of dark brown very fine sandy loam about 4 inches thick. The subsurface layer is light brownish gray loamy very fine sand about 5 inches thick. The subsoil is about 24 inches thick. It is mottled. The upper part is mixed pale brown loamy very fine sand and dark brown, firm very fine sandy loam. The next part is brown, firm very fine sandy loam. The lower part is yellowish brown, friable very fine sandy loam. The substratum to a depth of about 60 inches is light yellowish brown, mottled, stratified very fine sandy loam and loamy very fine sand.

The Grace soils are well drained and moderately well drained. Typically, they have a surface layer of very dark grayish brown very fine sandy loam about 9 inches thick. The subsoil is 27 inches thick. The upper part is dark yellowish brown, friable very fine sandy loam surrounded by pale brown loamy very fine sand. The next part is brown, friable very fine sandy loam. The lower part is brown and light yellowish brown, friable very fine sandy loam. The substratum to a depth of about 60 inches is light brown, stratified very fine sandy loam and loamy very fine sand.

The Glawe soils are poorly drained. Typically, they have a surface layer of black mucky very fine sandy loam about 10 inches thick. The substratum extends to a depth of 60 inches or more. It is mottled. The upper part is gray loamy very fine sand. The next part is light brownish gray very fine sandy loam. The lower part is pale brown, stratified silt loam, very fine sandy loam, and loamy very fine sand.

Minor in this association are the Ocqueoc, Bowers, Ingalls, and Burleigh soils and the Croswell soils that have a loamy substratum. The well drained Ocqueoc and moderately well drained Croswell soils are on

sandy knolls, rises, and low ridges. The somewhat poorly drained Bowers and Ingalls soils are in landscape positions similar to those of the Moltke soils. The poorly drained Burleigh soils are in landscape positions similar to those of the Glawe soils.

Most areas of this association are used as cropland or pasture. Some of the acreage is used as woodland or is idle land.

The soils in this association are generally suited to woodland. The equipment limitation and the windthrow hazard are the major management concerns.

The soils in this association are well suited, moderately well suited, or poorly suited to cropland and pasture, depending on drainage. Excess water and the hazard of soil blowing are major management concerns. Water erosion is a hazard in the undulating areas of Grace soils.

The soils in this association are moderately well suited, poorly suited, or unsuited to building site development and septic tank absorption fields, depending on drainage. Excess water and restricted permeability are the major management concerns.

8. Cheboygan-Emmet-Onaway Association

Nearly level to very hilly, well drained and moderately well drained, sandy and loamy soils on drumlins, ground moraines, and till plains

The slope of the major soils in this association ranges from 0 to 35 percent. These soils are on elongated or oval hills, ridges, and gently rolling plains.

This association makes up 8 percent of the county. It is about 45 percent Cheboygan soils, 15 percent Emmet soils, 15 percent Onaway soils, and 25 percent soils of minor extent.

The Cheboygan soils are well drained. Typically, they have a surface layer of black loamy sand about 5 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown and strong brown, very friable loamy sand that has a few chunks of cemented material. The lower part is reddish brown, friable sandy loam and brown, friable loamy sand. The substratum to a depth of about 60 inches is light brown sandy loam.

The Emmet soils are well drained and moderately well drained. Typically, they have a surface layer of dark brown sandy loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of about 60 inches is light reddish brown sandy loam.

The Onaway soils are well drained and moderately well drained. Typically, they have a surface layer of very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam.

Minor in this association are the Klacking, Omena, Graycalm, Kalkaska, Iosco, and Hagensville soils. The well drained Klacking and Omena soils are in landscape positions similar to those of the major soils. The somewhat excessively drained Graycalm and Kalkaska soils are on side slopes, hills, and ridges. The somewhat poorly drained Iosco and Hagensville soils are in depressions and drainageways.

Most areas of this association are used as cropland or pasture. Some of the acreage is used as woodland or is idle land. Most of the nearly level to gently rolling areas are used as cropland. The rolling or hilly areas are used mainly as pasture or are wooded.

The soils in this association are generally suited to woodland, depending on the slope. The erosion hazard and the equipment limitation are the major management concerns.

The soils in this association are well suited, moderately well suited, poorly suited, or unsuited to cropland and pasture, depending on the slope. Water erosion is a major hazard in the cropped areas. Wind erosion is a hazard in areas of the Cheboygan soils.

The soils in this association are well suited, moderately well suited, poorly suited, or unsuited to building site development and septic tank absorption fields, depending on the slope. Restricted permeability is a limitation in areas of the Onaway soils. Excess water is a management concern if the moderately well drained areas of the association are used as sites for septic tank absorption fields.

9. Croswell-Pinconning-Hettinger Association

Nearly level and gently undulating, moderately well drained and poorly drained, sandy and loamy soils on lake plains, outwash plains, beach ridges, and terraces

The slope of the major soils in this association ranges from 0 to 3 percent. The Pinconning and Hettinger soils are on broad, flat plains, in swales, and in drainageways. The Croswell soils are on slight rises, knolls, and the slightly higher flats.

This association makes up 13 percent of the county. It is about 35 percent Croswell and similar soils, 20 percent Pinconning and similar soils, 20 percent

Hettinger and similar soils, and 25 percent soils of minor extent.

The Croswell soils are moderately well drained. Typically, they have about 1 inch of partially decomposed forest litter on the surface. The surface layer is very dark grayish brown sand about 4 inches thick. The subsurface layer is grayish brown sand about 6 inches thick. The subsoil is very friable sand about 23 inches thick. The upper part is strong brown, the next part is yellowish brown and mottled, and the lower part is brownish yellow and mottled. The substratum to a depth of about 60 inches is light yellowish brown, mottled sand.

The Pinconning soils are poorly drained. Typically, they have a surface layer of black mucky sand about 8 inches thick. The upper part of the substratum is grayish brown, brown, and dark grayish brown, mottled sand. The lower part to a depth of about 60 inches is brown, mottled silty clay loam.

The Hettinger soils are poorly drained. Typically, they have a surface layer of very dark gray loam about 7 inches thick. The subsoil is about 19 inches thick. It is mottled. The upper part is grayish brown, firm silty clay loam. The lower part is light brownish gray, firm silt loam. The substratum to a depth of about 60 inches is light brown, stratified silt loam, silty clay loam, and very fine sandy loam.

Minor in this association are the well drained Menominee and Wallace soils, the somewhat poorly drained Bowers and Allendale soils, the moderately well drained Croswell soils that have a loamy substratum, and the somewhat poorly drained Au Gres soils that have a loamy substratum. Menominee soils are on uplands. Wallace soils are on ridges. The Croswell soils that have a loamy substratum are on rises and low ridges. Bowers, Allendale, and Au Gres soils are in landscape positions between those of the Croswell soils and the Hettinger or Pinconning soils.

Most areas of this association are used as woodland. Some of the acreage is used as cropland or pasture or is idle land.

The soils in this association are generally suited to woodland. The equipment limitation and the windthrow hazard are the major management concerns. Seedling mortality is an additional concern in areas of the Pinconning and Hettinger soils.

The soils in this association are moderately well suited or poorly suited to cropland and pasture, depending on drainage. Excess water and the hazard of soil blowing are management concerns in areas of the Pinconning and Croswell soils. Excess water is the major management concern in areas of the Hettinger soils.

The soils in this association are poorly suited or unsuited to building site development and septic tank absorption fields. Excess water and restricted permeability are the major management concerns.

10. Au Gres-Roscommon Association

Nearly level and very gently sloping, somewhat poorly drained and poorly drained, sandy soils on outwash plains, lake plains, and till plains

The slope of the major soils in this association ranges from 0 to 3 percent. The Au Gres soils are on flats, slight rises, and low knolls. The Roscommon soils are in swales, on low flats, and in depressions and drainageways.

This association makes up 5 percent of the county. It is about 40 percent Au Gres soils, 40 percent Roscommon soils, and 20 percent soils of minor extent.

The Au Gres soils are somewhat poorly drained. Typically, they have a surface layer of light brownish gray sand about 4 inches thick under a black mat of partially decomposed forest litter. The subsoil is about 26 inches thick. It is mottled. The upper part is dark reddish brown, very friable loamy sand. The lower part is yellowish brown, loose sand. The substratum to a depth of about 60 inches is yellowish brown sand.

The Roscommon soils are poorly drained. Typically, they have a surface layer of black muck about 4 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, brown, and pale brown, mottled sand.

Minor in this association are the excessively drained Rubicon soils; the moderately well drained Croswell soils; the very poorly drained, organic Tawas and Dawson soils; and the poorly drained Evart soils. Rubicon soils are on ridges and uplands. Croswell soils are slightly higher on the landscape than the Au Gres soils. Tawas and Dawson soils are in depressions and swales. Evart soils are along streams and rivers.

Most areas of this association are used as woodland. Some of the acreage is used for wildlife habitat or recreational areas or is idle land.

The soils in this association are generally well suited to woodland. The equipment limitation, seedling mortality, and the windthrow hazard are major management concerns.

The soils in this association are poorly suited to cropland and pasture. Droughtiness and the hazard of soil blowing are major management concerns if these soils are used as cropland or pasture. Wetness is an additional management concern in areas that are not adequately drained.

The soils in this association are poorly suited or

unsuited to building site development and septic tank absorption fields. Excess water and a poor filtering capacity are the major management concerns.

11. Cathro-Lupton-Tawas Association

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

The slope of the major soils in this association ranges from 0 to 2 percent. These soils are in depressions, drainageways, bogs, and swamps.

This association makes up 9 percent of the county. It is about 35 percent Cathro soils, 30 percent Lupton soils, 25 percent Tawas soils, and 10 percent soils of minor extent.

Typically, the Cathro soils have a surface layer of black muck about 6 inches thick. The next 28 inches is very dark brown and black muck. The substratum to a depth of about 60 inches is grayish brown silty clay loam.

Typically, the Lupton soils have a surface layer of black muck about 5 inches thick. Below this to a depth of about 60 inches is black, very dark brown, and very dark grayish brown muck.

Typically, the Tawas soils have a surface layer of black muck about 8 inches thick. The next 10 inches also is black muck. The substratum to a depth of about 60 inches is sand. It is pale brown in the upper part and dark reddish brown in the lower part.

Minor in this association are the poorly drained Pinconning and Roscommon soils in the slightly higher landscape positions and the somewhat poorly drained Au Gres and Bowers soils on low knolls, ridges, and nearly level uplands. In some areas the Au Gres soils have a loamy substratum.

Most areas of this association are used as woodland. A small acreage is used as pasture or is idle land. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns in the wooded areas.

The soils in this association are unsuited to cropland and pasture and to building site development and septic tank absorption fields.

Broad Land Use Considerations

The soils of Presque Isle County vary widely in texture, drainage, and slope. The general soil map is helpful in identifying broad areas that can be developed for residential, agricultural, recreational, and other uses. It cannot be used, however, in the selection of sites for specific structures or specific crops.

Soils that are severely limited as sites for residential and other urban developments are extensive in the survey area. The soils in associations 1, 9, and 10 and in most areas of association 11 are severely limited for these uses because they have a seasonal high water table. The soils in the rolling to steep areas of associations 2, 4, 5, and 8 are severely limited because of the slope. The soils in associations 3 and 6 are severely limited because of the depth to bedrock.

Soils that are suited to urban development include those in the less sloping areas of associations 5 and 8, the well drained areas of association 7, and the areas of associations 3 and 6 that are deep over bedrock. Most of these soils, however, are either prime farmland or farmland of local importance. This fact should not be overlooked when broad land use decisions are made.

Soils in the gently sloping or level areas of associations 5 and 8 and the well drained and moderately well drained areas of association 7 are well suited to general farming. Krakow soils in association 6 are well suited to general farming if the flagginess is overcome. Moltke and Glawe soils in association 7 are well suited to farming if the wetness is overcome.

The soils in the county range from well suited to poorly suited to woodland. Northern hardwoods, such as sugar maple, beech, yellow birch, and ash, are in associations 5 and 8 and parts of associations 4, 6, and 7. Aspen and pine forests are in associations 2 and 4. Balsam, cedar, aspen, and spruce are in associations 1, 3, 9, and 10 and parts of association 6. The organic soils in association 11 generally have forests of cedar, balsam, and spruce. Some aspen, white birch, red maple, and tamarack are in areas where the soils are more acid. Areas near Lake Huron and Black Lake have forests of white birch, balsam, striped maple, and cedar, and some support northern hardwoods.

The soils in associations 2 and 4 are suited to recreational development. Most of these soils are along Lake Huron and the many inland lakes and have been developed for use as residential areas or summer homes and cottages. Hunting camps are in many areas of marginal land throughout the county. Deer, bear, rabbits, grouse, and squirrel are a few of the many game species hunted for food and recreation. The slope is a limitation for many recreational uses in some areas in the uplands.

Many of the soils in the survey area are suited to habitat for wetland wildlife. The organic soils and the poorly drained mineral soils provide habitat for many species, such as ducks, beaver, and muskrat. They also are well suited to use as nature study areas.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Onaway fine sandy loam, 2 to 6 percent slopes, is a phase of the Onaway series.

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

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Au Gres-Roscommon complex, 0 to 3 percent slopes, is an example.

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

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

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

Some of the boundaries on the detailed soil maps of Presque Isle County do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences are the result of modifications or refinements in soil series concepts and variations in the intensity of mapping or in the extent of the soils in the survey areas.

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

Soil Descriptions

2—Lupton muck. This very deep, nearly level, very poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 1,000 acres in size.

Typically, the surface layer is black muck about 5

inches thick. The rest of the soil to a depth of 60 inches is black, very dark brown, and very dark grayish brown muck.

Included with this soil in mapping are small areas of the very poorly drained Tawas and Cathro soils. Tawas soils are underlain by sand within a depth of 51 inches. Cathro soils are underlain by loamy material within a depth of 51 inches. Both soils are in landscape positions similar to those of the Lupton soil. They make up 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the Lupton soil. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from early fall through spring and during other extremely wet periods.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of low strength, ordinary crawler tractors and rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment is needed. The equipment can be used during periods in winter when access roads are frozen. Because of the wetness, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

Because of subsidence, ponding, and low strength, this soil is unsuited to building site development.

The land capability classification is VIw; the woodland ordination symbol is 2W; the Michigan soil management group is Mc.

3—Tawas muck. This very deep, nearly level, very poorly drained soil is in depressions, on low flats, and in drainageways. It is subject to ponding. Individual areas are irregular in shape or long and narrow and range from 5 to 200 acres in size.

Typically, the surface layer is black muck about 8 inches thick. The next 10 inches also is black muck. The substratum to a depth of 60 inches is sand. It is pale brown in the upper part and dark reddish brown in the lower part. In places the substratum has strata of loamy sand, loamy fine sand, or finer textured material.

Included with this soil in mapping are small areas of Roscommon and Lupton soils. Roscommon soils are poorly drained. They have organic layers less than 6 inches thick. Lupton soils are very poorly drained. They have organic layers 51 or more inches thick. Both soils are in landscape positions similar to those of the Tawas soil. They make up 5 to 10 percent of the map unit.

Permeability is moderately slow to moderately rapid in the mucky layers of the Tawas soil and rapid in the underlying sand. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of low strength, ordinary crawler tractors and rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment is needed. The equipment can be used during periods in winter when access roads are frozen. Because of the wetness, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, severe seedling mortality, and plant competition, trees are not planted on this soil.

Because of subsidence, ponding, and low strength, this soil is unsuited to building site development.

The land capability classification is VIw; the woodland ordination symbol is 5W; the Michigan soil management group is M/4c.

4B—Klacking sand, 0 to 6 percent slopes. This very deep, nearly level to gently sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark gray sand about 2 inches thick. The subsurface layer is light brownish gray sand about 3 inches thick. The upper part of the subsoil is yellowish brown, very friable sand about 13 inches thick. The next part is about 26 inches of very pale brown, very friable fine sand and very pale brown, friable loamy fine sand that has bands of brown fine sandy loam. The lower part of the subsoil is dark brown, friable fine sandy loam about 4 inches thick. The substratum to a depth of 60 inches is pale brown, loose sand.

Included with this soil in mapping are small areas of the Croswell soils that have a loamy substratum and small areas of Graycalm and Cheboygan soils. Croswell

Figure 3.—A farmed area of Klacking sand, 0 to 6 percent slopes. Onaway fine sandy loam, 12 to 18 percent slopes, is on the drumlin in the background.

soils are moderately well drained and are in low depressions. Graycalm soils are somewhat excessively drained. They have fewer bands in the subsoil than the Klacking soil. Cheboygan soils are well drained. They have a loamy substratum. Graycalm and Cheboygan soils are in landscape positions similar to those of the Klacking soil. Included soils make up 1 to 10 percent of the map unit.

Permeability is moderately rapid in the Klacking soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. A few are used as cropland (fig. 3).

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is fairly well suited to cropland and pasture. Soil blowing is a hazard in the areas used as cropland. Droughtiness also is a management concern. Conservation tillage, windbreaks, incorporation of crop residue into the soil, and cover crops help to control soil blowing and conserve moisture.

This soil is well suited to building site development and septic tank absorption fields.

The land capability classification is IIIs; the woodland ordination symbol is 6S; the Michigan soil management group is 4a.

4C—Klacking sand, 6 to 12 percent slopes. This very deep, gently rolling, well drained soil is on knolls, ridges, and side slopes. Individual areas are irregular in shape and range from 7 to 100 acres in size.

Typically, the surface layer is very dark gray sand about 2 inches thick. The subsurface layer is light brownish sand about 3 inches thick. The upper part of the subsoil is yellowish brown, very friable sand about 13 inches thick. The next 26 inches is very pale brown, very friable fine sand and very pale brown, friable loamy fine sand that has bands of brown fine sandy loam. The lower part of the subsoil is dark brown, friable fine sandy loam about 4 inches thick. The substratum to a depth of 60 inches is pale brown, loose sand.

Included with this soil in mapping are small areas of Rubicon, Graycalm, and Cheboygan soils. Rubicon soils are excessively drained. They are sandy throughout. Graycalm soils are somewhat excessively drained. They have fewer bands in the subsoil than the Klacking soil. Cheboygan soils are well drained. They have a loamy

substratum. All of the included soils are in landscape positions similar to those of the Klacking soil. They make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the Klacking soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Landings can be established in small nearly level areas, if any are available. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is fairly well suited to cropland and pasture. Water erosion and soil blowing are hazards in the areas used as cropland. Droughtiness also is a management concern. Crop rotations that include grasses or legumes, stripcropping, and grassed waterways can be effective in controlling water erosion. Conservation tillage, windbreaks, incorporation of crop residue into the soil, and cover crops help to control soil blowing and conserve moisture.

This soil is fairly well suited to building site development. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The soil is only moderately well suited to septic tank absorption fields because of the slope. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IIIe; the woodland ordination symbol is 6S; the Michigan soil management group is 4a.

5B—Rubicon sand, 0 to 8 percent slopes. This very deep, nearly level to gently rolling, excessively drained soil is on uplands. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is brown, strong brown, and brownish yellow, very friable sand about 22 inches thick. The substratum to a depth of 60 inches is very pale brown sand. In places the upper part of the subsoil is weakly cemented. In some areas strata of gravelly sand are below a depth of 40 inches.

Included with this soil in mapping are small areas of Grayling, Croswell, and Au Gres soils. Grayling soils have a subsoil that is lighter colored than that of the Rubicon soil. They are in landscape positions similar to those of the Rubicon soil. Croswell soils are moderately well drained and are in low depressions. Au Gres soils are somewhat poorly drained and are in low depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Rubicon soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is generally unsuited to cropland and pasture because of droughtiness and soil blowing. If good management is applied, however, some crops can be grown. The best suited crops are those that are tolerant of drought. The supply of available moisture is not adequate for other crops. A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture and controlling soil blowing.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 4S; the Michigan soil management group is 5.3a.

5C—Rubicon sand, 8 to 15 percent slopes. This very deep, gently rolling or rolling, excessively drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape and range from about 3 to nearly 100 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is brown, strong brown, and brownish yellow, very friable sand about 22 inches thick. The substratum to a depth of 60 inches is very

pale brown sand. In places the upper part of the subsoil is weakly cemented. In some areas strata of gravelly sand are below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat excessively drained Graycalm soils. These soils have thin bands of loamy sand in the subsoil. They are in landscape positions similar to those of the Rubicon soil. They make up 1 to 15 percent of the map unit.

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

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is generally unsuited to cropland because of droughtiness and soil blowing. If good management is applied, however, some crops can be grown. The best suited crops are those that are tolerant of drought. The supply of available moisture is not adequate for other crops. A system of conservation tillage that leaves crop residue on the surface is effective in conserving moisture and controlling soil blowing.

This soil is only moderately well suited to building site development because of the slope. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling may be necessary in some areas. The soil is poorly suited to septic tank absorption fields because of poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 4S; the Michigan soil management group is 5.3a.

5E—Rubicon sand, 15 to 35 percent slopes. This very deep, rolling to steep, excessively drained soil is on hills, ridges, and side slopes. Individual areas are irregular in shape and range from 3 to 80 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is brown sand about 4 inches thick. The subsoil is brown, strong brown, and brownish yellow, very friable sand about 22 inches thick. The substratum to a depth of 60 inches is very pale brown sand. In places the upper part of the subsoil is weakly cemented. In some areas strata of gravelly sand are below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat excessively drained Graycalm soils. These soils have thin bands of loamy sand in the subsoil. They are in landscape positions similar to those of the Rubicon soil. They make up 5 to 15 percent of the map unit.

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

Because of the slope, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the erosion hazard, the equipment limitation, and seedling mortality. The slope limits the selection of sites for logging roads and landings. Erosion can result from the concentration of runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. Loose sand and the slope can interfere with the traction of wheeled equipment. As a result, logging roads should be built on the contour or on the gentler slopes. Because of droughtiness, seedling losses can be as high as 25 to 50 percent, especially on southern exposures. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. The slope can hinder the use of planting equipment.

This soil is unsuited to building site development and septic tank absorption fields because of the slope. Overcoming this limitation is difficult. A poor filtering capacity is an additional limitation on sites for septic tank absorption fields.

The land capability classification is VIIs; the woodland ordination symbol is 4R; the Michigan soil management group is 5.3a.

6B—Alpena very gravelly sandy loam, 0 to 8 percent slopes. This very deep, nearly level to gently rolling, excessively drained soil is on low narrow ridges and broad flats. Individual areas are irregular in shape or long and narrow and range from 3 to more than 150 acres in size.

Typically, the surface layer is dark brown very gravelly sandy loam about 8 inches thick. The substratum to a depth of 60 inches is brown and pale brown very gravelly sand. In some places the surface layer is loamy sand. In other places it is cobbly or

stony. In some areas limestone channers are throughout the profile.

Included with this soil in mapping are small areas of Esau and Kiva soils. Esau soils are somewhat poorly drained and are in depressions and drainageways. Kiva soils have a loamy mantle that is thicker than that of the Alpena soil. They are in landscape positions similar to those of the Alpena soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is very rapid in the Alpena soil. The available water capacity is very low. Surface runoff is slow.

Because of excess gravel and droughtiness, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Because of droughtiness, seedling losses can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. The excess gravel can hinder the use of planting equipment.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 3F; the Michigan soil management group is Ga.

6C—Alpena very gravelly sandy loam, 8 to 15 percent slopes. This very deep, moderately sloping and rolling, excessively drained soil is on beach ridges, knolls, and side slopes. Individual areas are long and narrow and range from 3 to more than 100 acres in size.

Typically, the surface layer is dark brown very gravelly sandy loam about 8 inches thick. The substratum to a depth of 60 inches is brown and pale brown very gravelly sand. In some places the surface layer is loamy sand. In other places the surface layers are cobbly or stony. In some areas limestone channers are throughout the profile.

Included with this soil in mapping are small areas of Esau and Kiva soils. Esau soils are somewhat poorly drained and are in depressions and drainageways. Kiva soils are loamy to a greater depth than the Alpena soil. They are in landscape positions similar to those of the Alpena soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is very rapid in the Alpena soil. The available water capacity is very low. Surface runoff is slow.

Because of the slope, excess gravel, and droughtiness, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Because of droughtiness, seedling losses can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. The excess gravel can hinder the use of planting equipment.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling may be necessary in some areas. The soil is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 3F; the Michigan soil management group is Ga.

7A—Emmet sandy loam, moderately wet, 0 to 2 percent slopes. This very deep, nearly level, moderately well drained soil is on upland flats. Individual areas are irregular in shape or long and narrow and range from 5 to 80 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of 60 inches is light reddish brown, mottled sandy loam.

Included with this soil in mapping are small areas of Hagensville, Cheboygan, and Onaway soils. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Cheboygan soils are well drained. They are coarser textured in the upper part than the Emmet soil. Onaway soils are finer textured in the subsoil than the Emmet soil. Cheboygan and Onaway soils are in landscape positions similar to those of the Emmet soil. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 6.0 feet from late fall to early spring.

Most areas are used as cropland. Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and

plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cultivated crops and hay. The major management needs are measures that conserve moisture. Examples are returning crop residue to the soil and applying a system of conservation tillage that leaves crop residue on the surface.

This soil is moderately well suited to building site development. The wetness is a limitation on sites for dwellings with basements. These dwellings can be constructed on well compacted fill material, which raises the site above the level of wetness. Also, a subsurface drainage system can be installed to lower the seasonal high water table. The soil is poorly suited to septic tank absorption fields because of the wetness. Special construction methods, such as filling or mounding with suitable material, are needed to raise the absorption field above the seasonal high water table.

The land capability classification is IIs; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

7B—Emmet sandy loam, 2 to 6 percent slopes. This very deep, nearly level to undulating, well drained soil is on uplands. Individual areas are irregular in shape or long and narrow and range from 3 to 100 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of 60 inches is light reddish brown sandy loam.

Included with this soil in mapping are small areas of Hagensville, Cheboygan, and Onaway soils. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Cheboygan soils are well drained. They are coarser textured in the upper part than the Emmet soil. Onaway soils are finer textured in the subsoil than the Emmet soil. Cheboygan and Onaway soils are in landscape positions similar to those of the Emmet soil. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is medium.

Most areas are used as cropland (fig. 4). Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cultivated crops and hay. The major management needs are measures that control water erosion and conserve moisture. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Returning crop residue to the soil or applying a system of conservation tillage that leaves crop residue on the surface can be effective in conserving moisture.

This soil is well suited to building site development. It is only moderately well suited to septic tank absorption fields because of the moderate permeability. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

The land capability classification is IIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

7C—Emmet sandy loam, 6 to 12 percent slopes. This very deep, gently rolling, well drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to 70 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 24 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of 60 inches is light reddish brown sandy loam.

Included with this soil in mapping are small areas of Onaway and Cheboygan soils. Onaway soils are finer textured in the subsoil than the Emmet soil, and Cheboygan soils are coarser textured in the upper part. Both soils are in landscape positions similar to those of the Emmet soil. They make up 10 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is medium.

Figure 4.—No-till corn in an area of Emmet sandy loam, 2 to 6 percent slopes.

Most areas are used as cropland. Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cultivated crops and hay. The major management needs are measures that control water erosion and conserve moisture. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Returning crop residue to the soil or applying a system of conservation tillage that leaves crop residue on the surface can be effective in conserving moisture.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The soil is only moderately well suited to septic tank absorption fields because of the moderate permeability and the slope. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IIIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

7C2—Emmet sandy loam, 6 to 12 percent slopes, eroded. This very deep, gently rolling, well drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from about 5 to 50 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 20 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of 60 inches is light reddish brown sandy loam.

Included with this soil in mapping are small areas of Onaway and Cheboygan soils. Onaway soils are finer textured in the subsoil than the Emmet soil, and Cheboygan soils are coarser textured in the upper part. Both soils are in landscape positions similar to those of the Emmet soil. They make up 10 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is medium.

This soil is used as cropland. It is poorly suited to cultivated crops because of the slope and the loss of nutrients and organic matter resulting from past erosion. If the soil is cultivated, the major management needs are measures that control water erosion, increase the organic matter content, and conserve moisture. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Returning crop residue to the soil or applying a system of conservation tillage that leaves crop residue on the surface can be effective in conserving moisture. Adding organic material increases the organic matter content and the available water capacity.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling may be necessary in some areas. The soil is only moderately well suited to septic tank absorption fields because of the moderate permeability and the slope. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IIIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

7D—Emmet sandy loam, 12 to 18 percent slopes. This very deep, rolling, well drained soil is on ridges, high knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from about 3 to 30 acres in size.

Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of 60 inches is light reddish brown sandy loam.

Included with this soil in mapping are small areas of Onaway and Cheboygan soils. Onaway soils are finer textured in the subsoil than the Emmet soil, and Cheboygan soils are coarser textured in the upper part. Both soils are in landscape positions similar to those of the Emmet soil. Also included are small areas of eroded soils. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is rapid.

Most areas are used as woodland. This soil is poorly suited to cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. The slope limits the availability of sites for landings. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cultivated crops because of the slope. The major management needs are measures that control water erosion and conserve moisture. A cropping sequence that includes grasses and legumes, conservation tillage, and grassed

waterways can be effective in controlling water erosion in areas used for row crops. Returning crop residue to the soil or applying a system of conservation tillage that leaves crop residue on the surface can be effective in conserving soil moisture.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling may be necessary in some areas. The soil is only moderately well suited to septic tank absorption fields because of the moderate permeability and the slope. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IVe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

7E—Emmet sandy loam, 18 to 25 percent slopes. This very deep, hilly, well drained soil is on side slopes. Individual areas are long and narrow and range from about 3 to 20 acres in size.

Typically, the surface layer is dark brown sandy loam about 5 inches thick. The subsoil is about 22 inches thick. The upper part is reddish brown, friable sandy loam. The next part is brown, very friable loamy sand and strong brown, friable sandy loam. The lower part is reddish brown, firm sandy loam. The substratum to a depth of 60 inches is light reddish brown sandy loam.

Included with this soil in mapping are small areas of Onaway and Cheboygan soils. Onaway soils are finer textured in the subsoil than the Emmet soil, and Cheboygan soils are coarser textured in the upper part. Both soils are in landscape positions similar to those of the Emmet soil. They make up 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Emmet soil. Surface runoff is rapid.

Because of the slope, this soil is unsuited to cropland and building site development.

This soil is used as woodland. The erosion hazard, the equipment limitation, and plant competition are management concerns. Erosion can result from the concentration of runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. The slope can interfere with the traction of wheeled equipment. As a result, skid roads should be built on the contour or on the gentler slopes. The slope limits the selection of sites for logging roads and landings. It can hinder the use of planting equipment. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

The land capability classification is VIe; the woodland ordination symbol is 3R; the Michigan soil management group is 3a.

8A—Onaway fine sandy loam, moderately wet, 0 to 2 percent slopes. This very deep, nearly level, moderately well drained soil is on upland flats. Individual areas are irregular in shape and range from 5 to nearly 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown, mottled gravelly sandy loam.

Included with this soil in mapping are small areas of Hagensville, Omena, and Emmet soils. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Omena and Emmet soils are in landscape positions similar to those of the Onaway soil. They are coarser textured in the subsoil than the Onaway soil. Also, Omena soils have a thinner subsoil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 6.0 feet from late fall to early spring.

Most areas are used as cropland. Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cultivated crops and hay. The major management concern is compaction. Working the soil when it is too wet results in cloddiness and compaction, which inhibit root growth and alter the natural soil structure. Minimizing tillage and maintaining

the proper moisture content when tilling and harvesting can help to prevent excessive compaction.

This soil is well suited to buildings without basements and moderately well suited to buildings with basements. The wetness is the main limitation on sites for dwellings with basements. These dwellings can be constructed on well compacted fill material, which raises the site above the level of wetness. Also, a subsurface drainage system can be installed to lower the seasonal high water table. The soil is poorly suited to septic tank absorption fields because of the wetness and the moderately slow permeability. Special construction methods, such as filling or mounding with suitable material, are needed to raise the absorption field above the seasonal high water table. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

The land capability classification is IIs; the woodland ordination symbol is 3L; the Michigan soil management group is 2.5a.

8B—Onaway fine sandy loam, 2 to 6 percent slopes. This very deep, gently undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 3 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Hagensville, Omena, and Emmet soils. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Omena and Emmet soils are in landscape positions similar to those of the Onaway soil. They are coarser textured in the subsoil than the Onaway soil. Also, Omena soils have a thinner subsoil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is moderate. Surface runoff is medium.

Most areas are used as cropland. Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cultivated crops and hay. The major management needs are measures that control water erosion and help to prevent compaction. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Working the soil when it is too wet results in cloddiness and compaction, which inhibit root growth and alter the natural soil structure. Minimizing tillage and maintaining proper moisture content when tilling and harvesting can help to prevent excessive compaction.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the moderately slow permeability. Enlarging or pressurizing the absorption field helps to overcome the restricted permeability.

The land capability classification is IIe; the woodland ordination symbol is 3L; the Michigan soil management group is 2.5a.

8C—Onaway fine sandy loam, 6 to 12 percent slopes. This very deep, gently rolling, well drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Omena and Cheboygan soils. Omena soils have a thinner and coarser textured subsoil than the Onaway soil, and Cheboygan soils have sandy material in the upper part of the subsoil. Both soils are in landscape positions similar to those of the Onaway soil. They make up 10 to 20 percent of the map unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is moderate. Surface runoff is medium.

Most areas are used as cropland. Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, undesirable plants can invade clearcut areas

and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cultivated crops and hay. The major management concern in cultivated areas is the hazard of water erosion. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling, though costly, also can help to overcome the slope. The soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IIIe; the woodland ordination symbol is 3L; the Michigan soil management group is 2.5a.

8C2—Onaway fine sandy loam, 6 to 12 percent slopes, eroded. This very deep, gently rolling, well drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Omena and Cheboygan soils. Omena soils have a subsoil that is thinner and coarser textured than that of the Onaway soil, and Cheboygan soils have sandy material in the upper part of the subsoil. Both soils are in landscape positions similar to those of the Onaway soil. They make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is moderate. Surface runoff is medium.

This soil is used as cropland. It is moderately well suited to cultivated crops. The major management concerns are the hazard of water erosion and a low organic matter content. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Returning crop residue to the soil, applying a system of conservation tillage, and adding organic material to the soil increase the organic matter content and the available water capacity.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling, though costly, also can help to overcome the slope. The soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IIIe; the woodland ordination symbol is 3L; the Michigan soil management group is 2.5a.

8D—Onaway fine sandy loam, 12 to 18 percent slopes. This very deep, rolling, well drained soil is on ridges, high knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is reddish brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Omena and Cheboygan soils. Omena soils have a subsoil that is thinner and coarser textured than that of the Onaway soil. Cheboygan soils have sandy material in the upper part of the subsoil. Both soils are in landscape positions similar to those of the Onaway soil. They make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is moderate. Surface runoff is rapid.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. The slope limits the selection of sites for logging roads and landings. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable

species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cultivated crops because of the slope. The major management concern is water erosion. A cropping sequence that includes grasses and legumes, conservation tillage, and grassed waterways can be effective in controlling water erosion in areas used for row crops.

This soil is moderately well suited to building site development. The slope is the main limitation. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and leveling, though costly, also can help to overcome the slope. The soil is poorly suited to septic tank absorption fields because of the moderately slow permeability. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IVe; the woodland ordination symbol is 3L; the Michigan soil management group is 2.5a.

8E—Onaway fine sandy loam, 18 to 25 percent slopes. This very deep, hilly, well drained soil is on ridges, hills, and side slopes. Individual areas are irregular in shape or long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is dark brown, friable fine sandy loam. The next part is brown, friable fine sandy loam. The lower part is strong brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Omena and Cheboygan soils. Omena soils have a subsoil that is thinner and coarser textured than that of the Onaway soil, and Cheboygan soils have sandy material in the upper part of the subsoil. Both soils are in landscape positions similar to those of the Onaway soil. They make up 5 to 10 percent of the map unit.

Permeability is moderately slow in the Onaway soil. The available water capacity is moderate. Surface runoff is rapid.

Because of the slope, this soil is unsuited to cropland and building site development.

This soil is used as woodland. The erosion hazard, the equipment limitation, and plant competition are management concerns. Erosion can result from the concentration of runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. The slope can interfere with the traction of wheeled equipment. As a result, logging roads should be built on the contour or on the gentler slopes. The slope limits the selection of sites for logging roads and landings. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation. The slope can hinder the use of planting equipment.

The land capability classification is VIe; the woodland ordination symbol is 3R; the Michigan soil management group is 2.5a.

9B—Summerville flaggy fine sandy loam, 0 to 6 percent slopes, rocky. This shallow, nearly level to undulating, well drained soil is on uplands. Rock outcrop and very shallow soils make up 1 to 10 percent of the map unit. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, about 1 inch of partially decomposed leaf litter is at the surface. The surface layer is dark reddish brown flaggy fine sandy loam about 4 inches thick. The subsurface layer is reddish gray flaggy fine sandy loam about 2 inches thick. The subsoil is about 11 inches thick. The upper part is mixed reddish brown, firm flaggy clay loam and pinkish gray, friable flaggy fine sandy loam. The lower part is dark reddish brown, firm flaggy clay loam. Limestone bedrock is at a depth of about 17 inches. In places the limestone bedrock is fractured. The fractures are filled with dark reddish brown, firm clay loam. In some areas the surface soil and subsoil do not have so many flagstones. In places large stones are on the surface. In areas near the shore of Lake Huron, the soil is cobbly.

Included with this soil in mapping are small areas of Cunard and Ensign soils. Cunard soils are deeper over bedrock than the Summerville soil. They are in landscape positions similar to those of the Summerville soil. Ensign soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Summerville soil. The available water capacity is very low. Surface runoff is slow.

Because of the shallowness to bedrock and the flaggy surface layer, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation,

seedling mortality, and the windthrow hazard. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. Flagstones and large stones on the surface can limit the operating speed of skidders and can damage the equipment. Wheeled skidders should be operated at a reduced speed over carefully chosen routes. Because of droughtiness, losses of natural seedlings can be as high as 25 to 50 percent. Because of the depth to bedrock, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Because of the shallowness to bedrock, this soil is unsuited to building site development. It is unsuited to septic tank absorption fields because the layer of suitable filtering material is too thin and because seepage is a hazard. Overcoming these limitations is difficult and costly.

The land capability classification is VIs; the woodland ordination symbol is 3D; the Michigan soil management group is Ra.

9C—Summerville flaggy fine sandy loam, 6 to 18 percent slopes, rocky. This shallow, moderately sloping or rolling, well drained soil is on side slopes and escarpments. Rock outcrop and very shallow soils make up 1 to 10 percent of the map unit. Individual areas are irregular in shape or long and narrow and range from 5 to 60 acres in size.

Typically, about 1 inch of partially decomposed leaf litter is at the surface. The surface layer is dark reddish brown flaggy fine sandy loam about 4 inches thick. The next 2 inches is reddish brown flaggy fine sandy loam. The subsoil is about 11 inches thick. The upper part is mixed reddish brown, firm flaggy clay loam and pinkish gray, friable flaggy fine sandy loam. The lower part is dark reddish brown, firm flaggy clay loam. Limestone bedrock is at a depth of about 17 inches. In places the limestone bedrock is fractured. The fractures are filled with dark reddish brown, firm clay loam. In some areas the surface soil and the subsoil do not have so many flagstones. In places large stones are on the surface. In areas near the shore of Lake Huron, the soil is cobbly.

Included with this soil in mapping are small areas of Cunard soils. These soils are deeper over limestone bedrock than the Summerville soil. They are in landscape positions similar to those of the Summerville soil. They make up 10 to 15 percent of the map unit.

Permeability is moderate in the Summerville soil. The available water capacity is very low. Surface runoff is medium.

Because of the slope, the shallowness to bedrock, and the flaggy surface layer, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. Flagstones and large stones on the surface can limit the operating speed of skidders and can damage the equipment. Wheeled skidders should be operated at a reduced speed over carefully chosen routes. Because of droughtiness, losses of natural seedlings can be as high as 25 to 50 percent. Because of the depth to bedrock, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced.

Because of the shallowness to bedrock, this soil is unsuited to building site development. It is unsuited to septic tank absorption fields because the layer of suitable filtering material is too thin and because seepage is a hazard. Overcoming these limitations is difficult and costly.

The land capability classification is VIIs; the woodland ordination symbol is 3D; the Michigan soil management group is Ra.

10B—Cunard fine sandy loam, 1 to 6 percent slopes. This moderately deep, nearly level to undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is pale brown and yellowish brown, friable sandy loam. The next part is yellowish brown and brown, friable sandy loam. The lower part is dark brown, friable loam. The substratum is pale brown fine sandy loam about 1 inch thick. Limestone bedrock is at a depth of about 25 inches. In some places the soil has pockets of gravelly sandy loam or gravelly loamy sand. In other places limestone channers and flagstones are on the surface and throughout the profile.

Included with this soil in mapping are small areas of Bonduel, Summerville, and Krakow soils. Bonduel soils are somewhat poorly drained and are in depressions and drainageways. Summerville soils are less than 20 inches deep over limestone bedrock. Krakow soils are flaggy and are more than 40 inches deep over limestone bedrock. Summerville and Krakow soils are in

landscape positions similar to those of the Cunard soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Cunard soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, the windthrow hazard, and plant competition. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. Because of the depth to bedrock, the trees on this soil have a restricted rooting depth. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Undesirable plants can invade cutover areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cropland. The major management concerns are the hazard of water erosion and the low available water capacity. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. A system of conservation tillage that leaves crop residue on the surface and additions of other organic material can be effective in conserving moisture.

Because of the depth to bedrock, this soil is only moderately well suited to buildings without basements and is poorly suited to dwellings with basements. Overcoming this limitation is difficult and costly if basements are constructed. The soil is generally unsuited to septic tank absorption fields because the layer of suitable filtering material is too thin and because seepage is a hazard.

The land capability classification is IIe; the woodland ordination symbol is 3D; the Michigan soil management group is 2/Ra.

10C—Cunard fine sandy loam, 6 to 12 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes. Individual areas are long and narrow and range from 3 to 60 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is pale brown and yellowish brown, friable sandy loam. The next part is yellowish brown and brown, friable sandy loam. The lower part is dark brown, friable loam. The substratum is pale brown fine sandy loam about 1 inch thick. Limestone bedrock is at a depth of about 25 inches. In some places the soil has pockets of gravelly sandy loam or gravelly loamy sand. In other places limestone channers and flagstones are on the surface and throughout the profile.

Included with this soil in mapping are small areas of Summerville and Krakow soils. Summerville soils are less than 20 inches deep over limestone bedrock. Krakow soils are flaggy and are more than 40 inches deep over limestone bedrock. Summerville and Krakow soils are in landscape positions similar to those of the Cunard soil. They make up 5 to 15 percent of the map unit.

Permeability is moderate in the Cunard soil. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, the windthrow hazard, and plant competition. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. Because of the depth to bedrock, the trees on this soil have a restricted rooting depth. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Undesirable plants can invade cutover areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. The major management concerns are the hazard of water erosion and the low available water capacity. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. A system of conservation tillage that leaves crop residue on the surface and additions of other organic material can be effective in conserving moisture.

Because of the depth to bedrock, this soil is only moderately well suited to buildings without basements and is poorly suited to buildings with basements. Overcoming this limitation is difficult and costly if basements are constructed. The soil is generally unsuited to septic tank absorption fields because the layer of suitable filtering material is too thin and because seepage is a hazard.

The land capability classification is IIIe; the woodland ordination symbol is 3D; the Michigan soil management group is 2/Ra.

11A—Alstad loam, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is in depressions, in drainageways, and on flats. Individual areas are irregular in shape or long and narrow and range from 3 to 60 acres in size.

Typically, the surface layer is black loam about 12 inches thick. The subsurface layer is brown fine sandy loam about 2 inches thick. The subsoil is about 13 inches thick. The upper part is dark brown and brown, mottled, firm loam and fine sandy loam. The lower part is dark brown, firm loam. The substratum to a depth of 60 inches is light brown, mottled loam. In some places the surface layer is fine sandy loam. In other places the subsoil is stratified lacustrine material.

Included with this soil in mapping are small areas of Onaway and Hessel soils. Onaway soils are well drained and are on knolls and slight rises. Hessel soils are poorly drained and are in the lower landscape positions. Included soils make up 3 to 10 percent of the map unit.

Permeability is moderately slow in the Alstad soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet from late fall through early spring and during other periods of high precipitation.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, the windthrow hazard, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is well suited to cropland. The major management concerns are the wetness and compaction. The wetness can be reduced by installing a subsurface or surface drainage system that includes sufficient outlets and that helps to lower the water table. Minimizing tillage and delaying tillage and harvesting when the soil is wet help to prevent compaction and alteration of soil structure.

Because of the wetness, this soil is poorly suited to building site development. This limitation can be overcome by installing a subsurface drainage system that helps to lower the water table. Constructing the buildings on well compacted fill material, which raises the level of the site, also can help to overcome the wetness. The soil is generally unsuited to septic tank absorption fields because of the wetness and the moderately slow permeability.

The land capability classification is IIw; the woodland ordination symbol is 3W; the Michigan soil management group is 2.5b.

12A—Bonduel loam, 0 to 3 percent slopes. This moderately deep, nearly level and very gently sloping, somewhat poorly drained soil is in drainageways, in depressions, and on flats. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is dark reddish brown loam about 8 inches thick. The subsoil is reddish brown, mottled, firm clay loam about 5 inches thick. The substratum is yellowish brown, mottled sandy clay loam about 10 inches thick. Limestone bedrock is at a depth of about 23 inches. In some places the depth to limestone bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Cunard, Ensign, and Ruse soils. Cunard soils are well drained and are on knolls and slight rises. Ensign soils have bedrock at a depth of about 20 inches. They are in landscape positions similar to those of the Bonduel soil. Ruse soils are poorly drained and are in depressions and drainageways. They have bedrock within a depth of 20 inches. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Bonduel soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet from early fall through late spring.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, the windthrow hazard, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table and the depth to bedrock, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely

spaced. After the trees are cut, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is well suited to cropland. The major management concerns are the wetness and compaction. The wetness can be reduced by installing a surface drainage system that includes sufficient outlets and that helps to lower the water table. Minimizing tillage and delaying tillage and harvesting when the soil is wet help to prevent compaction and alteration of soil structure.

Because of the wetness and the depth to bedrock, this soil is generally unsuited to building site development and septic tank absorption fields.

The land capability classification is IIw; the woodland ordination symbol is 4W; the Michigan soil management group is 2/Rbc.

13B—Croswell sand, 0 to 4 percent slopes. This very deep, nearly level and gently undulating, moderately well drained soil is on flats, low ridges, and knolls. Individual areas are irregular in shape or long and narrow and range from 3 to 40 acres in size.

Typically, about 1 inch of partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown sand about 4 inches thick. The subsurface layer is grayish brown sand about 6 inches thick. The subsoil is very friable sand about 23 inches thick. The upper part is strong brown. The next part is yellowish brown and mottled. The lower part is brownish yellow and mottled. The substratum to a depth of 60 inches is light yellowish brown, mottled sand. In places the surface soil and subsoil are fine sand. In some areas the subsoil is weakly cemented. In other areas the substratum is gravelly.

Included with this soil in mapping are areas of Au Gres and Rubicon soils. Au Gres soils are somewhat poorly drained and are in depressions and drainageways. Rubicon soils are excessively drained and are higher on the landscape than the Croswell soil. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Croswell soil. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2 to 4 feet from late fall through spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is poorly suited to cropland. Some crops can be grown, however, if the cropland is managed properly. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, buffer strips, and field windbreaks help to prevent excessive soil blowing. Returning crop residue to the soil, growing green manure crops, or regularly adding other organic material increases the available water capacity.

Because of the wetness, this soil is only moderately well suited to building site development and is poorly suited to dwellings with basements. This limitation can be overcome by installing a subsurface drainage system that helps to lower the seasonal high water table. Constructing the buildings on well compacted fill material, which raises the level of the site, also can help to overcome the wetness. The soil is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity.

The land capability classification is IVs; the woodland ordination symbol is 5S; the Michigan soil management group is 5a.

14B—Menominee loamy sand, 2 to 6 percent slopes. This very deep, gently undulating and undulating, well drained soil is on upland flats and low knolls. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, about 1 inch of black, partially decomposed forest litter is at the surface. The surface layer is brown loamy sand about 6 inches thick. The subsoil is about 28 inches thick. The upper part is strong brown and yellowish brown, very friable fine sand. The next layer is light yellowish brown, friable loamy fine sand. The lower part is reddish brown, firm clay loam. The substratum to a depth of 60 inches is reddish brown, firm, stratified silty clay loam and very fine sandy loam. In places the surface layer is sand.

Included with this soil in mapping are small areas of

Melita and Allendale soils. Melita soils have loamy material below a depth of 40 inches. They are in landscape positions similar to those of the Menominee soil. Allendale soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the upper part of the Menominee soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. The major management concerns are the hazards of water erosion and soil blowing and droughtiness. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Establishing windbreaks and buffer strips, growing green manure cover crops, applying a system of conservation tillage, and returning crop residue to the soil help to control soil blowing and conserve moisture.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the moderately slow permeability in the lower part of the profile. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome this limitation.

The land capability classification is IIIs; the woodland ordination symbol is 6A; the Michigan soil management group is 4/2a.

15B—Krakow flaggy fine sandy loam, 1 to 6 percent slopes. This very deep, nearly level to undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 3 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown flaggy fine sandy loam about 2 inches thick. The subsurface layer is yellowish brown flaggy fine sandy loam about 9 inches thick. The subsoil is dark reddish brown, firm very flaggy clay loam about 5 inches thick. The substratum to a depth of 60 inches is dark brown and brown very flaggy loam. In places limestone bedrock is at a depth of 40 to 60 inches. In farmed areas many of the surface flagstones have been removed.

Included with this soil in mapping are small areas of Detour, Cunard, and Omena soils. Detour soils are somewhat poorly drained and are in depressions and drainageways. Cunard soils are 20 to 40 inches deep over limestone bedrock. Omena soils are coarser textured than the Krakow soil and have fewer rock fragments. Cunard and Omena soils are in landscape positions similar to those of the Krakow soil. Included soils make up 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Krakow soil. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. The flagstones on the surface can hinder tree planting. After trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to cropland because of the flaggy surface layer. It is moderately well suited to cultivated crops, however, if the flagstones are removed. The major management needs are measures that control water erosion and conserve moisture. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Returning crop residue to the soil or applying a system of conservation tillage that leaves crop residue on the surface can be effective in conserving moisture.

This soil is moderately well suited to building site development and septic tank absorption fields. The major limitation is the flagstones, which should be removed from the site. Some areas have extremely large slabs of limestone. Removing these slabs is costly. The moderate permeability is a limitation on sites for septic tank absorption fields. This limitation can be overcome by enlarging or pressurizing the absorption field or installing alternating drain fields.

The land capability classification is IIIs; the woodland ordination symbol is 3F; the Michigan soil management group is Ga.

15C—Krakow flaggy fine sandy loam, 6 to 12 percent slopes. This very deep, gently rolling, well drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to nearly 100 acres in size.

Typically, the surface layer is dark grayish brown flaggy fine sandy loam about 2 inches thick. The

subsurface layer is yellowish brown flaggy fine sandy loam about 9 inches thick. The subsoil is dark reddish brown, firm very flaggy clay loam about 5 inches thick. The substratum to a depth of 60 inches is dark brown and brown very flaggy loam. In places limestone bedrock is at a depth of 40 to 60 inches. In farmed areas many of the surface flagstones have been removed.

Included with this soil in mapping are small areas of Cunard and Omena soils. Cunard soils are 20 to 40 inches deep over limestone bedrock. Omena soils are coarser textured than the Krakow soil and have fewer rock fragments. Cunard and Omena soils are in landscape positions similar to those of the Krakow soil. Included soils make up 5 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Krakow soil. Surface runoff is medium.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. The large flagstones on the surface can hinder tree planting. After trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to cropland because of the flaggy surface layer. It is moderately well suited to cultivated crops, however, if the flagstones are removed. If the soil is cultivated, the major management concern is the hazard of water erosion. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion.

This soil is moderately well suited to building site development and septic tank absorption fields. The major limitations are the large flagstones and the slope. The flagstones should be removed from the site. Land shaping and leveling may be needed. Some areas have extremely large slabs of limestone. Removing these slabs is costly. The moderate permeability is a limitation on sites for septic tank absorption fields. This limitation can be overcome by enlarging or pressurizing the absorption field or installing alternating drain fields. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is VIs; the woodland ordination symbol is 3F; the Michigan soil management group is Ga.

15D—Krakow flaggy fine sandy loam, 12 to 18 percent slopes. This very deep, rolling, well drained soil is on ridges, high knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to 40 acres in size.

Typically, the surface layer is dark grayish brown flaggy fine sandy loam about 2 inches thick. The subsurface layer is yellowish brown flaggy fine sandy loam about 9 inches thick. The subsoil is dark reddish brown, firm very flaggy clay loam about 5 inches thick. The substratum to a depth of 60 inches is dark brown and brown very flaggy loam. In places limestone bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Omena and Summerville soils. These soils are in landscape positions similar to those of the Krakow soil. Omena soils are coarser textured in the subsoil than the Krakow soil and have fewer limestone flagstones. Summerville soils are shallow over limestone bedrock. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Krakow soil. Surface runoff is rapid.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly restricted in spring and in other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily. The large flagstones on the surface can hinder tree planting. The slope limits the selection of sites for landings. After trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to cropland because of the slope and the flaggy surface layer.

Because of the slope and the flaggy surface layer, this soil is only moderately well suited to building site development and septic tank absorption fields. The flagstones should be removed from the site. Buildings should be designed so that they conform to the natural slope of the land. Land shaping is usually necessary. The moderate permeability is a limitation on sites for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field or installing alternating drain fields. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is VIs; the woodland ordination symbol is 3F; the Michigan soil management group is 3a.

16A—Iosco loamy sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is in depressions, in drainageways, and on flats. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is light gray fine sand about 5 inches thick. The subsoil is about 25 inches thick. It is mottled. The upper part is dark brown, very friable loamy sand. The next part is pale brown, very friable loamy fine sand. The lower part is reddish brown, firm sandy clay loam. The substratum to a depth of 60 inches is light reddish brown, mottled sandy loam. In some places, particularly in Bearinger Township, the substratum is compacted and perches water. In other places the upper part of the subsoil is weakly cemented.

Included with this soil in mapping are small areas of Brevort and Hagensville soils and small areas of the Croswell soils that have a loamy substratum. Brevort soils are poorly drained and are in the lower landscape positions. Hagensville soils are finer textured than the Iosco soil. They are in landscape positions similar to those of the Iosco soil. Croswell soils are moderately well drained and are on slight rises and low ridges. They are deeper to the contrasting loamy material than the Iosco soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Iosco soil and moderate in the loamy lower part. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, the windthrow hazard, and plant competition. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, undesirable plants can invade cutover areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is moderately well suited to cropland. The major management concerns are the wetness and soil blowing. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, buffer strips, vegetative barriers, and field windbreaks help to control soil blowing.

Because of the wetness, this soil is poorly suited to building site development and septic tank absorption fields. Installing a subsurface drainage system helps to lower the water table if outlets are available. Constructing the buildings on well compacted fill material, which raises the level of the site, also can help to overcome the wetness. On sites for septic tank absorption fields, mounding or filling with suitable material, enlarging the absorption field, installing alternating drain fields, or pressurizing the absorption field helps to overcome the wetness.

The land capability classification is IIIw; the woodland ordination symbol is 4W; the Michigan soil management group is 4/2b.

17—Roscommon muck. This very deep, nearly level, poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape or long and narrow and range from 3 to nearly 100 acres in size.

Typically, the surface layer is black muck about 4 inches thick. The substratum to a depth of 60 inches is dark grayish brown, brown, and pale brown, mottled sand. In places the surface layer is thinner.

Included with this soil in mapping are small areas of Au Gres, Croswell, and Tawas soils. Au Gres soils are somewhat poorly drained and are in the slightly higher landscape positions. Croswell soils are moderately well drained and are on low knolls and ridges. Tawas soils have more than 16 inches of muck at the surface. They are in landscape positions similar to those of the Roscommon soil. Included soils make up 5 to 20 percent of the map unit.

Permeability is rapid in the Roscommon soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from early fall through spring.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system.

Because of the wetness, seedling mortality can be more than 50 percent. Because of the seasonal high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

This soil is poorly suited to cropland. If good management is applied, however, some crops can be grown. Excess water, soil blowing, and the low available water capacity are the major management concerns. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, vegetative barriers, and field windbreaks help to control soil blowing. Returning crop residue to the soil, planting green manure crops, or regularly adding other organic material increases the available water capacity.

Because of the high water table and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is VIw; the woodland ordination symbol is 6W; the Michigan soil management group is 5c.

18—Brevort mucky loamy sand. This very deep, nearly level, poorly drained soil is in depressions and drainageways. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black mucky loamy sand about 6 inches thick. The upper part of the substratum is grayish brown, light olive brown, and light brownish gray, mottled loamy sand. The lower part to a depth of 60 inches is grayish brown sandy loam and loam. In places the surface layer is muck or sand.

Included with this soil in mapping are small areas of Cathro, Hessel, and Iosco soils. Cathro soils are very poorly drained and have a thick organic surface layer. They are in the slightly lower landscape positions. Hessel soils have a loamy surface layer. They are in landscape positions similar to those of the Brevort soil. Iosco soils are somewhat poorly drained and are in the slightly higher landscape positions. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid or rapid in the sandy part of the Brevort soil and moderately slow in the loamy material. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, seedling mortality can be more than 50 percent. Because of the seasonal high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

If adequately drained, this soil is moderately well suited to cropland. The major management concerns are excess water and soil blowing. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, vegetative barriers, cover crops, and field windbreaks help to prevent excessive soil blowing.

Because of the high water table and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw; the woodland ordination symbol is 2W; the Michigan soil management group is 4/2c.

20—Hessel mucky flaggy loam, bedrock substratum. This deep, nearly level, poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 3 to more than 200 acres in size.

Typically, the surface layer is black mucky flaggy loam about 6 inches thick. The subsoil is light olive brown, mottled, friable flaggy loam about 10 inches thick. The substratum is about 34 inches thick. It is brown, mottled flaggy loam in the upper part and grayish brown gravelly sandy loam in the lower part. Limestone bedrock is at a depth of about 50 inches. In some places a thin organic layer is at the surface. In

other places the soil has as much as 80 percent flagstones, cobbles, and channers throughout. Some areas are underlain by limestone bedrock at a depth of more than 60 inches.

Included with this soil in mapping are areas of Esau, Cathro, and Detour soils. Esau and Detour soils are somewhat poorly drained and are slightly higher on the landscape than the Hessel soil. Cathro soils are very poorly drained and have an organic surface layer. They are in depressions. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Hessel soil. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring.

Because of the wetness and the content of rock fragments, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, seedling mortality can be more than 50 percent. Because of the seasonal high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

Because of the high water table and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw; the woodland ordination symbol is 6W; the Michigan soil management group is Gbc.

21—Cathro muck. This very deep, nearly level, very poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape or long and narrow and range from 5 to several hundred acres in size.

Typically, the surface layer is black muck about 6 inches thick. The next 28 inches is very dark brown and black muck. The substratum to a depth of 60 inches is grayish brown silty clay loam. In places the substratum is sandy loam. In some areas marl is above the mineral material. In other areas limestone bedrock is within a depth of 60 inches.

Included with this soil in mapping are areas of Hessel, Hettinger, Tawas, and Lupton soils. These soils are in landscape positions similar to those of the Cathro soil. Hessel and Hettinger soils are poorly drained and are loamy. Tawas soils are underlain by sand. Lupton soils have an organic layer more than 51 inches thick. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic part of the Cathro soil and moderate or moderately slow in the mineral part. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of low strength, ordinary crawler tractors and rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment is needed. The equipment can be used during periods in winter when access roads are frozen. Because of the wetness and the organic surface layer, seedling mortality can be more than 50 percent. Because of the wetness, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

Because of the low strength and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vlw; the woodland ordination symbol is 5W; the Michigan soil management group is M/3c.

23—Greenwood peat. This very deep, nearly level, very poorly drained soil is in depressions and in areas surrounding lakes. It is subject to ponding. Individual areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is yellowish brown peat about 6 inches thick. The next layer is yellowish brown peat about 6 inches thick. Below this to a depth of 60 inches is dark reddish brown mucky peat.

Included with this soil in mapping are small areas of Dawson and Roscommon soils. These soils are near the edges of the map unit. They are sandy throughout. Dawson soils are underlain by sand within a depth of 51 inches. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate or moderately rapid in the Greenwood soil. The available water capacity is very high. Surface runoff is very slow or ponded. The high water table is near or above the surface from early fall through spring.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of low strength, ordinary crawler tractors and rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment is needed. The equipment can be used during periods in winter when access roads are frozen. Because of the wetness and the organic surface layer, the seedling mortality rate is more than 50 percent. Because of the wetness, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

Because of the low strength and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIw; the woodland ordination symbol is 2W; the Michigan soil management group is Mc-a.

24B—Melita loamy sand, 0 to 6 percent slopes. This very deep, nearly level to undulating, somewhat excessively drained soil is on uplands. Individual areas are irregular in shape and range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown, very friable loamy sand and yellowish brown and brownish yellow, very friable sand. The next part is mixed reddish brown, firm silty clay loam and light brownish gray sandy loam. The lower part is reddish brown, firm silty clay loam.

Included with this soil in mapping are small areas of the Croswell soils that have a loamy substratum and small areas of Menominee and Rubicon soils. Croswell soils are moderately well drained and are in depressions. Menominee soils are well drained and are in landscape positions similar to those of the Melita soil. They are shallower to the underlying loamy material than the Melita soil. Rubicon soils are excessively drained and are slightly higher on the landscape than the Melita soil. They are sandy throughout. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the sandy part of the Melita soil and moderately slow in the loamy part. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland. Droughtiness and soil blowing are the major management concerns. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, and field windbreaks help to control soil blowing. Returning crop residue to the soil, growing green manure crops, or regularly adding other organic material increases the available water capacity. Irrigation can be beneficial during the drier summer months.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the moderately slow permeability in the lower part of the profile and a poor filtering capacity in the upper part. Enlarging the absorption field or using a pressurized sewage disposal system reduces the risk of ground water pollution.

The land capability classification is IVs; the woodland ordination symbol is 3A; the Michigan soil management group is 5/2a.

24C—Melita loamy sand, 6 to 12 percent slopes. This very deep, gently rolling, somewhat excessively drained soil is on knolls and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown, very friable loamy sand and yellowish brown and brownish yellow, very friable sand. The next part is mixed reddish brown, firm silty clay loam and light brownish gray sandy loam. The lower part is reddish

brown, firm silty clay loam. In places the lower part of the subsoil is sandy loam.

Included with this soil in mapping are small areas of the Croswell soils that have a loamy substratum and small areas of Menominee and Rubicon soils. Croswell soils are moderately well drained and are in depressions. Menominee soils are well drained and are in landscape positions similar to those of the Melita soil. They are shallower to the underlying loamy material than the Melita soil. Rubicon soils are excessively drained and are slightly higher on the landscape than the Melita soil. They are sandy throughout. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the sandy part of the Melita soil and moderately slow in the loamy part. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland. The major management concerns are water erosion, soil blowing, droughtiness, and a low content of organic matter. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Field windbreaks, vegetative barriers, and winter cover crops help to control soil blowing. Applying a system of conservation tillage and periodically adding manure or other organic material to the soil increase the available water capacity and the content of organic matter. Irrigation can be beneficial during the drier summer months.

This soil is moderately well suited to building site development. The slope is the major management concern. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The slope and a poor filtering capacity are management concerns on sites for septic tank absorption fields. The moderately slow permeability in the lower part of the soil and a poor filtering capacity in the upper part are limitations. Enlarging or pressurizing the absorption field reduces the risk of ground water pollution. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

The land capability classification is IVs; the woodland ordination symbol is 3A; the Michigan soil management group is 5/2a.

25A—Au Gres sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is in depressions, in drainageways, and on low flats. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, about 2 inches of black, partially decomposed forest litter is at the surface. The surface layer is light brownish gray sand about 4 inches thick. The subsoil is about 26 inches thick. It is mottled and very friable. The upper part is dark reddish brown loamy sand. The lower part is yellowish brown sand. The substratum to a depth of 60 inches is yellowish brown sand. In some areas in Bearinger Township, the soil has a stony surface layer.

Included with this soil in mapping are small areas of Croswell and Roscommon soils. Croswell soils are moderately well drained and are in the higher landscape positions. Roscommon soils are poorly drained and are in depressions. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Au Gres soil. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate the seasonal wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland. Some crops can be grown, however, if the cropland is managed properly. The major management concerns are the wetness, soil blowing, and the low available water capacity. A surface or subsurface drainage system can

lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, buffer strips, or field windbreaks can help to control soil blowing. Additions of organic material increase the organic matter content and the available water capacity.

This soil is poorly suited to building site development. The major concern is the wetness. Subsurface drains can lower the water table. Constructing the buildings on well compacted fill material also can help to overcome the wetness. The soil is poorly suited to septic tank absorption fields because of the wetness and a poor filtering capacity. The poor filtering capacity can result in the pollution of ground water. Mounding the absorption field with suitable fill material and using a pressurized sewage disposal system help to overcome this limitation.

The land capability classification is IVw; the woodland ordination symbol is 6W; the Michigan soil management group is 5b.

28A—Moltke very fine sandy loam, 0 to 3 percent slopes. This very deep, nearly level and gently undulating, somewhat poorly drained soil is in depressions, in drainageways, and on flats. Individual areas are irregular in shape and range from 3 to more than 100 acres in size.

Typically, the surface layer is dark brown very fine sandy loam about 4 inches thick. The subsurface layer is light brownish gray loamy very fine sand about 5 inches thick. The subsoil is about 24 inches thick. It is mottled. The upper part is mixed pale brown loamy very fine sand and dark brown, firm very fine sandy loam. The next part is brown, firm very fine sandy loam. The lower part is yellowish brown, friable very fine sandy loam. The substratum to a depth of about 60 inches is light yellowish brown, mottled, stratified very fine sandy loam and loamy very fine sand. In places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Grace, Bowers, and Glawe soils. Grace soils are well drained and are in the higher landscape positions. Bowers soils are finer textured than the Moltke soil. They are in landscape positions similar to those of the Moltke soil. Glawe soils are poorly drained and are in depressions. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Moltke soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Ruts form easily if skidders are used when the soil is wet. Deep ruts tend to restrict lateral drainage, alter soil structure, and damage tree roots. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the wetness, seedling mortality is a management concern. Planting seedlings that can tolerate wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is well suited to cropland. The wetness, soil blowing, and compaction are the major management concerns. A subsurface drainage system can lower the water table. Cover crops, a system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, buffer strips, vegetative barriers, and field windbreaks help to control soil blowing. Minimizing tillage operations and delaying tillage and harvesting when the soil is wet help to prevent compaction and alteration of soil structure.

Because of the wetness, this soil is poorly suited to building site development and septic tank absorption fields. Constructing the buildings on well compacted fill material, which raises the level of the site, helps to overcome the wetness. On sites for septic tank absorption fields, mounding with suitable material or pressurizing the absorption field helps to overcome the wetness.

The land capability classification is IIw; the woodland ordination symbol is 3W; the Michigan soil management group is 3b-s.

29—Glawe mucky very fine sandy loam. This very deep, nearly level, poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is black mucky very fine sandy loam about 10 inches thick. The substratum extends to a depth of 60 inches or more. It is mottled.

The upper part is gray loamy very fine sand. The next part is light brownish gray very fine sandy loam. The lower part is pale brown, stratified silt loam, very fine sandy loam, and loamy very fine sand.

Included with this soil in mapping are small areas of Moltke, Cathro, and Hettinger soils. Moltke soils are somewhat poorly drained and are slightly higher on the landscape than the Glawe soil. Cathro soils are very poorly drained and are slightly lower on the landscape than the Glawe soil. They have an organic surface layer. Hettinger soils are in landscape positions similar to those of the Glawe soil. They are finer textured than the Glawe soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Glawe soil. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, the use of equipment is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, seedling mortality can be more than 50 percent. Because of the seasonal high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

If adequately drained, this soil is well suited to cropland. Excess water, compaction, and a low soil temperature in the spring are the major management concerns. A surface or subsurface drainage system can lower the water table. Minimizing tillage and delaying tillage and harvesting during periods when the soil is wet help to prevent compaction. Ridge tillage helps the soil to warm up and dry out in spring, thus allowing earlier planting and faster germination.

Because of the high water table and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw; the woodland ordination symbol is 2W; the Michigan soil management group is 3c-s.

30—Evart silt loam. This very deep, nearly level, poorly drained soil is on low flats adjacent to rivers and creeks. It is subject to flooding during periods of rapid spring melt and during extremely heavy rains. Individual areas are long and narrow and range from 3 to 20 acres in size.

Typically, the surface layer is black silt loam about 12 inches thick. The substratum to a depth of about 60 inches is pale brown and grayish brown, mottled sand that has a few thin organic streaks. In some places the substratum is very stony. In other places it is loamy.

Included with this soil in mapping are small areas of Winterfield and Tawas soils. Winterfield soils are somewhat poorly drained and are in the higher landscape positions. Tawas soils are very poorly drained and are in landscape positions similar to those of the Evart soil. They have a thick organic surface layer. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Evart soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is at or near the surface in late fall, during periods of spring melt, and during other periods of high precipitation.

Because of the flooding, the wetness, and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, seedling mortality can be more than 50 percent. Because of the seasonal high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, plant competition, and the flooding, trees are generally not planted on this soil.

Because of the flooding and the wetness, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIw; the

woodland ordination symbol is 2W; the Michigan soil management group is L-4c.

31B—Mancelona loamy sand, 2 to 6 percent slopes. This very deep, gently undulating and undulating, somewhat excessively drained soil is on upland plains and low ridges. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loamy sand about 10 inches thick. The subsoil is about 14 inches thick. The upper part is dark brown, very friable gravelly loamy sand. The next part is reddish brown, friable gravelly sandy loam. The lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is light yellowish brown, stratified sand and gravel.

Included with this soil in mapping are small areas of East Lake, Gladwin, and Rubicon soils. East Lake and Rubicon soils are in landscape positions similar to those of the Mancelona soil. East Lake soils do not have a loamy subsoil. Rubicon soils are excessively drained and do not have a loamy subsoil or a gravelly substratum. Gladwin soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. Droughtiness and soil blowing are the major management concerns. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, and field windbreaks help to control soil blowing. Leaving crop residue on the surface, growing green manure crops, or regularly adding other organic material increases the available water capacity. Irrigation can be beneficial during the drier summer months.

This soil is well suited to building site development. It is only moderately well suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs; the woodland ordination symbol is 3A; the Michigan soil management group is 4a.

31C—Mancelona loamy sand, 6 to 15 percent slopes. This very deep, gently rolling, somewhat excessively drained soil is on ridges and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to 60 acres in size.

Typically, the surface layer is dark brown loamy sand about 3 inches thick. The subsurface layer is grayish brown loamy sand about 3 inches thick. The subsoil is about 14 inches thick. The upper part is dark brown, very friable gravelly loamy sand. The next part is reddish brown, friable gravelly sandy loam. The lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is light yellowish brown, stratified sand and gravel.

Included with this soil in mapping are small areas of East Lake and Rubicon soils. These soils are in landscape positions similar to those of the Mancelona soil. East Lake soils do not have a loamy subsoil. Rubicon soils are excessively drained and do not have a loamy subsoil or a gravelly substratum. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Mancelona soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. The major management concerns are water erosion, droughtiness, a low content of organic matter, and soil blowing. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Field windbreaks, vegetative barriers, and winter cover crops help to control soil blowing. Applying a system of conservation tillage and periodically adding manure or other organic material to the soil increase the available water capacity and the content of organic matter.

This soil is moderately well suited to building site development and septic tank absorption fields. The slope is the major limitation on building sites. The buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The slope and a poor filtering

capacity are limitations on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is IIIe; the woodland ordination symbol is 3A; the Michigan soil management group is 4a.

31E—Mancelona loamy sand, 15 to 35 percent slopes. This very deep, rolling to steep, somewhat excessively drained soil is on hills, ridges, and side slopes. Individual areas are irregular in shape or long and narrow and range from 3 to 40 acres in size.

Typically, the surface layer is dark brown loamy sand about 3 inches thick. The subsurface layer is grayish brown loamy sand about 3 inches thick. The subsoil is about 14 inches thick. The upper part is dark brown, very friable gravelly loamy sand. The next part is reddish brown, friable gravelly sandy loam. The lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is light yellowish brown, stratified sand and gravel.

Included with this soil in mapping are small areas of East Lake and Rubicon soils. These soils are in landscape positions similar to those of the Mancelona soil. East Lake soils do not have a loamy subsoil. Rubicon soils are excessively drained and do not have a loamy subsoil or a gravelly substratum. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of the Mancelona soil and very rapid in the substratum. The available water capacity is low. Surface runoff is medium.

Because of the slope, this soil is unsuited to cropland.

This soil is used as woodland. The hazard of erosion, the equipment limitation, and plant competition are management concerns. Erosion can result from the concentration of runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. The slope can interfere with the traction of wheeled equipment. As a result, logging roads should be built on the contour or on the gentler slopes. The slope limits the selection of sites for logging roads and landings. It can hinder the use of planting equipment. After the trees are harvested, undesirable plants can invade clearcut areas and delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to building site development and septic tank absorption fields. The slope is the major management concern on building sites. The buildings should be designed so that they conform to the natural slope of the land. The slope and a poor filtering capacity are management concerns on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly.

The land capability classification is VIIe; the woodland ordination symbol is 3R; the Michigan soil management group is 4a.

33A—Detour flaggy loam, 0 to 3 percent slopes. This very deep, nearly level and gently undulating, somewhat poorly drained soil is in depressions, in drainageways, and on flats. Individual areas are irregular in shape and range from 3 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown flaggy loam about 5 inches thick. The subsoil is about 21 inches thick. It is mottled. The upper part is brown and yellowish brown, friable flaggy loam. The lower part is brown, friable flaggy sandy loam. The substratum to a depth of 60 inches is dark grayish brown flaggy sandy loam. In some areas limestone bedrock is at a depth of 40 to 60 inches. In other areas the rock fragments are dominantly cobbles and stones. In some places the surface layer is sandy loam or fine sandy loam. In other places it is extremely cobbly or flaggy.

Included with this soil in mapping are small areas of Krakow, Hessel, and Bonduel soils. Krakow soils are well drained and are on the higher knolls and ridges. Hessel soils are poorly drained and are in depressions and drainageways. Bonduel soils are underlain by limestone bedrock. They are in landscape positions similar to those of the Detour soil. Included soils make up 5 to 20 percent of the map unit.

Permeability is slow in the Detour soil. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 2.0 feet from late fall through early spring and during other periods of high precipitation.

Because of the wetness and the content of rock fragments, this soil is generally unsuited to cropland.

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

competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate seasonal wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Flagstones on the surface can hinder tree planting. In places the stones on the surface can reduce the operating speed of skidders. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to building site development because of the wetness and the content of rock fragments. It is generally unsuited to septic tank absorption fields because of the wetness, the slow permeability, and the content of rock fragments.

The land capability classification is VIw; the woodland ordination symbol is 7W; the Michigan soil management group is Gbc.

35A—Ingalls sand, 0 to 3 percent slopes. This very deep, nearly level and gently undulating, somewhat poorly drained soil is in depressions, on flats, and in drainageways. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, about 1 inch of black, partially decomposed leaf litter is at the surface. The surface layer is black sand about 3 inches thick. The subsurface layer is pinkish gray sand about 8 inches thick. The subsoil is about 14 inches thick. It is mottled. The upper part is dark reddish brown, friable loamy sand. The lower part is strong brown, very friable sand. The upper part of the substratum is yellowish brown, mottled sand. The lower part to a depth of 60 inches is dark brown, brown, and pinkish gray, stratified silt loam and very fine sandy loam. In some areas the surface layer is fine sand.

Included with this soil in mapping are small areas of Allendale and Burleigh soils and small areas of the Croswell soils that have a loamy substratum. Allendale soils are finer textured in the substratum than the Ingalls soil. They are in landscape positions similar to those of the Ingalls soil. Burleigh soils are poorly drained and are in the lower depressions and drainageways. Croswell soils are moderately well drained and are on low knolls. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Ingalls soil and moderately slow in the stratified lower part. The available water capacity is moderate. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate the seasonal wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is only moderately well suited to cropland, but crops can be grown if the cropland is managed properly. The major management concerns are the wetness, soil blowing, and the low available water capacity. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, buffer strips, and field windbreaks help to control soil blowing. Regular additions of organic material to the soil increase the content of organic matter and the available water capacity.

This soil is poorly suited to building site development and septic tank absorption fields because of the wetness. Constructing the buildings on well compacted fill material, which raises the level of the site, can help to overcome the wetness. On sites for septic tank absorption fields, mounding with suitable material or

pressurizing the absorption field helps to overcome the wetness.

The land capability classification is IIIw; the woodland ordination symbol is 4W; the Michigan soil management group is 4/2b.

36—Burleigh mucky loamy fine sand. This very deep, nearly level, poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black mucky loamy fine sand about 5 inches thick. The substratum is mottled. The upper part is gray and dark yellowish brown loamy fine sand. The lower part to a depth of 60 inches is reddish brown, light brown, brown, and pale brown, stratified very fine sand and silty clay loam.

Included with this soil in mapping are small areas of Cathro, Glawe, and Ingalls soils. Cathro and Glawe soils are in landscape positions similar to those of the Burleigh soil. Cathro soils have a thick organic surface layer. Glawe soils have a loamy surface layer. Ingalls soils are somewhat poorly drained and are on low knolls. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the sandy upper part of the Burleigh soil and moderately slow in the lower stratified part. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring and during other periods of high precipitation.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, seedling mortality can be more than 50 percent. Trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

If adequately drained, this soil is moderately well suited to cropland. The major management concerns are the wetness and soil blowing. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, vegetative barriers, cover crops, and field windbreaks help to control soil blowing.

Because of the high water table and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw; the woodland ordination symbol is 2W; the Michigan soil management group is 4/2c.

37A—Gladwin loamy sand, 0 to 3 percent slopes. This very deep, nearly level and gently undulating, somewhat poorly drained soil is in depressions, in drainageways, and on flats. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black loamy sand about 8 inches thick. The subsoil is about 28 inches thick. It is mottled. The upper part is dark yellowish brown and yellowish brown, very friable sand. The lower part is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is pale brown, stratified sand and gravel.

Included with this soil in mapping are small areas of East Lake, Mancelona, and Wheatley soils. East Lake and Mancelona soils are somewhat excessively drained and are on knolls and ridges. Wheatley soils are poorly drained and are in low depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Gladwin soil and rapid or very rapid in the lower part. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate the seasonal wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind

and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is moderately well suited to cropland. The major management concerns are the wetness and soil blowing. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface helps to prevent excessive soil loss. Cover crops, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing.

This soil is poorly suited to building site development and septic tank absorption fields. The wetness is the major limitation on building sites. If sufficient outlets are available, a subsurface drainage system can lower the water table. Constructing the buildings on well compacted fill also can help to overcome the wetness. A poor filtering capacity and the wetness are management concerns on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Filling or mounding with suitable material or pressurizing the absorption field helps to overcome this limitation.

The land capability classification is IIIw; the woodland ordination symbol is 4W; the Michigan soil management group is 4b.

38—Ruse loam. This shallow, nearly level, poorly drained soil is in depressions and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 30 acres in size.

Typically, the surface layer is very dark gray loam about 5 inches thick. The subsoil is about 7 inches thick. It is mottled and firm. The upper part is light olive brown loam. The lower part is light olive brown fine sandy loam. Limestone bedrock is at a depth of about 12 inches. In some places as much as 60 percent limestone channers and flagstones are throughout the solum. In other places the soil has a thin organic surface layer.

Included with this soil in mapping are small areas of Ensign and Hessel soils. Ensign soils are somewhat poorly drained and are on the higher benches. Hessel soils are deeper over limestone bedrock than the Ruse soil. They are in landscape positions similar to those of the Ruse soil. Included soils make up 5 to 10 percent of map unit.

Permeability is moderate in the Ruse soil. The available water capacity is very low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring.

Because of the wetness and the depth to bedrock, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, the use of equipment is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the high water table, seedling mortality can be more than 50 percent. Trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

Because of the depth to bedrock, the high water table, and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIw; the woodland ordination symbol is 5W; the Michigan soil management group is Rbc.

39B—Grayling sand, 0 to 8 percent slopes. This very deep, nearly level to gently rolling, excessively drained soil is on uplands. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black sand about 1 inch thick. The subsoil is very friable sand about 24 inches thick. The upper part is strong brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Au Gres, Graycalm, and Rubicon soils. Au Gres soils are somewhat poorly drained and are in depressions and drainageways. Graycalm and Rubicon soils are in landscape positions similar to those of the Grayling soil. Graycalm soils have thin bands of loamy sand or sandy loam in the subsoil. Rubicon soils have a subsoil that is darker than that of the Grayling soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Grayling soil. The available water capacity is low. Surface runoff is very slow.

Because of droughtiness, a scarcity of plant

nutrients, and soil blowing, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is well suited to building site development. It is only moderately well suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 4S; the Michigan soil management group is 5.7a.

39C—Grayling sand, 8 to 15 percent slopes. This very deep, gently rolling, excessively drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is black sand about 1 inch thick. The subsoil is very friable sand about 24 inches thick. The upper part is strong brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Graycalm and Rubicon soils. These soils are in landscape positions similar to those of the Grayling soil. Graycalm soils have very thin bands of loamy sand or sandy loam in the subsoil. Rubicon soils have a subsoil that is darker than that of the Grayling soil. Included soils make up 1 to 10 percent of the map unit.

Permeability is rapid in the Grayling soil. The available water capacity is low. Surface runoff is slow.

Because of the slope, droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. The slope limits the number of suitable landing sites. Landings can be established in small, nearly level areas, if any are available, or in the nearly level adjacent areas. Because of droughtiness, seedling mortality can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is only moderately well suited to building site development. The slope is a management concern. Buildings should be designed so that they conform to the natural slope of the land. The soil is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 4S; the Michigan soil management group is 5.7a.

40B—Nunica silt loam, 2 to 6 percent slopes. This very deep, gently undulating and undulating, moderately well drained soil is on low knolls and uplands. Individual areas are irregular in shape and range from 3 to 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is reddish brown, firm silty clay loam and grayish brown very fine sandy loam. The next part is reddish brown, firm silty clay loam. The lower part is brown, firm silty clay loam. The substratum to a depth of about 60 inches is light brown, mottled silt loam, silty clay loam, and silt.

Included with this soil in mapping are small areas of Bowers and Menominee soils. Bowers soils are somewhat poorly drained and are in depressions and drainageways. Menominee soils are sandy in the upper part of the subsoil. They are on low knolls and ridges. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow in the Nunica soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 3 to 5 feet from late fall through spring.

Most areas are used as cropland. Some are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cultivated crops and hay. The major management needs are measures that

control water erosion and help to prevent compaction. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Working the soil when it is too wet results in cloddiness and compaction, which inhibit root growth and alter the natural soil structure. Minimizing tillage and harvesting when the soil is too wet can help to prevent excessive compaction.

This soil is moderately well suited to building site development. The shrink-swell potential is the major concern. Constructing buildings with wider foundation trenches than is normal and backfilling with suitable coarse fill material can help to overcome the effects of shrinking and swelling. The soil is poorly suited to septic tank absorption fields because of the moderately slow permeability and the seasonal high water table. Enlarging the absorption field, mounding with suitable material, installing alternating drain fields, or pressurizing the absorption field helps to overcome these limitations.

The land capability classification is IIe; the woodland ordination symbol is 3L; the Michigan soil management group is 1.5a.

41A—Bowers silt loam, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is on flats and in depressions. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is light brownish gray, mottled silt loam about 2 inches thick. The subsoil is reddish brown, firm silty clay loam about 9 inches thick. The substratum to a depth of about 60 inches is pink and light reddish brown, mottled silty clay loam. In places the substratum is stratified very fine sand to silty clay.

Included with this soil in mapping are small areas of Allendale, Hettinger, and Nunica soils. Allendale soils are sandy in the upper part of the subsoil. They are on low knolls and ridges. Hettinger soils are poorly drained and are in depressions and drainageways. Nunica soils are moderately well drained and are on low knolls. Included soils make up 5 to 10 percent of the map unit.

Permeability is slow in the Bowers soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, the windthrow hazard, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is well suited to cropland. The wetness and compaction are the major management concerns. A subsurface drainage system can lower the water table. Minimizing tillage operations and delaying tillage and harvesting when the soil is wet help to prevent compaction and alteration of soil structure. A cropping sequence that includes grasses and legumes also helps to maintain soil structure.

This soil is poorly suited to building site development and is generally unsuited to septic tank absorption fields because of the wetness and the slow permeability. Constructing buildings on well compacted fill can help to overcome the wetness.

The land capability classification is IIw; the woodland ordination symbol is 7W; the Michigan soil management group is 1.5b.

42—Hettinger loam. This very deep, nearly level, poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsoil is about 19 inches thick. It is mottled and firm. The upper part is grayish brown silty clay loam. The lower part is light brownish gray silt loam. The substratum to a depth of about 60 inches is light brown, mottled, stratified silt loam, silty clay loam, and very fine sandy loam. Some areas have a thin organic surface layer.

Included with this soil in mapping are small areas of Cathro, Pinconning, and Bowers soils. Cathro soils have more than 16 inches of muck at the surface. They are in the lower swales and depressions. Pinconning soils have a sandy surface layer. They are in landscape positions similar to those of the Hettinger soil. Bowers soils are somewhat poorly drained and are in the

slightly higher landscape positions. Included soils make up 5 to 10 percent of the map unit.

Permeability is slow in the Hettinger soil. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the high water table, the loss of natural seedlings can be more than 50 percent. Trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

If adequately drained, this soil is well suited to cropland. Excess water, compaction, and a low soil temperature in the spring are the major management concerns. Surface and subsurface drainage systems can lower the water table. Minimizing tillage and delaying tillage and harvesting during periods when the soil is wet help to prevent compaction. Ridge tillage helps the soil to warm up and dry out in the spring, thus allowing earlier planting and faster germination.

Because of the high water table, the ponding, and the slow permeability, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw; the woodland ordination symbol is 6W; the Michigan soil management group is 1.5c

43B—Graycalm sand, 0 to 8 percent slopes. This very deep, nearly level to gently rolling, somewhat excessively drained soil is on uplands. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil to a depth of 60 inches is very friable sand. The upper part is brownish yellow and yellowish brown. The next part is light yellowish brown. The lower part is light yellowish brown and has very thin bands of strong brown, very friable loamy sand.

Included with this soil in mapping are small areas of Cheboygan, Rubicon, and Au Gres soils. Cheboygan and Rubicon soils are in landscape positions similar to those of the Graycalm soil. Cheboygan soils are well drained. They have finer textures in the subsoil than the Graycalm soil. Rubicon soils do not have bands of loamy sand in the subsoil. Au Gres soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Graycalm soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is fairly well suited to cropland and pasture. If crops are grown, soil blowing is a hazard. Droughtiness also is a management concern. Applying a system of conservation tillage, establishing windbreaks, returning crop residue to the soil, and planting cover crops help to control soil blowing and conserve moisture.

This soil is well suited to building site development and moderately well suited to septic tank absorption fields. A poor filtering capacity is the major management concern on sites for septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs; the woodland ordination symbol is 6S; the Michigan soil management group is 5a.

43C—Graycalm sand, 8 to 15 percent slopes. This very deep, gently rolling and rolling, somewhat excessively drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil extends

to a depth of about 60 inches. It is very friable sand. The upper part is brownish yellow and yellowish brown. The next part is light yellowish brown. The lower part is light yellowish brown and has very thin bands of strong brown, very friable loamy sand.

Included with this soil in mapping are small areas of Cheboygan and Rubicon soils. These soils are in landscape positions similar to those of the Graycalm soil. Cheboygan soils are well drained. They have finer textures in the subsoil than the Graycalm soil. Rubicon soils do not have bands of loamy sand in the subsoil. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Graycalm soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. This soil is generally unsuited to cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The slope limits the number of suitable landing sites. Landings can be established in small, nearly level areas, if any are available, or in the nearly level adjacent areas. Because of droughtiness, seedling losses can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is moderately well suited to building site development. The slope is a management concern. The buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The soil is poorly suited to septic tank absorption fields. The slope and a poor filtering capacity are limitations. Land shaping and installing distribution lines across the slope are generally necessary for the proper functioning of absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 6S; the Michigan soil management group is 5a.

43E—Graycalm sand, 15 to 35 percent slopes. This very deep, rolling to steep, somewhat excessively drained soil is on hills, ridges, and side slopes. Individual areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil extends to a depth of 60 inches. It is very friable sand. The upper part is brownish yellow and yellowish brown. The next part is light yellowish brown. The lower part is light yellowish brown and has very thin bands of strong brown, very friable loamy sand.

Included with this soil in mapping are small areas of Cheboygan and Rubicon soils. These soils are in landscape positions similar to those of the Graycalm soil. Cheboygan soils are well drained. They have finer textures in the subsoil than the Graycalm soil. Rubicon soils do not have bands of loamy sand in the subsoil. Included soils make up 10 to 15 percent of the map unit.

Permeability is rapid in the Graycalm soil. The available water capacity is low. Surface runoff is medium.

Because of the slope, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, the hazard of erosion, and seedling mortality. The slope and loose sand can interfere with the traction of wheeled equipment. Skid roads should be built on the contour or on the gentler slopes. The slope limits the selection of sites for logging roads and landings and can hinder tree planting operations. Erosion can result from the concentration of runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. Because of droughtiness, seedling losses can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is unsuited to building site development and septic tank absorption fields because of the slope and a poor filtering capacity.

The land capability classification is VIIs; the woodland ordination symbol is 6R; the Michigan soil management group is 5a.

44A—Au Gres sand, loamy substratum, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is in depressions, in drainageways, and on flats. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black, partially decomposed leaves and twigs about 2 inches thick. The subsurface layer is light brownish gray sand about 4 inches thick. The subsoil is about 44 inches thick. The upper part is dark reddish brown, mottled, friable sand. The next part is dark brown and yellowish brown, mottled, very friable sand. The lower part is brown, friable sandy loam. The substratum to a depth of about

60 inches is brown silty clay loam. In places the substratum is sandy loam.

Included with this soil in mapping are small areas of the Croswell soils that have a loamy substratum and small areas of Allendale and Pinconning soils. Croswell soils are moderately well drained and are on slight knolls and ridges. Allendale and Pinconning soils are in landscape positions similar to those of the Au Gres soil. Allendale soils have a loamy subsoil within a depth of 40 inches. Pinconning soils are poorly drained. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Au Gres soil and moderately slow in the loamy lower part. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the seasonal high water table, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the wetness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the wetness, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland, but some crops can be grown if the cropland is managed properly. The major management concerns are the wetness, soil blowing, and the low available water capacity. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, buffer strips, or field windbreaks help to prevent excessive soil loss or soil blowing.

This soil is poorly suited to building site development and septic tank absorption fields. The wetness is the major management concern on building sites. Installing subsurface drains can lower the water table. Constructing the buildings on raised, well compacted fill material also helps to overcome the wetness. The wetness and a poor filtering capacity are management concerns on sites for septic tank absorption fields. Filling or mounding with suitable material can raise the site above the level of wetness. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Using a pressurized sewage disposal system helps to overcome this limitation.

The land capability classification is IVw; the woodland ordination symbol is 6W; the Michigan soil management group is 5b.

45B—Croswell loamy sand, loamy substratum, 0 to 4 percent slopes. This very deep, nearly level and gently undulating, moderately well drained soil is on low knolls, low ridges, and upland flats. Individual areas are irregular in shape or long and narrow and range from 3 to 40 acres in size.

Typically, about 2 inches of dark reddish brown, partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown loamy sand about 4 inches thick. The subsurface layer is grayish brown sand about 6 inches thick. The subsoil is about 43 inches thick. The upper part is strong brown, very friable loamy sand that has some dark brown, medium-sized concretions or tongues of cemented loamy sand. The next part is light yellowish brown, very friable loamy sand. The lower part is light yellowish brown, mottled, very friable sand. The substratum to a depth of about 60 inches is pale brown, stratified very fine sandy loam and fine sandy loam. In some areas the soil has a clayey substratum.

Included with this soil in mapping are small areas of the Au Gres soils that have a loamy substratum and small areas of Rubicon soils. Au Gres soils are somewhat poorly drained and are in depressions and drainageways. Rubicon soils are somewhat excessively drained and are on the higher knolls and ridges. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Croswell soil and moderately slow in the loamy lower part. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 5.0 feet from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Because of droughtiness, seedling mortality can be as

high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cropland, but some crops can be grown if the cropland is managed properly. The major management concerns are soil blowing and the low available water capacity. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, buffer strips, and field windbreaks help to prevent excessive soil loss. Returning crop residue to the soil, growing green manure crops, or regularly adding other organic material increases the available water capacity.

This soil is moderately well suited to building site development. The wetness is a major management concern on sites for buildings with basements. Constructing the buildings on well compacted fill material helps to overcome the wetness. Installing an artificial drainage system can lower the seasonal high water table. The soil is poorly suited to septic tank absorption fields. The wetness and a poor filtering capacity are limitations. Filling or mounding with suitable material can raise the site above the level of wetness. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Using a pressurized sewage disposal system helps to overcome this limitation.

The land capability classification is IVs; the woodland ordination symbol is 7A; the Michigan soil management group is 5a.

47B—Cheboygan loamy sand, 0 to 6 percent slopes. This very deep, nearly level to undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface layer is black loamy sand about 5 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown and strong brown, very friable loamy sand that has a few chunks of cemented material. The lower part is reddish brown, friable sandy loam and brown, friable loamy sand. The substratum to a depth of 60 inches is light brown, firm sandy loam. In places the substratum is friable.

Included with this soil in mapping are small areas of Emmet, Melita, and Hagensville soils. Emmet and Melita soils are in landscape positions similar to those of the Cheboygan soil. Emmet soils have a loamy surface layer. Melita soils are somewhat excessively drained. They are deeper over loamy material than the Cheboygan soil. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the sandy upper part of the Cheboygan soil and very slow in the loamy lower part. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. The major management concerns are water erosion, droughtiness, a low content of organic matter, and soil blowing. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Field windbreaks, vegetative barriers, and winter cover crops help to control soil blowing. Applying a system of conservation tillage and periodically adding manure or other organic material to the soil can increase the available water capacity and the content of organic matter.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the very slow permeability. Increasing the size of the absorption fields, mounding with suitable material, installing alternating drain fields, or pressurizing the absorption fields helps to overcome this limitation.

The land capability classification is IIIs; the woodland ordination symbol is 3A; the Michigan soil management group is 4/2a.

47C—Cheboygan loamy sand, 6 to 12 percent slopes. This very deep, gently rolling, well drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is black loamy sand about 5 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown and strong brown, very friable loamy sand that has a few chunks of cemented material. The lower part is reddish

brown, friable sandy loam and brown, friable loamy sand. The substratum to a depth of 60 inches is light brown, firm sandy loam. In places the substratum is friable.

Included with this soil in mapping are small areas of Emmet, Melita, and Hagensville soils. Emmet and Melita soils are in landscape positions similar to those of the Cheboygan soil. Emmet soils have a loamy surface layer. Melita soils are somewhat excessively drained. They are deeper over loamy material than the Cheboygan soil. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the sandy upper part of the Cheboygan soil and very slow in the loamy lower part. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concern is plant competition. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. The major management concerns are water erosion, droughtiness, a low content of organic matter, and soil blowing. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Field windbreaks, vegetative barriers, and winter cover crops help to control soil blowing. Applying a system of conservation tillage and periodically adding manure or other organic material to the soil increase the available water capacity and the content of organic matter.

This soil is moderately well suited to building site development. The slope is a management concern. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The soil is poorly suited to septic tank absorption fields. The restricted permeability and the slope are the major management concerns. Land shaping and installing distribution lines across the slope can help to ensure that the absorption fields function properly. Enlarging the absorption fields, mounding with suitable material, installing alternating drain fields, or pressurizing the absorption fields helps to overcome the restricted permeability.

The land capability classification is IIIe; the woodland ordination symbol is 3A; the Michigan soil management group is 4/2a.

47D—Cheboygan loamy sand, 12 to 18 percent slopes. This very deep, rolling, well drained soil is on ridges, high knolls, and side slopes. Individual areas are irregular in shape or long and narrow and range from 5 to 50 acres in size.

Typically, the surface layer is black loamy sand about 5 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown and strong brown, very friable loamy sand that has a few chunks of cemented material. The lower part is reddish brown, friable sandy loam and brown, friable loamy sand. The substratum to a depth of 60 inches is light brown, firm sandy loam. In places the substratum is friable.

Included with this soil in mapping are small areas of Emmet and Melita soils. These soils are in landscape positions similar to those of the Cheboygan soil. Emmet soils have a loamy surface layer. Melita soils are somewhat excessively drained. They are deeper over loamy material than the Cheboygan soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the sandy upper part of the Cheboygan soil and very slow in the loamy lower part. The available water capacity is low. Surface runoff is medium.

Because of the slope, droughtiness, and soil blowing, this soil is poorly suited to cropland.

Where this soil is used as woodland, the major management concerns are the slope and plant competition. The slope limits the selection of sites for landings. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If this soil is used as cropland, the major management concerns are water erosion, droughtiness, a low content of organic matter, and soil blowing. Planting permanent grasses and legumes, applying a system of conservation tillage, and establishing grassed waterways can be effective in controlling water erosion. Field windbreaks, vegetative barriers, and winter cover crops help to control soil blowing. Conservation tillage and periodic additions of manure or other organic material increase the available water capacity and the content of organic matter.

This soil is moderately well suited to building site development. The slope is a management concern. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The soil is poorly suited to septic tank absorption fields. The slope and the

restricted permeability are management concerns. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. Enlarging the absorption fields, mounding with suitable material, installing alternating drain fields, or pressurizing the absorption fields helps to overcome the restricted permeability.

The land capability classification is IVe; the woodland ordination symbol is 3A; the Michigan soil management group is 4/2a.

47E—Cheboygan loamy sand, 18 to 35 percent slopes. This very deep, hilly and steep, well drained soil is on hills, ridges, and side slopes. Individual areas are irregular in shape or long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is black loamy sand about 5 inches thick. The subsurface layer is pinkish gray loamy sand about 4 inches thick. The subsoil is about 19 inches thick. The upper part is dark brown and strong brown, very friable loamy sand that has a few chunks of cemented material. The lower part is reddish brown, friable sandy loam and brown, friable loamy sand. The substratum to a depth of 60 inches is light brown, firm sandy loam. In places the substratum is friable.

Included with this soil in mapping are small areas of Emmet and Melita soils. These soils are in landscape positions similar to those of the Cheboygan soil. Emmet soils have a loamy surface layer. Melita soils are somewhat excessively drained. They are deeper over loamy material than the Cheboygan soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the sandy upper part of the Cheboygan soil and very slow in the loamy lower part. The available water capacity is low. Surface runoff is medium.

Because of the slope, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, the hazard of erosion, and plant competition. The slope can interfere with the traction of wheeled equipment. Skid roads should be built on the contour or on the gentler slopes. The slope also limits the selection of sites for logging roads and landings and can hinder tree planting operations. Erosion may result from the concentration of surface runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is unsuited to building site development and septic tank absorption fields because of the slope and the restricted permeability.

The land capability classification is VIIe; the woodland ordination symbol is 3R; the Michigan soil management group is 4/2a.

48B—Udipsamments, nearly level to undulating. These very deep, well drained and moderately well drained soils are in areas where the landscape has been disturbed. In most areas sandy material on ridges and knolls has been removed for use as fill or sand. In places depressions and flat swampy areas have been filled prior to construction. Some areas are gas and oil well sites. Individual areas are commonly irregularly shaped, square, or rectangular and range from 3 to 15 acres in size.

There is no sequence of topsoil, subsoil, and substratum because the original soils have been removed or covered. Permeability is rapid, and the available water capacity is low. Surface runoff is slow.

In some areas these soils are suited to building site development, and in others they are suited to recreational uses. Onsite investigation is needed to determine the suitability for specific uses.

No interpretive groups are assigned.

49—Beaches. This very deep, nearly level to gently rolling map unit consists of narrow strips along Lake Huron. It is frequently flooded and subject to ice build-up during winter. The surface is either cobbly or sandy. In some areas cobbles cover the entire surface.

Included in mapping are low dunes adjacent to the beaches. Some of the dunes support dunegrass and a few scattered coniferous trees and shrubs. In places escarpments are adjacent to the beaches.

This unit is unsuited to cropland, woodland, and building site development. Many areas are used for recreational development. Erosion, seepage, and instability are the major management concerns. In places bedrock is at or near the surface.

No interpretive groups are assigned.

50—Aquents. These very deep, nearly level, somewhat poorly drained or poorly drained soils are at well-drilling sites and in other disturbed areas. Individual areas range from 3 to 10 acres in size.

Included in mapping are small areas of undisturbed soils. These soils make up less than 15 percent of the map unit.

The soil properties in this unit vary greatly and

should be determined by onsite investigation.

Most of the acreage is idle land. Some areas do not have a plant cover.

The suitability of these soils for cropland, woodland, pasture, building site development, and recreational uses varies greatly. Onsite investigation is needed to determine the management needed to overcome the major hazards and limitations.

No interpretive groups are assigned.

51B—East Lake sand, 0 to 8 percent slopes. This very deep, nearly level to gently rolling, somewhat excessively drained soil is on uplands and plains. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, about 1 inch of black, partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown sand about 2 inches thick. The subsurface layer is brown sand about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, very friable loamy sand. The next part is strong brown, loose sand. The lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is pale brown, stratified sand and gravel. In places a thin layer of gravelly sandy loam is above the substratum.

Included with this soil in mapping are small areas of Rubicon, Eastport, and Gladwin soils. Rubicon and Eastport soils are in landscape positions similar to those of the East Lake soil. They are sandy throughout. Rubicon soils are more acid than the East Lake soil. Gladwin soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 3 to 15 percent of the map unit.

Permeability is rapid in the East Lake soil. The available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is fairly well suited to cropland and pasture. Soil blowing is a hazard in cultivated areas. Droughtiness also is a management concern. Applying a system of conservation tillage, establishing windbreaks, returning crop residue to the soil, and growing cover crops help to control soil blowing and conserve moisture.

This soil is well suited to building site development but is only moderately well suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs; the woodland ordination symbol is 2S; the Michigan soil management group is 5a.

51C—East Lake sand, 8 to 15 percent slopes. This very deep, gently rolling and rolling, somewhat excessively drained soil is on ridges, knolls, and side slopes. Individual areas are irregular in shape and range from 5 to more than 40 acres in size.

Typically, about 1 inch of black, partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown sand about 2 inches thick. The subsurface layer is brown sand about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, very friable loamy sand. The next part is strong brown, loose sand. The lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is pale brown, stratified sand and gravel. In places a thin layer of gravelly sandy loam is above the substratum.

Included with this soil in mapping are small areas of Rubicon, Eastport, and Gladwin soils. Rubicon and Eastport soils are in landscape positions similar to those of the East Lake soil. They are sandy throughout. Rubicon soils are more acid than the East Lake soil. Gladwin soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 3 to 15 percent of the map unit.

Permeability is rapid in the East Lake soil. The available water capacity is low. Surface runoff is slow.

Because of the slope, droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is moderately well suited to building site development. The slope is a management concern.

Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some places. The soil is poorly suited to septic tank absorption fields. The slope and a poor filtering capacity are management concerns. Land shaping and installing the distribution lines across the slope help to ensure that the absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 2S; the Michigan soil management group is 5a.

51E—East Lake sand, 15 to 35 percent slopes. This very deep, rolling to steep, somewhat excessively drained soil is on hills, ridges, and side slopes. Individual areas are irregular in shape or long and narrow and range from 5 to 40 acres in size.

Typically, about 1 inch of black, partially decomposed forest litter is at the surface. The surface layer is very dark grayish brown sand about 2 inches thick. The subsurface layer is brown sand about 7 inches thick. The subsoil is about 27 inches thick. The upper part is dark brown, very friable loamy sand. The next part is strong brown, loose sand. The lower part is brownish yellow, loose sand. The substratum to a depth of about 60 inches is pale brown, stratified sand and gravel. In places a thin layer of gravelly sandy loam is above the substratum.

Included with this soil in mapping are small areas of Rubicon and Eastport soils. These soils are in landscape positions similar to those of the East Lake soil. They are sandy throughout. They make up 5 to 15 percent of the map unit.

Permeability is rapid in the East Lake soil. The available water capacity is low. Surface runoff is medium.

Because of the slope, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. Loose sand and the slope can interfere with the traction of wheeled equipment. Skid roads should be built on the contour or on the gentler slopes. The slope limits the selection of sites for logging roads and landings and can hinder the use of planting equipment. Erosion can result from the concentration of surface runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent, especially on southern exposures. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is unsuited to building site development and septic tank absorption fields because of the slope and a poor filtering capacity.

The land capability classification is VIIs; the woodland ordination symbol is 2R; the Michigan soil management group is 5a.

52A—Hagensville fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is in depressions and drainageways and on flats. Individual areas are irregular in shape or long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is yellowish brown, mottled, friable fine sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is sandy loam. It is mottled. The upper part is brown, and the lower part is yellowish brown.

Included with this soil in mapping are small areas of Hessel and Omena soils. Hessel soils are poorly drained and are lower on the landscape than the Hagensville soil. Omena soils are well drained and are on knolls. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Hagensville soil. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 2.0 feet from late fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the wetness, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are

cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is well suited to cropland. The major management concerns are the wetness and soil blowing. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface helps to prevent excessive soil loss. Cover crops, buffer strips, vegetative barriers, and field windbreaks also help to control soil blowing.

This soil is poorly suited to building site development and septic tank absorption fields because of the wetness. Building sites can be raised by using suitable well compacted fill material. On sites for septic tank absorption fields, mounding with suitable material and pressurizing the absorption field help to overcome the wetness.

The land capability classification is IIw; the woodland ordination symbol is 3W; the Michigan soil management group is 3b.

52B—Hagensville fine sandy loam, 2 to 6 percent slopes. This very deep, very gently sloping and undulating, somewhat poorly drained soil is in depressions and drainageways and on low knolls and ridges. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is yellowish brown, mottled, friable fine sandy loam about 4 inches thick. The substratum to a depth of about 60 inches is sandy loam. It is mottled. The upper part is brown, and the lower part is yellowish brown.

Included with this soil in mapping are small areas of Hessel and Omena soils. Hessel soils are poorly drained and are lower on the landscape than the Hagensville soil. Omena soils are well drained and are on knolls. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Hagensville soil. Surface runoff is medium. The seasonal high water table is at a depth of 0.5 inch to 2.0 inches from late fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

If adequately drained, this soil is well suited to cropland. The major management concerns are water erosion, the wetness, and soil blowing. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, grassed waterways, and cover crops help to control water erosion. Buffer strips, vegetative barriers, cover crops, and field windbreaks help to control soil blowing.

This soil is poorly suited to building site development and septic tank absorption fields because of the wetness. Building sites can be raised by using suitable well compacted fill material. On sites for septic tank absorption fields, mounding with suitable material and pressurizing the absorption field help to overcome the wetness.

The land capability classification is IIe; the woodland ordination symbol is 3W; the Michigan soil management group is 3b.

53—Hessel loam. This very deep, nearly level, poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 3 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is mottled, grayish brown, friable fine sandy loam about 4 inches thick. The substratum to a depth of 60 inches is mottled, grayish brown gravelly fine sandy loam. In some areas the subsoil is loam.

Included with this soil in mapping are small areas of Cathro and Hagensville soils. Cathro soils are very poorly drained. They have a thick, organic surface

layer. They are lower on the landscape than the Hessel soil. Hagensville soils are somewhat poorly drained and are on low knolls and at the edges of the map unit. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow in the Hessel soil. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Ruts form easily if skidders are used when the soil is wet. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, losses of natural seedlings can be more than 50 percent. Because of the high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

If adequately drained, this soil is moderately well suited to cropland. The major management concerns are the wetness and a low soil temperature in the spring. A surface and subsurface drainage system can lower the water table. Ridge tillage helps the soil to warm up and dry out in spring, thus allowing earlier planting and faster germination.

This soil is unsuited to building site development and septic tank absorption fields because of the wetness and the ponding.

The land capability classification is Vw; the woodland ordination symbol is 6W; the Michigan soil management group is 3c.

55B—Johnswood very flaggy loam, 1 to 6 percent slopes. This deep, nearly level to undulating, moderately well drained soil is on flats above and below limestone escarpments and on beach ridges. Individual areas are irregular in shape and range from 3 to 250 acres in size.

Typically, about 2 inches of dark brown, partially decomposed twigs and leaves is at the surface. The surface layer is black very flaggy loam about 5 inches thick. The subsoil is dark yellowish brown, mottled, firm very flaggy clay loam about 8 inches thick. The substratum to a depth of 60 inches is dark grayish brown very flaggy loam. In some places bedrock is at a depth of more than 40 inches. In other places stones and small boulders are at the surface.

Included with this soil in mapping are small areas of Cunard and Detour soils. Cunard soils have limestone bedrock within a depth of 40 inches. They are in landscape positions similar to those of the Johnswood soil. Detour soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 15 percent of the map unit.

Permeability is slow in the Johnswood soil. The available water capacity is low. Surface runoff is medium. A perched water table is within a depth of 1 to 2 feet for brief periods from fall through spring and during other periods of high precipitation.

Because of the content of rock fragments, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, the windthrow hazard, seedling mortality, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. The flaggy and stony surface can hinder the use of planting equipment and reduce the operating speed of skidders. Because of the high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to building site development and septic tank absorption fields because of the wetness, the large stones, and the slow permeability. Overcoming these limitations is difficult and generally impractical.

The land capability classification is VIs; the woodland ordination symbol is 3F; the Michigan soil management group is 3a.

56C—Deer Park-Croswell-Au Gres complex, 0 to 12 percent slopes. These very deep, gently undulating to gently rolling, excessively drained to somewhat poorly drained soils are on beach ridges and in swales

near Lake Huron. Individual areas are irregular in shape or long and narrow and generally are parallel to Lake Huron. They range from 20 to 500 acres in size.

The Deer Park soil makes up about 40 to 50 percent of the unit, the Croswell soil 20 to 30 percent, and the Au Gres soil 15 to 25 percent. The three soils occur as areas so narrow that mapping them separately was not practical at the scale used in mapping.

Typically, the Deer Park soil has a surface layer of black sand about 2 inches thick. The subsurface layer is pale brown sand about 6 inches thick. The subsoil is yellowish brown, loose sand about 20 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Typically, the Croswell soil has about 1 inch of dark reddish brown, partially decomposed forest litter at the surface. The surface layer is very dark grayish brown sand about 4 inches thick. The subsurface layer is grayish brown sand about 6 inches thick. The subsoil is sand about 23 inches thick. The upper part is strong brown and very friable. The next part is yellowish brown, mottled, and very friable. The lower part is brownish yellow, mottled, and loose. The substratum to a depth of about 60 inches is light yellowish brown, mottled sand. In places the soil is fine sand. In some areas the subsoil is weakly cemented.

Typically, the Au Gres soil has a surface layer of black, partially decomposed forest litter about 2 inches thick. The subsurface layer is light brownish gray sand about 4 inches thick. The subsoil is about 26 inches thick. The upper part is dark reddish brown, mottled, very friable loamy sand. The lower part is yellowish brown, mottled, very friable sand. The substratum to a depth of 60 inches is yellowish brown sand. In some areas thin strata of gravel are in the substratum.

Included with these soils in mapping are small areas of Roscommon and Tawas soils. Roscommon soils are poorly drained. Tawas soils are very poorly drained. They a have thick surface layer of muck. Included soils make up 0 to 10 percent of the map unit.

Permeability is rapid in the Deer Park, Croswell, and Au Gres soils. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2.0 to 4.0 feet in the Croswell soil and at a depth of 0.5 foot to 1.5 feet in the Au Gres soil from late fall through spring.

Because of the complex slopes and the wetness, these soils are generally unsuited to cropland.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the high water table in the Au Gres soil, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. The best sites for landings are the nearly level areas of Deer Park and Croswell soils. Loose sand in heavily traveled areas of the Deer Park and Croswell soils can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness in the Deer Park soil, seedling mortality can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. Because of the wetness of the Au Gres soil, windthrow can be a problem. It can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration on the Au Gres soil unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

The Deer Park soil is well suited to building site development. Because of the wetness, the Croswell soil is only moderately well suited to buildings with basements and the Au Gres soil is poorly suited to building site development. Mounding the site with well compacted fill material helps to overcome the wetness. All of the soils are poorly suited to septic tank absorption fields because of a poor filtering capacity. They readily absorb but do not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIIs; the woodland ordination symbols are 4S, 5S, and 6W; the Michigan soil management groups are 5.3a, 5a, and 5b.

57A—Grace very fine sandy loam, moderately wet, 0 to 2 percent slopes. This very deep, nearly level, moderately well drained soil is on upland flats. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable very fine sandy loam surrounded by pale brown loamy very fine sand. The next part is brown, friable very fine sandy loam. The lower part is brown and light yellowish brown, friable very fine sandy loam. The substratum to a depth of 60 inches is light brown, mottled, stratified very fine sandy loam and loamy very fine sand. In places very thin lenses of fine sand, silt, and clay are in the substratum.

Included with this soil in mapping are small areas of Moltke and Glawe soils. These soils are in depressions and drainageways. Moltke soils are somewhat poorly drained, and Glawe soils are poorly drained. Included

soils make up 0 to 5 percent of the map unit.

Permeability is moderate in the Grace soil. The available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 3 to 5 feet from late fall through spring.

Most areas are used as cropland. A few are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in the spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cropland. The major management concern is soil blowing. Applying a system of conservation tillage or planting field windbreaks, vegetative barriers, or winter cover crops can help to control soil blowing.

This soil is only moderately well suited to building site development and septic tank absorption fields because of the wetness. Buildings with basements can be constructed on well compacted fill material, which raises the site above the level of wetness. A subsurface drainage system can lower the seasonal high water table. On sites for septic tank absorption fields, filling or mounding with suitable material can raise the site above the level of wetness.

The land capability classification is IIs; the woodland ordination symbol is 3L; the Michigan soil management group is 3a-s.

57B—Grace very fine sandy loam, 2 to 6 percent slopes. This very deep, very gently sloping and undulating, well drained soil is on uplands. Individual areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part is dark yellowish brown, friable very fine sandy loam surrounded by pale brown loamy very fine sand. The next part is brown, friable very fine sandy loam. The lower part is brown and light yellowish brown, friable very fine sandy loam. The substratum to a depth of about 60 inches is light brown, stratified very fine sandy loam and loamy very fine sand. In places the soil has very thin lenses of fine sand, silt, or clay.

Included with this soil in mapping are small areas of Moltke and Glawe soils. These soils are in depressions and drainageways. Moltke soils are somewhat poorly drained, and Glawe soils are poorly drained. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the Grace soil. The available water capacity is high. Surface runoff is medium.

Most areas are used as cropland. A few are used as woodland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in the spring and during other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to cropland. The major management concerns are water erosion and soil blowing. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Applying a system of conservation tillage or establishing field windbreaks, vegetative barriers, or winter cover crops helps to control soil blowing.

This soil is well suited to building site development. It is only moderately well suited to septic tank absorption fields because of the moderate permeability. Enlarging or pressurizing the absorption field or installing alternating drain fields helps to overcome the restricted permeability.

The land capability classification is IIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a-s.

58B—Kalkaska sand, 0 to 8 percent slopes. This very deep, nearly level to gently rolling, somewhat excessively drained soil is on uplands. Individual areas are irregular in shape and range from 3 to 80 acres in size.

Typically, about 3 inches of partially decomposed leaf litter is at the surface. The surface layer is brown sand about 8 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark reddish brown and has some weakly cemented material. The lower part is dark yellowish brown and yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Rubicon, Croswell, and Au Gres soils. Rubicon soils have lighter colors in the upper part of the subsoil than the Kalkaska soil. They are in landscape positions

similar to those of the Kalkaska soil. Croswell soils are moderately well drained and are in low depressions. Au Gres soils are somewhat poorly drained and are in low depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is very slow.

Because of droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is poorly suited to cropland. Some crops can be grown, however, if the cropland is properly managed. A system of conservation tillage that leaves crop residue on the surface conserves moisture and helps to control soil blowing. The best suited crops are those that are tolerant of drought. The supply of available moisture is not adequate for other crops.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is well suited to building site development but is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs; the woodland ordination symbol is 3S; the Michigan soil management group is 5a.

58C—Kalkaska sand, 8 to 15 percent slopes. This very deep, gently rolling and rolling, somewhat excessively drained soil is on side slopes, knolls, and ridges. Individual areas are irregular in shape and range from 3 to 80 acres in size.

Typically, about 3 inches of partially decomposed leaf litter is at the surface. The surface layer is brown sand about 8 inches thick. The subsoil is very friable sand about 30 inches thick. The upper part is dark reddish brown and has some weakly cemented material. The lower part is dark yellowish brown and yellowish brown. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Cheboygan and Rubicon soils. These soils are in landscape positions similar to those of the Kalkaska soil. Cheboygan soils are well drained and have a loamy substratum. Rubicon soils have lighter colors in the upper part of the subsoil than the Kalkaska soil. Included soils make up 1 to 15 percent of the map unit.

Permeability is rapid in the Kalkaska soil. The available water capacity is low. Surface runoff is slow.

Because of the slope, droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is generally unsuited to cropland. Most areas are used as woodland (fig. 5).

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is moderately well suited to building site development. The slope is a management concern. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The soil is poorly suited to septic tank absorption fields. The slope and a poor filtering capacity are management concerns. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 3S; the Michigan soil management group is 5a.

59—Aquents and Histosols, ponded. This map unit consists of very deep, very poorly drained, nearly level mineral and organic soils. These soils are mainly in marsh areas, where the vegetation consists of cattails, reeds, grasses, woody shrubs, and scattered clumps of trees that are tolerant of wetness. They are also in swamps, where the vegetation consists of trees. In most areas the soils are ponded during most of the year. Individual areas are irregular in shape or long and narrow and range from 4 to more than 200 acres in size.

Included with these soils in mapping are small areas of poorly drained and somewhat poorly drained soils. Included soils make up less than 15 percent of the map unit.

Where these soils are used as woodland, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the wetness

Figure 5.—Northern hardwoods in an area of Kalkaska sand, 8 to 15 percent slopes.

and an organic surface layer, the loss of natural seedlings can be more than 50 percent. Because of the wetness, the trees on these soils are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, the severe seedling mortality rate, and plant competition, trees are generally not planted on these soils.

No interpretive groups are assigned.

60B—Deer Park sand, 1 to 8 percent slopes. This very deep, nearly level to gently rolling, excessively drained soil is on low ridges and on the side slopes of stabilized sand dunes. Individual areas are long and narrow and are within 1 mile of the Lake Huron shoreline. They range from 5 to 50 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is pale brown sand about 6 inches thick. The subsoil is yellowish brown, loose sand about 20 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Eastport, Croswell, and Au Gres soils. Eastport soils are less acid than the Deer Park soil. They are on the lower dunes and beach ridges. The moderately well drained Croswell and somewhat poorly drained Au Gres soils are in depressions and between beach ridges and dunes. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Deer Park soil. The available water capacity is very low. Surface runoff is very slow.

Because of droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is well suited to building site development but is only moderately well suited to septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIIs; the woodland ordination symbol is 4S; the Michigan soil management group is 5.3a.

60C—Deer Park sand, 8 to 15 percent slopes. This very deep, gently rolling, excessively drained soil is on ridges and on the side slopes of stabilized sand dunes. Individual areas are long and narrow and are within 1 mile of the Lake Huron shoreline. They range from 5 to 60 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is pale brown sand about 6 inches thick. The subsoil is yellowish brown, loose sand about 20 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Eastport, Croswell, and Au Gres soils. Eastport soils are less acid than the Deer Park soil. They are on the lower dunes and beach ridges. The moderately well drained Croswell and somewhat poorly drained Au Gres

soils are in depressions and between beach ridges and dunes. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Deer Park soil. The available water capacity is very low. Surface runoff is slow.

Because of the slope, droughtiness, a scarcity of plant nutrients, and soil blowing, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is moderately well suited to building site development and septic tank absorption fields. The slope is a management concern on building sites. The buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. The slope and a poor filtering capacity are management concerns on sites for septic tank absorption fields. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIIs; the woodland ordination symbol is 4S; the Michigan soil management group is 5.3a.

60E—Deer Park sand, 15 to 45 percent slopes. This very deep, rolling to steep, excessively drained soil is on hills, ridges, and the side slopes of stabilized sand dunes. Individual areas are long and narrow and are within 1 mile of the Lake Huron shoreline. They range from 5 to 40 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is pale brown sand about 6 inches thick. The subsoil is yellowish brown, loose sand about 20 inches thick. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Eastport and Croswell soils. Eastport soils are less acid than the Deer Park soil. They are on the lower dunes and beach ridges. Croswell soils are moderately well drained and are in depressions and between dunes. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Deer Park soil. The available water capacity is very low. Surface runoff is medium.

Because of the slope, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, the erosion hazard, and seedling mortality. Loose sand and steep slopes can interfere with the traction of wheeled equipment. Skid roads should be built on the contour or on the gentler slopes. The slope limits the selection of sites for logging roads and landings and can hinder the use of planting equipment. Erosion may result from the concentration of surface runoff on logging roads, on skid roads, in the tracks of wheeled equipment, and on landings. Removing water with water bars, out-sloping or in-sloping road surfaces, culverts, and drop structures and seeding roads and trails after the trees are logged help to prevent excessive soil loss. Because of droughtiness, seedling losses can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

Because of the slope, this soil is unsuited to building site development and septic tank absorption fields. A poor filtering capacity is an additional limitation on sites for septic tank absorption fields.

The land capability classification is VIIs; the woodland ordination symbol is 4R; the Michigan soil management group is 5.3a.

62—Dawson peat. This very deep, nearly level, very poorly drained soil is in depressions. It is subject to ponding. Individual areas are irregular in shape or long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is pale olive peat about 4 inches thick. The next layer is black muck about 20 inches thick. The substratum to a depth of about 60 inches is brown sand.

Included with this soil in mapping are small areas of Greenwood and Kinross soils. Greenwood soils have organic deposits more than 50 inches thick. They are in landscape positions similar to those of the Dawson soil. Kinross soils are poorly drained and do not have a thick organic surface layer. They are near the edges of the map unit and on slight rises. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow to moderately rapid in the organic part of the Dawson soil and rapid in the sandy material. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from early fall through spring.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Ordinary crawler tractors and rubber-tired skidders generally cannot be used on this soil. Special harvesting equipment is needed. The equipment can be used during periods in winter when access roads are frozen. Because of the wetness and the organic surface layer, the loss of natural seedlings can be more than 50 percent. Because of the wetness, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

Because of low strength and the ponding, this soil is unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIw; the woodland ordination symbol is 2W; the Michigan soil management group is M/4c-a.

63—Pits, borrow. This map unit consists of areas from which gravel, sand, or other material has been removed for use as fill or aggregate. In most areas the exposed underlying material is calcareous and supports little or no vegetation. Areas that are excavated to a depth below the water table are subject to ponding. Individual areas of this map unit range from 3 to 200 acres in size.

Many areas are actively mined sand or gravel pits. Some contain trash or other debris. Onsite investigation is needed to determine the suitability of this map unit for any use.

No interpretive groups are assigned.

64A—Ensign flaggy loam, 0 to 3 percent slopes. This shallow, nearly level and very gently sloping, somewhat poorly drained soil is in drainageways, in depressions, and on flats. Individual areas are irregular in shape or long and narrow and range from 3 to more than 100 acres in size.

Typically, the surface layer is black flaggy loam about 4 inches thick. The next layer is very dark grayish brown flaggy loam about 5 inches thick. The subsoil is dark brown, mottled, friable flaggy loam about 6 inches thick. Limestone bedrock is at a depth of about 15 inches. In places a substratum of sandy loam is directly above the limestone bedrock.

Included with this soil in mapping are small areas of Bonduel, Summerville, and Ruse soils. Bonduel soils have limestone bedrock at a depth of 20 to 40 inches. They are in landscape positions similar to those of the Ensign soil. Summerville soils are well drained and are on low ridges. Ruse soils are poorly drained and are lower on the landscape than the Ensign soil. Also included are areas of soils that are very flaggy. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the Ensign soil. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.0 foot from late fall through spring.

Because of the wetness, the content of rock fragments, and the depth to bedrock, this soil is generally unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, the windthrow hazard, seedling mortality, and plant competition. Ruts form easily if skidders are used when the soil is wet. Where deep ruts have formed, lateral drainage can be restricted, soil structure altered, and tree roots damaged. Consequently, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. Because of the high water table and the depth to bedrock, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Because of the wetness and the depth to bedrock, the seedling mortality rate can be high. After the trees are harvested, plant competition can be expected to delay natural regeneration unless precautionary measures are applied.

This soil is unsuited to building site development and septic tank absorption fields because of the depth to bedrock and the wetness.

The land capability classification is VIIw; the woodland ordination symbol is 2W; the Michigan soil management group is Rbc.

65—Wheatley muck. This very deep, nearly level, poorly drained or very poorly drained soil is in depressions, in drainageways, and on low flats. It is subject to ponding. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is black muck about 6 inches thick. The next layer is very dark gray loamy sand about 2 inches thick. The upper part of the substratum is dark grayish brown sand. The next part is dark grayish brown, mottled gravelly sand. The lower part to a depth of 60 inches is grayish brown very gravelly sand.

Included with this soil in mapping are small areas of

Tawas, Gladwin, and Esau soils. Tawas soils have a thick organic surface layer. They are in landscape positions similar to those of the Wheatley soil. Gladwin and Esau soils are somewhat poorly drained and are on low ridges and knolls. Esau soils have a loamy surface layer over very gravelly sand. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Wheatley soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, the loss of natural seedlings can be more than 50 percent. Because of the high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

This soil is unsuited to building site development and septic tank absorption fields because of the high water table and the ponding.

The land capability classification is Vw; the woodland ordination symbol is 2W; the Michigan soil management group is 5c.

66C—Wallace sand, 2 to 15 percent slopes. This very deep, very gently rolling to rolling, well drained soil is on ridges and side slopes. Individual areas are long and narrow and range from 4 to 40 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsurface layer is light gray sand about 7 inches thick. The subsoil is about 30 inches thick. The upper part is dark reddish brown sand that is about 60 percent strongly cemented. The rest of the upper part is very friable. The cemented material extends in tongues to a depth of about 39 inches. The lower part of the subsoil is brown and yellowish brown, loose sand. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Rubicon and Au Gres soils. Rubicon soils are excessively drained and are in landscape positions similar to those of the Wallace soil. They have a lighter colored subsoil than the Wallace soil. Also, they have less cemented material. Au Gres soils are somewhat poorly drained and are in depressions. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow in the cemented part of the Wallace soil and rapid in the rest of the profile. The available water capacity is very low. Surface runoff is slow.

Because of droughtiness, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is poorly suited to building site development because of the slope and the cemented subsoil. It is poorly suited to septic tank absorption fields because of the slope, the restricted permeability in the cemented part, and a poor filtering capacity. These limitations are difficult to overcome.

The land capability classification is VIs; the woodland ordination symbol is 6D; the Michigan soil management group is 5a-h.

67B—Eastport sand, 1 to 8 percent slopes. This very deep, nearly level to gently rolling, excessively drained soil is on low beach ridges and upland flats. Individual areas are long and narrow and range from 3 to 100 acres in size.

Typically, the surface layer is black sand about 1 inch thick. The subsurface layer is grayish brown sand about 2 inches thick. The subsoil is yellowish brown, strong brown, and light yellowish brown, loose sand about 32 inches thick. The substratum to a depth of about 60 inches is very pale brown sand.

Included with this soil in mapping are small areas of East Lake, Croswell, and Au Gres soils. East Lake soils are somewhat excessively drained and are on upland flats and beach ridges. They have a gravelly substratum. The moderately well drained Croswell and somewhat poorly drained Au Gres soils are in depressions, in drainageways, and between dunes and beach ridges. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Eastport soil. The

available water capacity is low. Surface runoff is slow.

This soil is generally unsuited to cropland and pasture because of droughtiness, a scarcity of plant nutrients, and soil blowing.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. The best sites for landings are the nearly level areas. Because of droughtiness, seedling mortality can be more than 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is well suited to building site development but only moderately well suited to septic tank absorption fields. The soil readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 7S; the Michigan soil management group is 5.3a.

69A—Winterfield loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is on terraces and sand bars along rivers and creeks. It is subject to flooding during periods of rapid spring snowmelt and extremely heavy rains. Individual areas are irregular in shape or long and narrow and range from 3 to 20 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 6 inches thick. The upper part of the substratum is yellowish brown, mottled fine sand. The lower part to a depth of about 60 inches is light yellowish brown, mottled fine sand and pale brown loamy fine sand that has a few thin organic streaks. In places the substratum is very stony below a depth of 30 or 40 inches.

Included with this soil in mapping are small areas of Evart and Tawas soils. These soils are in depressions and oxbows. Evart soils are poorly drained. Tawas soils are very poorly drained and have a thick organic surface layer. Also included are small areas of the adjacent upland soils. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Winterfield soil. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall through spring and during other periods of high precipitation.

Because of the hazard of flooding, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. The use of equipment is briefly restricted in spring during periods of flooding and in other excessively wet periods. Equipment should be used only when the soil is relatively dry or when access roads are sufficiently frozen. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate wetness or using special methods of site preparation, such as bedding before planting, helps to reduce the seedling mortality rate. Because of the high water table, the trees on this soil are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants.

This soil is unsuited to building site development and septic tank absorption fields because of the hazard of flooding and the high water table.

The land capability classification is VIIw; the woodland ordination symbol is 6W; the Michigan soil management group is L-4c.

70A—Au Gres-Roscommon complex, 0 to 3 percent slopes. These very deep soils are nearly level and very gently sloping. The somewhat poorly drained Au Gres soil is on low knolls. The poorly drained Roscommon soil is on flats. The Roscommon soil is subject to ponding. Individual areas of this unit are irregular in shape or long and narrow and range from 10 to 200 acres in size.

The Au Gres soil makes up about 35 to 60 percent of the unit, and the Roscommon soil makes up 30 to 35 percent. The two soils occur as areas so intricately mixed or so narrow that mapping them separately was not practical at the scale used in mapping.

Typically, the Au Gres soil has about 2 inches of black, partially decomposed forest litter at the surface. The surface layer is light brownish gray sand about 4 inches thick. The subsoil is about 26 inches thick. It is mottled. The upper part is dark reddish brown, very friable loamy sand, and the lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is yellowish brown sand.

Typically, the Roscommon soil has a surface layer of black muck about 4 inches thick. The substratum to a depth of 60 inches is dark grayish brown, brown, and pale brown, mottled sand. In some areas the soil has a thin organic surface layer.

Included with these soils in mapping are small areas of Tawas and Croswell soils. Tawas soils are very poorly drained and have a thick organic surface layer. They are in landscape positions similar to those of the Roscommon soil. Croswell soils are moderately well drained and are on the higher knolls and on low ridges. Included soils make up 3 to 10 percent of the map unit.

Permeability is rapid in the Au Gres and Roscommon soils. The available water capacity is low. Surface runoff is very slow on the Au Gres soil and very slow or ponded on the Roscommon soil. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet in the Au Gres soil and near or above the surface in the Roscommon soil from fall through spring.

Because of the wetness, these soils are generally unsuited to cropland.

These soils are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the high water table, the use of equipment is limited to periods when the soil is relatively dry or when access roads are frozen. Year-round roads on the Roscommon soil require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, seedling losses can be as high as 25 to 50 percent on the Au Gres soil and can be more than 50 percent on the Roscommon soil. Because of the seasonal high water table, the trees on these soils are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Trees generally are not planted on the Roscommon soil because of the wetness and plant competition. If trees are planted on the Au Gres soil, site preparation by mechanical or chemical means is needed to control competing vegetation.

The Au Gres soil is poorly suited to building site development and septic tank absorption fields. The wetness is a limitation on building sites. Installing subsurface drains and constructing the buildings on raised, well compacted fill material can help to overcome this limitation. The wetness and a poor filtering capacity are limitations on sites for septic tank absorption fields. Filling or mounding the absorption field with suitable material can raise the site above the level of wetness. Pressurizing the absorption field can also help to overcome the wetness. The soil does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. The Roscommon soil is unsuited to building site development and septic tank absorption fields because of the seasonal high water table and the ponding.

The land capability classification is IVw; the woodland ordination symbol is 6W; the Michigan soil management groups are 5b and 5c.

71—Roscommon-Tawas complex. These very deep, nearly level soils are in depressions, on low flats, and in swales. They are subject to ponding. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

The poorly drained Roscommon soil makes up about 40 to 60 percent of the unit, and the very poorly drained Tawas soil makes up 35 to 40 percent. The two soils occur as areas so intricately mixed that mapping them separately was not practical at the scale used in mapping.

Typically, the Roscommon soil has a surface layer of black muck about 4 inches thick. The substratum to a depth of 60 inches is dark grayish brown, brown, and pale brown, mottled sand.

Typically, the Tawas soil has a surface layer of black muck about 8 inches thick. The next layer is black muck about 10 inches thick. The substratum extends to a depth of 60 inches. It is sand. It is pale brown in the upper part and dark reddish gray in the lower part.

Included with these soils in mapping are small areas of Lupton, Au Gres, and Croswell soils. Lupton soils formed in thick deposits of organic material. They are in landscape positions similar to those of the Roscommon and Tawas soils. Au Gres soils are somewhat poorly drained and are slightly higher on the landscape than the Roscommon and Tawas soils. Croswell soils are moderately well drained and are on low knolls and ridges. Included soils make up 0 to 15 percent of the map unit.

Permeability is rapid in the Roscommon soil. It is moderately slow to moderately rapid in the mucky layers of the Tawas soil and rapid in the underlying sand. The available water capacity is low in the Roscommon soil and high in the Tawas soil. Surface runoff is very slow or ponded on both soils. The seasonal high water table is near or above the surface from fall through spring.

Because of the wetness and the hazard of frost, these soils are unsuited to cropland.

These soils are used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, the use of equipment on the Roscommon soil is limited to periods when the soil is relatively dry or sufficiently frozen. Year-round roads on the Roscommon soil require roadfill and gravel, and culverts are needed to maintain the natural drainage

system. Ordinary crawler tractors and rubber-tired skidders generally cannot be used on the Tawas soil because of the wetness and the organic surface layer. Because of the wetness, the loss of natural seedlings can be more than 50 percent on these soils. Because of the high water table, the trees on these soils are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are harvested, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on these soils.

Because of the high water table and the ponding on both soils and low strength in the Tawas soil, this unit is unsuited to building site development and septic tank absorption fields.

The land capability classification is Vlw; the woodland ordination symbols are 6W and 5W; the Michigan soil management groups are 5c and M/4c.

73A—Omena fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, well drained soil is on uplands. Individual areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is sandy loam about 5 inches thick. The upper part is strong brown and firm, and the lower part is dark yellowish brown and friable. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam. In some cultivated areas, all of the subsoil has been incorporated into the surface layer.

Included with this soil in mapping are small areas of Onaway, Krakow, and Hagensville soils. Onaway and Krakow soils are in landscape positions similar to those of the Omena soil. Onaway soils have a subsoil that is thicker than that of the Omena soil. Krakow soils are very flaggy in the subsoil and in some areas have limestone bedrock at a depth of more than 40 inches. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 20 percent of the map unit.

Permeability and the available water capacity are moderate in the Omena soil. Surface runoff is slow.

This soil is well suited to cultivated crops. The major management concern is soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, buffer strips, vegetative barriers, and field windbreaks help to control soil blowing.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to building site development and septic tank absorption fields.

The land capability classification is IIs; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

73B—Omena fine sandy loam, 2 to 6 percent slopes. This very deep, gently undulating and undulating, well drained soil is on upland plains and low knolls. Individual areas are irregular in shape and range from 3 to 700 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is sandy loam about 5 inches thick. The upper part is strong brown and firm, and the lower part is dark yellowish brown and friable. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam. In some cultivated areas all of the subsoil has been incorporated into the surface layer.

Included with this soil in mapping are small areas of Onaway, Krakow, and Hagensville soils. Onaway and Krakow soils are in landscape positions similar to those of the Omena soil. Onaway soils have a subsoil that is thicker than that of the Omena soil. Krakow soils are very flaggy in the subsoil and in some areas have limestone bedrock at a depth of more than 40 inches. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 20 percent of the map unit.

Permeability and the available water capacity are moderate in the Omena soil. Surface runoff is slow.

Most areas are used as cropland (fig. 6). Some are used as woodland.

This soil is well suited to cultivated crops. Water erosion and soil blowing are hazards in cultivated areas. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, grassed waterways, and cover crops help to control water erosion. Buffer strips, vegetative barriers, cover crops, and field windbreaks help to control soil blowing.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly

Figure 6.—Alfalfa and corn in an area of Omena fine sandy loam, 2 to 6 percent slopes. Evart soils are on the flood plain along the river.

limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is well suited to building site development and septic tank absorption fields.

The land capability classification is IIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

73C—Omena fine sandy loam, 6 to 12 percent slopes. This very deep, gently rolling, well drained soil is on knolls, ridges, and side slopes. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is sandy loam about 5 inches thick. The upper part is strong brown and firm, and the lower part is dark yellowish brown and friable. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam. In many cultivated areas all of the subsoil has been incorporated into the surface layer.

Included with this soil in mapping are small areas of Onaway, Krakow, and Hagensville soils. Onaway and Krakow soils are in landscape positions similar to those of the Omena soil. Onaway soils have a subsoil that is thicker than that of the Omena soil. Krakow soils are very flaggy in the subsoil and in some areas have limestone bedrock at a depth of more than 40 inches. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Omena soil. Surface runoff is medium.

Most areas are used as cropland. Some are used as woodland.

This soil is moderately well suited to cultivated crops. Water erosion and soil blowing are hazards in cultivated areas. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, grassed waterways, and cover crops help to control water erosion. Buffer strips, vegetative barriers, cover crops, and field windbreaks help to control soil blowing.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in the spring and other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. After the trees are harvested, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

Because of the slope, this soil is only moderately well suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

The land capability classification is IIIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

73C2—Omena fine sandy loam, 6 to 12 percent slopes, eroded. This very deep, gently rolling, well drained soil is on knolls, ridges, and side slopes. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is dark yellowish brown, friable sandy loam about 1 inch thick. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Onaway, Krakow, and Hagensville soils. Onaway and Krakow soils are in landscape positions similar to those of the Omena soil. Onaway soils have a subsoil that is thicker than that of the Omena soil. Krakow soils are very flaggy in the subsoil and in some areas have limestone bedrock at a depth of more than 40 inches. Hagensville soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Omena soil. Surface runoff is medium.

Most areas are used as cropland. This soil is moderately well suited to cultivated crops. It is more droughty and more susceptible to crusting than the less eroded Omena soils. Much of the original topsoil has been lost because of past erosion. Returning crop residue to the soil and regularly adding other organic material maintains fertility, minimizes crusting, and increases the rate of water infiltration. The major management concern is the hazard of water erosion. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion.

Because of the slope, this soil is only moderately well suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. Land shaping may be necessary in some areas. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

The land capability classification is IIIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

73D—Omena fine sandy loam, 12 to 18 percent slopes. This very deep, rolling, well drained soil is on high knolls, ridges, and side slopes. Individual areas are irregular in shape and range from 3 to 30 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsoil is sandy loam about 5 inches thick. The upper part is strong brown and firm, and the lower part is dark yellowish brown and friable. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam. In many cultivated areas the subsoil has been incorporated into the surface layer.

Included with this soil in mapping are small areas of Onaway and Krakow soils. These soils are in landscape positions similar to those of the Omena soil. Onaway soils have a subsoil that is thicker than that of the Omena soil. Krakow soils are very flaggy in the subsoil and in some areas have limestone bedrock at a depth of more than 40 inches. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Omena soil. Surface runoff is rapid.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and plant competition. The use of equipment is briefly limited in spring and in other excessively wet periods. If skidders are used when the soil is wet, soil structure is altered and ruts form easily. The slope limits the selection of sites for logging roads and landings. After the trees are harvested, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is poorly suited to cultivated crops because

of the slope. Water erosion is a major management concern in areas used for row crops. A cropping sequence that includes grasses and legumes, conservation tillage, and grassed waterways can be effective in controlling water erosion.

Because of the slope, this soil is poorly suited to building site development and septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

The land capability classification is IVe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

73D3—Omena fine sandy loam, 12 to 18 percent slopes, severely eroded. This very deep, rolling, well drained soil is on high knolls, ridges, and side slopes. Individual areas are irregular in shape and range from 3 to 30 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is yellowish brown gravelly sandy loam.

Included with this soil in mapping are small areas of Onaway and Krakow soils. These soils are in landscape positions similar to those of the Omena soil. Onaway soils have a subsoil that is thicker than that of the Omena soil. Krakow soils are very flaggy in the subsoil and in some areas have limestone bedrock at a depth of more than 40 inches. Included soils make up 5 to 10 percent of the map unit.

Permeability and the available water capacity are moderate in the Omena soil. Surface runoff is rapid.

This soil is used as cropland. It is poorly suited to cultivated crops because of the slope and a scarcity of nutrients and organic matter resulting from past erosion. In cultivated areas the major management needs are measures that control water erosion, increase the content of organic matter, and conserve moisture. Crop rotations that include grasses or legumes, stripcropping, conservation tillage, and grassed waterways can be effective in controlling water erosion. Returning crop residue to the soil or applying a system of conservation tillage that leaves crop residue on the surface conserves moisture. Adding organic material to the soil increases the organic matter content and the available water capacity.

This soil is poorly suited to building site development and septic tank absorption fields. The slope is the major management concern. Buildings should be designed so that they conform to the natural slope of the land. Land shaping and installing the distribution lines across the slope help to ensure that the absorption field functions properly.

The land capability classification is VIe; the woodland ordination symbol is 3L; the Michigan soil management group is 3a.

75—Pinconning mucky sand. This very deep, nearly level, poorly drained soil is on low flats and in depressions and drainageways. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, the surface layer is black mucky sand about 8 inches thick. The upper part of the substratum is grayish brown, brown, and dark grayish brown, mottled sand. The lower part to a depth of about 60 inches is grayish brown and brown, mottled silty clay loam.

Included with this soil in mapping are small areas of Allendale, Cathro, and Hettinger soils. Allendale soils are somewhat poorly drained and are on low knolls and ridges. Cathro and Hettinger soils are in landscape positions similar to those of the Pinconning soil. Cathro soils are very poorly drained and have a thick organic surface layer. Hettinger soils have a loamy surface layer. Included soils make up 5 to 20 percent of the map unit.

Permeability is rapid in the sandy upper part of the Pinconning soil and slow in the lower part. The seasonal high water table is near or above the surface from fall through spring.

Most areas are used as woodland. A few are used as cropland.

Where this soil is used as woodland, the equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. Because of the high water table, equipment use is limited to periods when the soil is relatively dry or when access roads are frozen. Year-round roads require roadfill and gravel, and culverts are needed to maintain the natural drainage system. Because of the wetness, loss of natural seedlings can be more than 50 percent. The trees on this soil are shallow rooted because of the high water table. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to prevent or delay natural regeneration unless precautionary measures are applied. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

If adequately drained, this soil is moderately well suited to cropland. The major management concerns are the wetness and soil blowing. A surface and subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the

soil and leaves all or part of the crop residue on the surface, vegetative barriers, cover crops, and field windbreaks help to control soil blowing.

This soil is unsuited to building site development and septic tank absorption fields because of the high water table and the ponding.

The land capability classification is Vw; the woodland ordination symbol is 3W; the Michigan soil management group is 4/1c.

76A—Allendale sand, 0 to 3 percent slopes. This very deep, nearly level or very gently sloping, somewhat poorly drained soil is in depressions and drainageways and on flats and low knolls. Individual areas are irregular in shape or long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown sand about 8 inches thick. The subsurface layer is light brownish gray sand about 5 inches thick. The subsoil is about 23 inches thick. The upper part is dark brown, mottled, very friable sand that has a few chunks of cemented material. The next part is strong brown, friable loamy sand surrounded by pinkish gray sand. The lower part is reddish brown, mottled, very firm silty clay. The substratum to a depth of about 60 inches is light reddish brown silty clay. In places the substratum is stratified silty clay and silt loam.

Included with this soil in mapping are small areas of the Croswell soils that have a loamy substratum and small areas of Pinconning and Bowers soils. Croswell soils are moderately well drained and are slightly higher on the landscape than the Allendale soil. Also, they have thicker deposits of sand over the loamy material. Pinconning soils are poorly drained and are in depressions and drainageways. Bowers soils are loamy throughout. They are in landscape positions similar to those of the Allendale soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the sandy upper part of the Allendale soil and very slow in the clayey lower part. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during other periods of high precipitation.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the wetness, the use of equipment is limited to periods when the soil is relatively dry or when access roads are sufficiently frozen. Because the surface layer becomes droughty in the summer months, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions or planting containerized seedlings can reduce the seedling mortality rate. Because of the high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control the undesirable plants.

This soil is fairly well suited to cropland. The major management concerns are the wetness, soil blowing, and the low available water capacity. A surface or subsurface drainage system can lower the water table. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, vegetative barriers, buffer strips, or field windbreaks help to control soil blowing.

This soil is poorly suited to building site development. The major management concern is the wetness. A subsurface drainage system can lower the water table. Constructing the buildings on well compacted fill material helps to overcome the wetness. The soil is poorly suited to septic tank absorption fields because of the wetness and a poor filtering capacity. Filling or mounding with suitable material can raise the site above the level of wetness. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIw; the woodland ordination symbol is 4W; the Michigan soil management group is 4/1b.

81B—Croswell cobbly sand, 0 to 4 percent slopes. This very deep, nearly level and gently undulating, moderately well drained soil is on low knolls and upland flats near Lake Huron. Individual areas are irregular in shape or long and narrow and range from 5 to 60 acres in size.

Typically, about 1 inch of black, partially decomposed forest litter is at the surface. The surface layer is very dark reddish brown cobbly sand about 2 inches thick. The subsurface layer is pinkish gray cobbly sand about 3 inches thick. The subsoil is very friable cobbly loamy sand about 31 inches thick. The upper part is dark brown, and the lower part is brown. The substratum to a depth of about 60 inches is yellowish brown sand that has some strata of gravel. In some areas large stones and flagstones are at the surface. In other areas a thin layer of gravelly sandy loam is directly above the substratum.

Included with this soil in mapping are small areas of Alpena, Rubicon, and Gladwin soils. Alpena and

Rubicon soils are excessively drained and are higher on the landscape than the Croswell soil. Gladwin soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 3 to 15 percent of the map unit.

Permeability is rapid in the Croswell soil. The available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2 to 4 feet from late fall through spring.

Most areas are used as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. The cobbly surface may hinder the use of planting equipment. Because of the seasonal high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is generally unsuited to cropland and pasture because of the cobbles, the droughtiness, a scarcity of plant nutrients, and soil blowing.

Because of the wetness, this soil is only moderately well suited to building site development and is poorly suited to dwellings with basements. A subsurface drainage system can lower the seasonal high water table. Constructing the buildings on well compacted fill material can raise the site above the level of wetness. The soil is generally unsuited to septic tank absorption fields because of the wetness and a poor filtering capacity.

The land capability classification is VIs; the woodland ordination symbol is 5S; the Michigan soil management group is 5a.

83B—Kiva-Alpena complex, 1 to 6 percent slopes. This map unit consists of very deep, nearly level and gently undulating, well drained and excessively well drained soils on plains, ridgetops, and old shoals. Individual areas are irregular in shape or long and narrow and range from 5 to 400 acres in size.

The Kiva soil makes up about 40 to 55 percent of the unit, and the Alpena soil makes up 35 to 50 percent. The two soils occur as areas so intricately mixed or so small that mapping them separately was not practical at the scale used in mapping.

Typically, the Kiva soil has a surface layer of black fine sandy loam about 7 inches thick. The subsoil is dark brown, friable gravelly sandy loam about 15 inches thick. The substratum to a depth of 60 inches is brown very gravelly coarse sand. In places the surface layer is gravelly sandy loam.

Typically, the Alpena soil has a surface layer of dark brown, very gravelly sandy loam about 8 inches thick. The substratum to a depth of 60 inches is brown and pale brown very gravelly sand. In some places the surface layer is loamy sand. In other places the soil has limestone channers throughout.

Included with these soils in mapping are small areas of Esau and Eastport soils. Esau soils are somewhat poorly drained and are in depressions and drainageways. Eastport soils are sandy throughout. They are in landscape positions similar to those of the Kiva and Alpena soils. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the upper part of the Kiva soil and very rapid in the underlying material. It is very rapid in the Alpena soil. The available water capacity is low in the Kiva soil and very low in the Alpena soil. Surface runoff is slow on both soils.

Most areas are used as woodland. Some are used as cropland.

Where these soils are used as woodland, the major management concerns are seedling mortality and plant competition. Because of droughtiness, seedling mortality can be more than 50 percent on the Alpena soil. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

These soils are moderately well suited to cropland and pasture. The major management concerns are water erosion and droughtiness. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, green manure crops, and regular additions of other organic material help to prevent excessive soil loss. Because of the limited available water capacity, small grain should be planted early in the spring or fall-seeded crops, such as rye or winter wheat, should be grown.

These soils are well suited to building site development. They are poorly suited to septic tank absorption fields because of a poor filtering capacity.

They readily absorb but do not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs; the woodland ordination symbols are 3A and 3F; the Michigan soil management groups are 4a and Ga.

84—Pits, quarry. This map unit consists of areas that have been mined for limestone bedrock. In some areas the quarries contain water. Large open excavations are near the Lake Huron shoreline. They have nearly vertical side slopes in most areas. One small abandoned quarry is on the south side of Black Lake.

Included in mapping are areas of Udorthents where excavated material has been deposited. Also included are areas that have settling basins in which fine residue is pumped for settling before allowing the water to flow back into Lake Huron.

Most areas of this map unit do not support vegetation. Onsite investigation is necessary to determine the potential of each area for various uses.

No interpretive groups are assigned.

85A—Esau flaggy sandy loam, 0 to 3 percent slopes. This very deep, nearly level and gently undulating, somewhat poorly drained soil is on low ridges, on flats, and in drainageways. Individual areas are irregular in shape or long and narrow and range from 3 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown flaggy sandy loam about 4 inches thick. The subsoil is dark brown, friable extremely flaggy sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is brown and brownish yellow, mottled extremely flaggy sand. In some areas the surface layer is stony or bouldery. In other areas limestone bedrock is below a depth of 40 inches. In some places the underlying material is stratified sand and gravel. In other places the soil is extremely gravelly throughout.

Included with this soil in mapping are small areas of Alpena, Detour, and Hessel soils. Alpena soils are excessively drained and are on ridges and knolls. Detour soils are loamy throughout. They are in landscape positions similar to those of the Esau soil. Hessel soils are poorly drained and are in depressions and drainageways. They are loamy throughout. Included soils make up 5 to 15 percent of the map unit.

Permeability is very rapid in the Esau soil. The available water capacity is very low. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through spring and during other periods of high precipitation.

Because of the wetness and the content of rock fragments, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation, seedling mortality, the windthrow hazard, and plant competition. Because of the high water table, the use of equipment is limited to periods when the soil is relatively dry or when logging roads are sufficiently frozen. The flagstones on the surface can hinder the use of planting equipment. Because of the seasonal high water table, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can tolerate wetness or using special methods of site preparation, such as bedding before planting, can reduce the seedling mortality rate. Because of the high water table, the trees on this soil are shallow rooted. Some may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to delay natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control undesirable plants.

This soil is unsuited to building site development and septic tank absorption fields because of the wetness.

The land capability classification is VIs; the woodland ordination symbol is 4W; the Michigan soil management group is Gbc.

86F—Udorthents and Udipsamments, very steep. These loamy and sandy soils are in areas surrounding sinkholes. In some areas they are subject to flooding, which forms small ponds that are intermittently dry. Some of the lakes in the area formed in the sinkholes, which have fluctuating water levels.

In some areas these soils support vegetation, but slippage can be a hazard. Use of these areas is very limited because of the slope and the instability of the soils. Onsite investigation is necessary to determine the suitability of each area for various uses.

No interpretive groups are assigned.

87C—Udorthents, level to gently rolling. This map unit consists of well drained or moderately well drained, loamy soils from which the original surface layer and part of the substratum have been removed. It also consists of well drained or moderately well drained soils that have been covered with fill material. In most areas the loamy material has been removed from ridges and knolls for use as fill or to level out areas for drilling sites. In places these soils are depressions, flat swampy areas, or lakefront areas that have been filled prior to construction. Individual areas of this map unit range from 3 to 40 acres in size.

Included in mapping are small areas of undisturbed

soils. They make up less than 15 percent of the map unit.

The suitability of these soils for cropland, woodland, and building site development varies greatly. Onsite investigation is needed to determine the management needed to overcome the major hazards and limitations.

No interpretive groups are assigned.

89B—Ocqueoc fine sand, 0 to 6 percent slopes. This very deep, nearly level to undulating, well drained soil is on upland flats and low knolls. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown fine sand about 6 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, friable fine sand. The next part is strong brown, very friable fine sand. The lower part is dark yellowish brown, very friable sand that has some weakly cemented material. The upper part of the substratum is yellowish brown loamy fine sand. The next part is reddish brown fine sandy loam. The lower part to a depth of about 60 inches is brown silt loam. In places the substratum has thin lenses of material that ranges from fine sand to clay.

Included with this soil in mapping are small areas of Moltke and Glawe soils. These soils are in depressions and drainageways. Moltke soils are somewhat poorly drained, and Glawe soils are poorly drained. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the sandy upper part of the Ocqueoc soil and moderately slow in the loamy lower part. The available water capacity is moderate. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, and plant competition. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate. Undesirable plants that invade clearcut areas can delay the establishment of desirable species. If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.

This soil is moderately well suited to cropland. The major management concerns are droughtiness and soil blowing. Conservation tillage, field windbreaks, vegetative barriers, and winter cover crops help to control soil blowing. Conservation tillage and regular additions of manure or other organic material to the soil increase the available water capacity and the organic matter content.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the restricted permeability in the substratum. Enlarging the absorption field or mounding with suitable material can help to overcome this limitation.

The land capability classification is IIIs; the woodland ordination symbol is 3S; the Michigan soil management group is 4/2a.

90B—Zimmerman fine sand, 2 to 8 percent slopes. This very deep, very gently undulating to gently rolling, excessively drained soil is on ridges, knolls, and upland flats. Individual areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown fine sand about 10 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is strong brown and yellowish brown, very friable fine sand. The lower part is light yellowish brown, loose fine sand that has a few thin bands of strong brown, very friable loamy fine sand.

Included with this soil in mapping are small areas of Ocqueoc and Ingalls soils. These soils are underlain by loamy material. Ocqueoc soils are well drained and are lower on the landscape than the Zimmerman soil. Ingalls soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability is rapid in the Zimmerman soil. The available water capacity is low. Surface runoff is slow.

Most areas are used as woodland. Some are used as cropland.

Where this soil is used as woodland, the major management concerns are the equipment limitation and seedling mortality. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, seedling mortality can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil is fairly well suited to cropland and pasture. Soil blowing is a hazard in cultivated areas. Droughtiness also is a management concern. Conservation tillage, windbreaks, cover crops, and incorporation of crop residue into the soil can conserve moisture and help to control soil blowing.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because

of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs; the woodland ordination symbol is 8S; the Michigan soil management group is 4a.

91B—Alpena cobbly sandy loam, bedrock substratum, 0 to 8 percent slopes. This deep, nearly level to gently rolling, excessively drained soil is on low beach ridges and broad flats near the Lake Huron shoreline. Individual areas are irregular in shape or long and narrow and range from 5 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown cobbly sandy loam about 8 inches thick. The subsoil is brown very gravelly sand about 26 inches thick. Limestone bedrock is at a depth of about 44 inches. In some areas the surface layer is sandy loam, loamy sand, or the flaggy, cobbly, or stony analogs of those textures. In other areas the limestone bedrock is within a depth of 40 inches.

Included with this soil in mapping are small areas of Alpena soils that are very deep and small areas of Bonduel soils. The very deep Alpena soils are on slight rises and the higher beach ridges. Bonduel soils are somewhat poorly drained and are in depressions and drainageways. Included soils make up 5 to 10 percent of the map unit.

Permeability is very rapid in the Alpena soil. The available water capacity is very low. Surface runoff is slow.

Because of droughtiness and the cobbly surface layer, this soil is unsuited to cropland.

This soil is used as woodland. The major management concerns are the equipment limitation and seedling mortality. The cobbly surface layer can interfere with the use of planting equipment. Because of droughtiness, seedling losses can be as high as 25 to 50 percent. Planting seedlings that can withstand droughty conditions and planting when the soil is moist can reduce the seedling mortality rate.

This soil generally is moderately well suited to building site development. It is only fairly well suited to buildings with basements, however, because of the depth to bedrock. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs; the woodland ordination symbol is 3F; the Michigan soil management group is Ga.

92—Kinross muck. This deep, nearly level, poorly drained soil is in depressions and on low flats. It is subject to ponding. Individual areas are irregular in shape, oval, or long and narrow and range from 5 to 400 acres in size.

Typically, the surface layer is black muck about 4 inches thick. The subsurface layer is pinkish gray, mottled fine sand about 5 inches thick. The subsoil is dark reddish brown, dark brown, and brown, friable and very friable fine sand about 13 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some places the surface layer is mucky sand. In other places it is more than 10 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Au Gres and very poorly drained Dawson soils. Au Gres soils are near the edge of the unit and on slight rises. Dawson soils are at the slightly lower elevations. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Kinross soil. The available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through spring and during other periods of high precipitation.

Because of the wetness and the hazard of frost, this soil is unsuited to cropland.

This soil is used as woodland. The equipment limitation, seedling mortality, the windthrow hazard, and plant competition are management concerns. The soil is wet from fall through spring and may be wet during other periods. Equipment can be used during dry summer months and during winter months when snow is adequate. On year-round roads, road fill and a gravel base are needed. Culverts are needed to maintain natural drainage systems. The number of suitable landing sites is severely limited because of the wetness. Because of the high water table, seedling losses can be more than 50 percent and the trees are shallow rooted. Many may be blown down during periods of high wind and excessive wetness. Windthrow can be minimized by harvest methods that do not leave the remaining trees widely spaced. After the trees are cut, plant competition can be expected to delay or prevent natural regeneration unless precautionary measures are applied. Special harvest methods may be needed to control undesirable plants. Because of the wetness, seedling mortality, and plant competition, trees are generally not planted on this soil.

The land capability classification is VIw; the woodland ordination symbol is 2W; the Michigan soil management group is 5c-a.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 85,900 acres in the survey area, or about 19 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the central and west-central parts, mainly in associations 5, 7, and 8, which are described under the heading "General Soil Map Units." About 40,000 acres of this prime farmland is used for crops. The crops grown on this land are mainly potatoes, corn, dry beans, and hay.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by such drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties *(8)*.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Carla Gregory, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified, and the system of land capability classification used by the Soil Conservation Service is explained.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

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.

In 1986, about 4,000 acres of corn was grown in the survey area, of which 2,500 acres was harvested for silage *(5)*. About 4,000 acres was planted to potatoes, 2,300 to wheat, 8,000 to oats, and 700 to barley. An estimated 4,000 acres was used for dry beans, and small acreages of soybeans were also grown. About 1,000 acres of certified seed is produced each year in the survey area, mainly kidney beans, potatoes, navy beans, oats, and barley.

The current trend is toward fewer but larger farms. The county has a substantial amount of idle cropland, which is gradually being incorporated into a few of the larger farms.

The soils and climate of the area are suited to some crops not commonly grown. Birdsfoot trefoil and Garrison creeping foxtail are suitable forage crops in poorly drained, cool areas, but only limited acreages of these crops are grown. Other crops, such as sunflowers, sorghum, and buckwheat, can be grown if economic conditions are favorable. Specialty crops, such as strawberries, raspberries, asparagus, carrots, and sweet corn, could also be grown.

Erosion, either water erosion or soil blowing, is the major hazard on about 27 percent of the cropland in the county. Water erosion is a hazard on soils that have a slope of more than 2 percent, such as Onaway and Emmet soils. Soil blowing is a problem on sandy soils, such as Klacking, Menominee, Cheboygan, and Mancelona soils. Also, the mucky Roscommon soils are subject to soil blowing unless they are protected. If winds are strong and the soil is dry, soil blowing can

damage young crops in just a few hours.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a moderately fine textured subsoil, such as Onaway soils, and on soils that are shallow over bedrock or gravel, such as Alpena and Cunard soils. It is also damaging on soils that tend to be droughty, such as Cheboygan and Mancelona soils. Second, erosion on farmland results in the sedimentation of streams. Control of erosion minimizes this pollution and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping areas of soils that have a moderately fine textured subsoil, preparing a good seedbed and tilling are difficult because the original friable surface layer has been eroded. This degree of erosion is common in the more sloping areas of Onaway soils. It results in a cloddy surface and crusting and interferes with plant emergence. Concentrated runoff can result in gully erosion. Land shaping may be required before the field can be tilled.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A conservation cropping system that keeps a plant cover on the surface for extended periods generally can keep soil losses to an amount that does not reduce the productivity of the soil. On livestock farms, which require pasture and hay, including forage crops of grasses and legumes in the cropping system helps to control erosion. The forage crops also add nitrogen to the soil and improve soil tilth.

No-till farming, stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage are practices that minimize the effects of water erosion and soil blowing. Conservation tillage, especially no-till farming, requires high levels of management and relies heavily on herbicides and insecticides for weed and pest control. No-till farming is effective in controlling erosion on the sandy, more sloping soils in the county but is less successful on soils that have a mucky or clayey surface layer.

Conservation tillage leaves crop residue on at least 30 percent of the surface at planting. Chisel plows, discs, and cultivators are generally used alone or in combination to ensure that an adequate amount of residue remains. Conservation tillage is one of the most cost-effective conservation practices. In addition to controlling erosion, it minimizes soil compaction by limiting the number of trips across the field.

Contour tillage and stripcropping are effective erosion-control measures. Because of the complexity of the slopes, however, these measures are not commonly used in Presque Isle County. Contour tillage is most practical on deep, well drained soils that are highly susceptible to erosion.

Grassed waterways are shallow ditches seeded to a mixture of grasses. They help to prevent gully erosion caused by concentrated runoff.

Soil wetness is a major management concern on about 17 percent of the cropland in the county. Improving soil drainage can increase crop production. Fieldwork is restricted when the soils are wet. A properly designed tile drainage system or surface drainage system can be used to remove excess water. Locating adequate outlets for surface drainage systems may be difficult in some areas.

Some of the soils in the county are naturally so wet that the production of crops common to the area is not practical unless the soils are artificially drained. Examples are the poorly drained Hettinger, Roscommon, Glawe, and Brevort soils. Tile drains may be needed in areas of the somewhat poorly drained Alstad, Hagensville, Au Gres, Iosco, Bowers, and Moltke soils if row crops are grown. Small areas of wet soils along drainageways, in swales, and in seeps are included in mapping with some soils, such as Onaway and Emmet soils. In these areas random lines of tile may be needed. In areas of soils that have restricted permeability, such as Alstad and Hettinger soils, drains should be more closely spaced than those in areas of finer textured soils, such as Iosco and Hagensville soils.

Information concerning the design and application of erosion-control measures and drainage systems for different soils is available in local offices of the Soil Conservation Service.

Conserving soil moisture during dry periods is a management concern in areas of Klacking, Croswell, Menominee, Iosco, Au Gres, Mancelona, and Cheboygan soils. Moisture can be conserved by a system of conservation tillage that leaves all or most of the crop residue on the surface. Regular additions of manure and other organic materials increase the available water capacity. Many of the soils in the county are suited to irrigation if proper management is applied. Some of the soil features that affect the design, layout, construction, management, and performance of irrigation systems are identified in table 16.

Soil fertility is naturally low in sandy soils, such as Au Gres, Croswell, and Iosco soils, and is medium or high in most of the loamy soils, such as Onaway, Omena, and Alstad soils. The level of fertility varies throughout the county because of past differences in use and management, but most of the soils respond well to applications of fertilizer. Some of the mineral soils may need periodic applications of ground limestone to raise

the pH level sufficiently for the production of alfalfa and other crops that grow best on nearly neutral soils. On all of the soils, the additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on expected yields *(6)*. Proper management of fertilizers can help to maintain water quality and prevent health hazards caused by the leaching of nitrates into the ground water supply and the runoff of phosphates into surface water.

Organic matter is an important source of nitrogen for crops. It also helps to maintain good tilth, minimizes surface crusting, increases the available water capacity and the water infiltration rate, and helps to control erosion. On most of the well drained to somewhat poorly drained soils, measures that maintain or increase the organic matter content are needed. Including grasses and legumes in the cropping sequence, planting cover crops in winter and green manure crops in summer, returning crop residue to the soil, and regularly adding other organic material help to maintain or increase the content of organic matter.

Tilth is an important factor affecting the germination of seeds. Soils with good tilth are granular and porous and have a moderate or high content of organic matter. Many of the soils in the county that are used for crops have a sandy loam, loam, or loamy sand surface layer. Tilth is fairly good in these soils if good management practices are applied. Operating machinery when the soils are wet results in soil compaction and surface crusting, which reduce the rate of water infiltration and increase the runoff rate. Compaction inhibits root development and reduces crop yields and organic matter content. An adequate drainage system, timely field operations, regular additions of crop residue or manure, and minimum tillage improve soil structure and tilth and minimize crusting.

Much of the permanent pasture in the county is in areas that are susceptible to erosion, and many pastured areas are on wet soils. Erosion-control practices are particularly important during seeding operations. Allowing livestock to graze during wet periods results in soil compaction and can retard the growth of pasture plants. Using proper harvesting methods in areas used for hay or silage improves plant growth and helps to prevent soil compaction.

The productivity of a pasture and its ability to protect the surface of the soil are influenced by the number of livestock that the pasture supports, the length of time that they graze, and the distribution of rainfall. Good pasture management includes stocking rates that maintain the desired forage species, pasture rotation, deferred grazing, restricted grazing during wet and extremely dry periods, and proper placement of watering facilities.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

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

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

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

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

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do

they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes *(10)*.

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table. Also given at the end of each map unit description is a Michigan soil management group *(7)*. The soils are assigned to a group according to the dominant profile texture, the natural drainage class, and the major management concerns. For soils making up a complex, the management groups are listed in the same order as the series named in the complex.

Woodland Management and Productivity

A total of about 290,000 acres, or 66 percent of the county, is woodland. Virgin forests once covered almost all of the land in Presque Isle County. By 1900, the native pine forests had been completely logged. During the next few decades, most hardwood and swamp timber forests were felled. Regrowth of areas that were not farmed was slow and in many cases was delayed by forest fires. Many of the sandier areas in the southern and southwestern parts of the county were repeatedly burned. The soils in these areas have shown a less vigorous recovery than similar soils in other areas because of the loss of nutrients and organic matter resulting from fire. Hardwood forests of maple, beech, yellow birch, and hemlock are in many areas of the sandier soils that were not severely burned. The wetter soils support forests of whitecedar, red maple, quaking aspen, balsam fir, spruces, white birch, ash, and white pine. The drier sand plains support forests of jack pine, red pine, northern red oak, and bigtooth aspen. A few areas, generally near Lake Huron and Black Lake, are dominated by white birch. Striped maple is a major component of the understory in these areas.

In most areas the forests now consist of mature trees that are harvested mainly for pulpwood. Other important products include firewood, fenceposts, ties, pallets, and building materials.

Most of the wooded areas could benefit from silvicultural practices, such as thinning the stands and controlling insects, diseases, and plant competition. The Presque Isle Soil Conservation District, the Soil Conservation Service, and the Michigan Department of Natural Resources, Division of Forestry, can help to determine specific woodland management needs.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an

indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength during the spring thaw period and during periods of high rainfall. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

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

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

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

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. The volume was determined through the use of standard yield tables *(12)*.

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

Trees to plant are those that are suitable for commercial wood production.

Table 9 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

season. The *most limiting season* in Presque Isle County 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, 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.

In table 9 a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high flotation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Logging areas and skid roads include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid roads, which generally are within the logging area, are roads or trails over which 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 area affected by logging.

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

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Approximately 290,000 acres of forest land, 89 inland lakes (the largest of which is Grand Lake), 300 miles of trout streams, and 72 miles of Great Lakes shoreline provide numerous opportunities for outdoor recreation in Presque Isle County. Public lands available for recreational use include 74,189 acres of state forest land, two state parks, five state forest campgrounds, Presque Isle County Park at 40 Mile Point, Fletcher County Park, Besser Quiet Area in Bell Pines, Lakeside Park in Rogers City, two boat harbors on Lake Huron, and various township parks. Other recreation areas include private campgrounds, a golf course, cross-country ski trails, fishing charters, and lake access sites on many of the larger inland lakes.

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 use 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 by a combination of these measures.

The information in table 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Presque Isle County has large and varied populations of fish and wildlife. The forested areas in the county provide cover for white-tailed deer, wild turkey, and bear. They also provide food and cover for fox, coyote, grouse, rabbit, squirrel, woodcock, groundhog, bobcat, skunk, porcupine, marten, and mice. Ducks, herons, kingfisher, marsh hawk, eagles, muskrat, beaver, raccoon, otter, and mink inhabit the wetlands and adjacent areas. Diving ducks, dabbling ducks, Canada blue geese, and snow geese also use these areas during their annual migrations. Other birds in the county include owls, woodpeckers, robins, chickadees, bluebirds, sparrows, hummingbirds, swallows, killdeer, hawks, turkey vultures, and crows. The streams and lakes support a variety of panfish, such as bluegill, perch, crappie, rock bass, and sunfish. They also support brook trout, brown trout, rainbow trout, and other game fish, such as pike, sturgeon, walleye, largemouth bass, and smallmouth bass. Lake Huron and its connecting waters support salmon, lake trout, steelhead, brown trout, whitefish, perch, pike, suckers, smelt, and carp.

Many areas of the county could be improved for use as wildlife habitat. Creating additional grassland areas with more than 50 percent forest or brush cover would increase the amount and quality of habitat for new and existing species. Maintaining the large areas of dense woodland and marshes near lakes and streams would preserve the habitat for bears, eagles, and other wildlife.

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 flood hazard. 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, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, birdsfoot trefoil, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are milkweed, goldenrod, ragweed, burdock, dandelion, strawberry, lambsquarters, and wild carrot.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, maple, apple, hawthorn, dogwood, birch, beech, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are crabapple, honeysuckle, dogwood, and cranberrybush.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

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

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include pheasant, meadowlark, field sparrow, deer, 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, woodland deer mouse, raccoon, coyote, 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, kingfisher, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the

design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation 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 the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to

bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

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

Table 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used

to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 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 depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 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, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

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

Water Management

Table 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 boulders, organic matter, or salts or sodium. 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 as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect 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 bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct

surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, 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 characterize key soils.

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

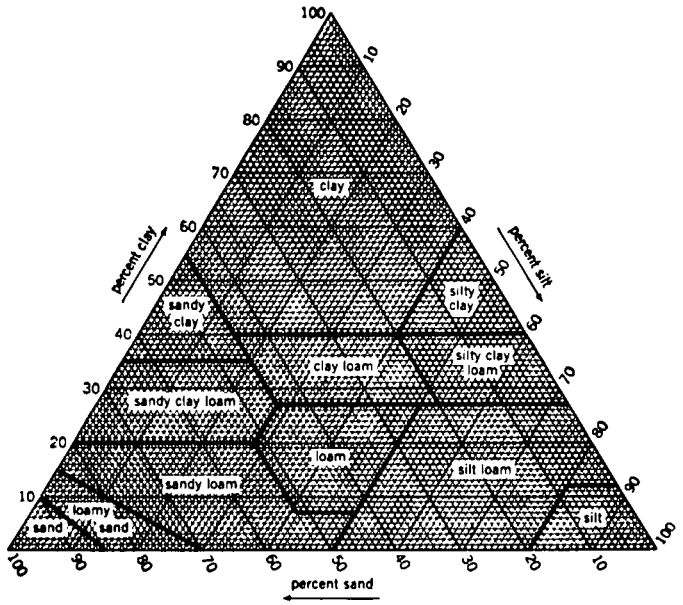

Figure 7.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "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. 7). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

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

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to

those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 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, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume

change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 19, the first letter is for drained areas and the second is for undrained areas.

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

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 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.

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

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be

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

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(11)*. 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 Aquod (*Aqu*, meaning water, plus *od*, from Spodosol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquods (*Hapl*, meaning minimal horizonation, plus *aquod*, the suborder of the Spodosols that has an aquic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy, mixed, frigid Entic Haplaquods.

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

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(9)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(11)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Allendale Series

The Allendale series consists of very deep, somewhat poorly drained soils in depressions, on flats and slight knolls, and in drainageways on lake plains,

ground moraines, and terraces. These soils formed in sandy deposits over stratified, clayey lacustrine material. Permeability is rapid in the upper part of the profile and very slow in the lower part. The slope ranges from 0 to 3 percent.

Typical pedon of Allendale sand, 0 to 3 percent slopes, 50 feet north and 50 feet east of the southwest corner of sec. 17, T. 34 N., R. 3 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; slightly acid; abrupt wavy boundary.

E—8 to 13 inches; light brownish gray (10YR 6/2) sand; very weak fine subangular blocky structure; very friable; slightly acid; abrupt wavy boundary.

Bs—13 to 21 inches; dark brown (7.5YR 4/4) sand; common medium distinct brown (7.5YR 5/2) and strong brown (7.5YR 4/6) mottles; massive; very friable; few medium chunks of strongly cemented, dark reddish brown (5YR 3/4) ortstein; slightly acid; abrupt irregular boundary.

B/E—21 to 24 inches; about 85 percent strong brown (7.5YR 5/6) loamy sand (Bt); pinkish gray (7.5YR 6/2) coatings of sand (E), 1 to 5 millimeters thick, on vertical faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

2Bt—24 to 30 inches; reddish brown (5YR 5/3) silty clay; common fine prominent light gray (N 7/0) mottles; moderate fine angular blocky structure; very firm; common faint reddish brown (5YR 3/4) clay films on faces of peds; mildly alkaline; clear wavy boundary.

2BC—30 to 36 inches; reddish brown (5YR 5/3) silty clay; common fine prominent light gray (N 7/0) and very dark grayish brown (10YR 3/2) mottles; weak fine angular blocky structure; very firm; slight effervescence; mildly alkaline; clear wavy boundary.

2C—36 to 60 inches; light reddish brown (5YR 6/4) silty clay; massive; firm; violent effervescence; moderately alkaline.

The sandy upper layers range from 20 to 40 inches in thickness. The Ap horizon has value and chroma of 2 or 3. The A horizon, if it occurs, has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is sand, loamy sand, or fine sand.

The Bs horizon has value of 3 to 5 and chroma of 3 to 6. It is sand, loamy sand, or fine sand. It has a few chunks of ortstein in some pedons. The B part of the B/E horizon has hue of 7.5YR or 5YR and value and chroma of 4 to 6. It is loamy sand or fine sandy loam. The E part has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 or 3. It is sand or fine sand. The 2Bt horizon has hue of 7.5YR or 5YR, value of 5 or 6, and chroma of 3 or 4. Some pedons do not have a 2BC horizon.

The 2C horizon has hue of 7.5YR or 5YR, value of 5 or 6, and chroma of 3 or 4. It has thin strata of silty clay loam or silt loam in some pedons.

Alpena Series

The Alpena series consists of deep and very deep, excessively drained, very rapidly permeable soils. These soils formed in loamy and gravelly glaciofluvial deposits on beach ridges, eskers, and old shoals. The slope ranges from 0 to 15 percent.

Typical pedon of Alpena very gravelly sandy loam, 0 to 8 percent slopes, 1,580 feet east and 400 feet north of the southwest corner of sec. 13, T. 34 N., R. 7 E.

A1—0 to 4 inches; dark brown (7.5YR 3/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; many fine and very fine roots; about 35 percent gravel and 10 percent cobbles; mildly alkaline; clear wavy boundary.

A2—4 to 8 inches; dark brown (10YR 3/3) very gravelly sandy loam; weak fine subangular blocky structure parting to weak fine granular; friable; many fine and very fine roots; about 35 percent gravel and 10 percent cobbles; mildly alkaline; clear wavy boundary.

2C1—8 to 29 inches; brown (10YR 5/3) very gravelly sand; very weak fine granular structure; very friable; many fine roots; about 45 percent gravel and 10 percent cobbles; slight effervescence; moderately alkaline; gradual wavy boundary.

2C2—29 to 60 inches; pale brown (10YR 6/3) very gravelly sand; single grained; loose; common fine roots; about 45 percent gravel and 15 percent cobbles; strong effervescence; moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness. The content of rock fragments ranges from 10 to 50 percent in the A horizon and from 35 to 65 percent in the 2C horizon.

The A1 horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is very gravelly or cobbly sandy loam. The A2 horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is loamy sand, sandy loam, or the gravelly or very gravelly analogs of those textures. Some pedons have a B horizon. The 2C horizon has value of 5 or 6 and chroma of 3 or 4. It is gravelly sand, very gravelly sand,

or stratified very gravelly sand and sand. Some pedons are underlain by limestone bedrock at a depth of 40 to 60 inches.

Alstad Series

The Alstad series consists of very deep, somewhat poorly drained, moderately slowly permeable soils. These soils formed in loamy material in depressions, in drainageways, and on flats on ground moraines and between drumlins. The slope ranges from 0 to 3 percent.

The Alstad soils in this county have a thicker and darker surface layer than is defined as the range for the series. This difference, however, does not affect use or behavior of the soils.

Typical pedon of Alstad loam, 0 to 3 percent slopes, 1,450 feet north and 100 feet west of the southeast corner of sec. 20, T. 35 N., R. 3 E.

Ap—0 to 12 inches; black (10YR 2/1) loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; slightly acid; abrupt smooth boundary.

E—12 to 14 inches; brown (10YR 5/3) fine sandy loam; weak fine subangular blocky structure; friable; neutral; abrupt wavy boundary.

B/E—14 to 20 inches; about 80 percent dark brown (7.5YR 3/4) loam (Bt); brown (10YR 5/3) fine sandy loam (E) on faces of peds; few fine distinct pinkish gray (7.5YR 6/2) mottles; moderate fine subangular blocky structure; firm; about 3 percent gravel and cobbles; neutral; gradual wavy boundary.

Bt—20 to 27 inches; dark brown (7.5YR 3/4) loam; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds and in pores; about 3 percent gravel and cobbles; mildly alkaline; abrupt irregular boundary.

C—27 to 60 inches; light brown (7.5YR 6/4) loam; few fine prominent yellowish red (5YR 5/6) mottles; massive; firm; about 3 percent gravel and cobbles; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 30 inches. The content of gravel and cobbles ranges from 0 to 10 percent.

The Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is loam, fine sandy loam, or silt loam. Some pedons have an E/B horizon. The Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, clay loam, or sandy clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is dominantly fine sandy loam, sandy clay loam, or loam. In some pedons, however, it has pockets or layers of sand or loamy sand.

Au Gres Series

The Au Gres series consists of very deep, somewhat poorly drained, rapidly permeable soils in depressions, in drainageways, and on flats on outwash plains, lake plains, and till plains. These soils formed in sandy deposits. The slope ranges from 0 to 3 percent.

Typical pedon of Au Gres sand, 0 to 3 percent slopes, 700 feet north and 250 feet west of the center of sec. 10, T. 34 N., R. 4 E.

Oi—2 inches to 0; black (10YR 2/1) organic mat; many fine roots; slightly acid; abrupt wavy boundary.

E—0 to 4 inches; light brownish gray (10YR 6/2) sand; single grained; loose; many fine roots; about 1 percent gravel; medium acid; abrupt wavy boundary.

Bhs—4 to 8 inches; dark reddish brown (5YR 3/3) loamy sand; few fine prominent strong brown (7.5YR 5/6) mottles; very weak medium subangular blocky structure; very friable; common fine roots; about 1 percent gravel; medium acid; abrupt irregular boundary.

Bs—8 to 30 inches; yellowish brown (10YR 5/6) sand; common medium prominent yellowish red (5YR 4/6) and few medium distinct grayish brown (10YR 5/2) mottles; single grained; loose; few fine roots; about 1 percent gravel; medium acid; clear wavy boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) sand; single grained; loose; about 1 percent gravel; slightly acid.

The solum ranges from 20 to 48 inches in thickness. The content of gravel ranges from 0 to 10 percent.

The A or Ap horizon, if it occurs, has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is sand or loamy sand. The Bhs horizon has hue of 7.5YR or 5YR and value and chroma of 2 or 3. The Bs horizon has hue of 10YR or 7.5YR and value and chroma of 3 to 5. The B horizon is sand or loamy sand. It has a few chunks of ortstein in some pedons. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. Some pedons are underlain by loamy lacustrine material or till at a depth of more than 40 inches.

Bonduel Series

The Bonduel series consists of moderately deep, somewhat poorly drained, moderately permeable soils

in drainageways, in depressions, and on flats on till plains and glacial lake benches. These soils formed in loamy glacial till over limestone bedrock. The slope ranges from 0 to 3 percent.

The Bonduel soils in this county have a thicker and darker surface layer than is defined as the range for the series. Also, the Bt horizon is 1 inch thinner. These differences, however, do not affect use or behavior of the soils.

Typical pedon of Bonduel loam, 0 to 3 percent slopes, 1,320 feet north and 200 feet west of the southeast corner of sec. 30, T. 35 N., R. 2 E.

Ap—0 to 8 inches; dark reddish brown (5YR 2/2) loam, brown (7.5YR 5/2) dry; clods parting to moderate medium granular structure; firm; mildly alkaline; abrupt smooth boundary.

Bt—8 to 13 inches; reddish brown (5YR 4/4) clay loam; few fine distinct yellowish red (5YR 5/6) and common medium distinct reddish gray (5YR 5/2) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; many distinct clay films on faces of peds; slight effervescence; mildly alkaline; abrupt wavy boundary.

C—13 to 23 inches; yellowish brown (10YR 5/4) sandy clay loam; common fine distinct yellowish brown (10YR 5/6) and many medium distinct grayish brown (10YR 5/2) mottles; massive; friable; about 8 percent gravel and cobbles; violent effervescence; moderately alkaline.

R—23 inches; limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The content of rock fragments ranges from 5 to 10 percent throughout the profile.

Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Ap horizon has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 or 2. Pedons in some undisturbed areas have a thin E horizon. This horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. It is loam or silt loam. Some pedons have an E/B or B/E horizon. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy clay loam, clay loam, or loam. Some pedons have a BC horizon, which has colors and textures similar to those of the C horizon. The C horizon has value of 5 or 6 and chroma of 3 or 4. It is clay loam, sandy loam, loam, or sandy clay loam. Some pedons have as much as 4 inches of bedrock residuum.

Bowers Series

The Bowers series consists of very deep, somewhat poorly drained, slowly permeable soils on lake plains. These soils formed in stratified, loamy material. The slope ranges from 0 to 3 percent.

The Bowers soils in this county have a darker surface layer than is defined as the range for the series. This difference, however, does not affect use or behavior of the soils.

Typical pedon of Bowers silt loam, 0 to 3 percent slopes, 2,375 feet west and 100 feet north of the southeast corner of sec. 25, T. 34 N., R. 4 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; mildly alkaline; abrupt smooth boundary.

E—7 to 9 inches; light brownish gray (10YR 6/2) silt loam; common fine faint grayish brown (10YR 5/2) and common fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; neutral; abrupt broken boundary.

Bt—9 to 18 inches; reddish brown (5YR 5/3) silty clay loam; moderate medium subangular blocky structure; firm; many distinct reddish brown (5YR 4/3) clay films on faces of peds; neutral; abrupt wavy boundary.

C1—18 to 42 inches; pink (5YR 7/3) silty clay loam; many medium prominent light gray (2.5Y 7/2) and common fine faint pink (5YR 7/4) mottles; weak very thick platy structure parting to moderate medium subangular blocky; firm; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; light reddish brown (5YR 6/3) silty clay loam; few fine prominent light gray (2.5Y 7/2) mottles; weak thick platy structure parting to weak fine subangular blocky; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 30 inches. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Ap horizon has hue of 10YR, 7.5YR, or 5YR, value of 3, and chroma of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 or 3. It is loam, fine sandy loam, or silt loam. Some pedons have an E/B or B/E horizon. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam or clay loam. Some pedons have a BC horizon. The C horizon has hue of 7.5YR or 5YR, value of 5 to 7, and chroma of 3 or 4. It is

dominantly silty clay loam, but in some pedons it has strata of very fine sand to silty clay.

Brevort Series

The Brevort series consists of very deep, poorly drained soils in depressions and drainageways on ground moraines and outwash plains. These soils formed in sandy material underlain by loamy glacial till. Permeability is moderately rapid or rapid in the sandy upper layers and moderately slow in the underlying loamy material. The slope ranges from 0 to 2 percent.

Typical pedon of Brevort mucky loamy sand, 1,700 feet east and 50 feet north of the southwest corner of sec. 3, T. 34 N., R. 5 E.

A—0 to 6 inches; black (10YR 2/1) mucky loamy sand, very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; many roots; neutral; abrupt wavy boundary.

Cg—6 to 10 inches; grayish brown (2.5Y 5/2) loamy sand; many medium distinct light olive brown (2.5Y 5/4) mottles; single grained; loose; common roots; neutral; abrupt wavy boundary.

C—10 to 26 inches; light olive brown (2.5Y 5/6) loamy sand; common fine distinct olive yellow (2.5Y 6/8) and few fine distinct light brownish gray (2.5Y 6/2) mottles; single grained; loose; few roots; mildly alkaline; abrupt wavy boundary.

C'g—26 to 38 inches; light brownish gray (10YR 6/2) loamy sand; few fine prominent light olive brown (2.5Y 5/6) mottles; single grained; loose; about 5 percent gravel; violent effervescence; moderately alkaline; abrupt wavy boundary.

2Cg1—38 to 50 inches; grayish brown (10YR 5/2) fine sandy loam; few fine distinct brownish yellow (10YR 6/6) mottles; massive; friable; about 5 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

2Cg2—50 to 60 inches; grayish brown (10YR 5/2) loam; few fine prominent light yellowish brown (2.5Y 6/4) mottles; massive; friable; about 5 percent gravel; violent effervescence; moderately alkaline.

The depth to carbonates and to the 2C horizon ranges from 20 to 40 inches. The content of gravel and cobbles ranges from 0 to 8 percent throughout the profile.

Pedons in cultivated areas have an Ap horizon, which has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A horizon has value of 2 or 3. The C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 1 to 6. It is sand, loamy sand, or loamy fine sand. The 2C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 1 to 6. It is sandy loam, fine sandy loam, loam, or silt loam. Some pedons have a 2C2 horizon of stratified, loamy material below a depth of 50 inches.

Burleigh Series

The Burleigh series consists of very deep, poorly drained soils on lake plains and outwash plains. These soils formed in sandy deposits over loamy and sandy stratified lacustrine sediments. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. The slope ranges from 0 to 2 percent.

Typical pedon of Burleigh mucky loamy fine sand, 825 feet west and 170 feet south of the center of sec. 19, T. 34 N., R. 5 E.

A—0 to 5 inches; black (10YR 2/1) mucky loamy fine sand, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

Cg—5 to 10 inches; gray (10YR 5/1) loamy fine sand; few fine faint dark gray (10YR 4/1) and pale brown (10YR 6/2) mottles; weak fine subangular blocky structure; very friable; few roots; neutral; abrupt wavy boundary.

C—10 to 26 inches; dark yellowish brown (10YR 4/6) loamy fine sand; many coarse distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

2C1—26 to 36 inches; stratified reddish brown (5YR 4/4) fine sandy loam and light brown (7.5YR 6/3) loamy fine sand; massive; firm; mildly alkaline; clear smooth boundary.

2C2—36 to 60 inches; stratified brown (7.5YR 5/4) silt loam and pale brown (10YR 6/3) very fine sand; massive; firm; violent effervescence; moderately alkaline.

Depth to the 2C horizon and to free carbonates ranges from 20 to 40 inches. Pedons in some areas have a thin organic layer at the surface.

The A horizon has hue of 10YR or 7.5YR and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is loamy fine sand, loamy sand, or sand. The 2C horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 5 or 6, and chroma of 1 to 4. It is stratified silt loam and very fine sand. Thin strata of fine sand to clay are in most pedons.

Cathro Series

The Cathro series consists of very deep, very poorly drained soils in depressions, in drainageways, and on low flats on lake plains, moraines, and till plains. These

soils formed in organic material 16 to 50 inches deep over loamy material. Permeability is moderately rapid to moderately slow in the organic material and moderate or moderately slow in the loamy material. The slope ranges from 0 to 2 percent.

Typical pedon of Cathro muck, 400 feet south and 30 feet east of the northwest corner of sec. 19, T. 33 N., R. 5 E.

Oa1—0 to 6 inches; muck, black (10YR 2/1) broken face and rubbed; about 35 percent fiber, less than 8 percent rubbed; weak fine granular structure; friable; many fine and medium roots; dominantly herbaceous fibers; neutral; clear smooth boundary.

Oa2—6 to 26 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; about 40 percent fibers, less than 10 percent rubbed; moderate fine granular structure; friable; common fine and medium roots; dominantly herbaceous fibers, a few fragments of charcoal and wood; neutral; clear wavy boundary.

Oa3—26 to 34 inches; muck, black (10YR 2/1) broken face and rubbed; about 30 percent fibers, less than 5 percent rubbed; weak medium platy structure; friable; dominantly herbaceous fibers, a few fragments of wood; neutral; clear smooth boundary.

C—34 to 60 inches; grayish brown (10YR 5/2) silty clay loam; massive; firm; mildly alkaline.

Depth to the loamy C horizon ranges from 16 to 50 inches. The organic material is dominantly herbaceous, but some pedons have layers that formed in woody material.

The organic layers have hue of 5YR, 7.5YR, or 10YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. The material is dominantly muck, but some pedons have thin layers of mucky peat. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam, loam, or silty clay loam. Some pedons have strata of sand or loamy sand above the loamy material.

Cheboygan Series

The Cheboygan series consists of very deep, well drained soils on moraines, drumlins, and till plains. These soils formed in sandy deposits over loamy glacial till. Permeability is moderately rapid in the sandy material and very slow in the substratum. The slope ranges from 0 to 35 percent.

Typical pedon of Cheboygan loamy sand, 0 to 6 percent slopes, 50 feet west and 595 feet south of the northeast corner of sec. 31, T. 35 N., R. 5 E.

A—0 to 5 inches; black (N 2/0) loamy sand, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine and medium roots; about 2 percent gravel and cobbles; medium acid; abrupt wavy boundary.

E—5 to 9 inches; pinkish gray (7.5YR 6/2) loamy sand; very weak fine subangular blocky structure; very friable; many fine and medium roots; about 2 percent gravel and cobbles; medium acid; abrupt wavy boundary.

Bs1—9 to 13 inches; dark brown (7.5YR 3/4) loamy sand; weak fine subangular blocky structure; very friable; many fine and medium roots; about 2 percent gravel and cobbles; strongly acid; clear irregular boundary.

Bs2—13 to 22 inches; strong brown (7.5YR 4/6) loamy sand; weak fine subangular blocky structure; very friable; about 10 percent weakly cemented ortstein; common fine and medium roots; about 2 percent gravel and cobbles; medium acid; clear wavy boundary.

2B/E—22 to 28 inches; about 75 percent reddish brown (5YR 4/4) sandy loam (Bt); surrounded by brown (7.5YR 5/2) loamy sand (E); moderate fine subangular blocky structure; friable; few fine roots; common distinct reddish brown (5YR 4/4) clay films on faces of peds; about 5 percent gravel and cobbles; medium acid; clear wavy boundary.

2Cd—28 to 60 inches; light brown (7.5YR 6/4) sandy loam; massive parting to weak thick platy fragments; firm in place, friable if disturbed; few fine roots; about 5 percent gravel and cobbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 48 inches. The content of gravel and cobbles ranges from 0 to 8 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. Pedons in cultivated areas have an Ap horizon, which has value of 2 or 3 and chroma of 1 to 3. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 or 2. It is sand or loamy sand. The Bs horizon has value of 3 to 5 and chroma of 3 to 6. It is loamy sand or sand. The B part of the 2B/E horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam, loam, or sandy clay loam. Some pedons have a separate Bt horizon, which has colors and textures similar to those of the 2B/E horizon. The E part of the 2B/E horizon has hue of 10YR or 7.5YR and chroma of 2 or 3. The 2Cd horizon has value of 4 to 6 and chroma of 3 or 4. It has thin strata of loamy sand or sand in some pedons.

Croswell Series

The Croswell series consists of very deep, moderately well drained, rapidly permeable soils on low moraines, outwash plains, and low beach ridges. These soils formed in sandy deposits. The slope ranges from 0 to 4 percent.

Typical pedon of Croswell sand, 0 to 4 percent slopes, 1,650 feet east and 1,050 feet south of the northwest corner of sec. 1, T. 34 N., R. 3 E.

Oe—1 inch to 0; dark reddish brown (5YR 2/2), partially decomposed leaves and twigs; many fine roots; very strongly acid; abrupt wavy boundary.
A—0 to 4 inches; very dark grayish brown (10YR 3/2) sand, gray (10YR 5/1) dry; very weak fine granular structure; very friable; many fine roots; extremely acid; abrupt wavy boundary.
E—4 to 10 inches; grayish brown (10YR 5/2) sand; very weak fine subangular blocky structure; very friable; common fine roots; strongly acid; abrupt wavy boundary.
Bs1—10 to 20 inches; strong brown (7.5YR 4/6) sand; very weak fine subangular blocky structure; very friable; common fine roots; strongly acid; clear wavy boundary.
Bs2—20 to 25 inches; yellowish brown (10YR 5/6) sand; few fine distinct yellowish brown (10YR 5/8) mottles; very weak fine subangular blocky structure; very friable; common fine roots; strongly acid; clear wavy boundary.
BC—25 to 33 inches; brownish yellow (10YR 6/6) sand; common medium prominent strong brown (7.5YR 4/6) mottles; single grained; loose; few medium roots; medium acid; gradual wavy boundary.
C—33 to 60 inches; light yellowish brown (10YR 6/4) sand; common medium distinct yellow (10YR 7/8) and prominent strong brown (7.5YR 5/8) mottles; single grained; loose; few medium roots; slightly acid.

The solum is typically 20 to 35 inches thick. The content of gravel ranges from 0 to 10 percent throughout the profile. The content of cobbles ranges from 0 to 30 percent in the solum. The depth to mottles ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is sand, cobbly sand, or loamy sand. Pedons in cultivated areas have an Ap horizon, which has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is sand, cobbly sand, or loamy sand. The Bs horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 to 6. It is sand, cobbly sand, or loamy sand. In some pedons weakly to strongly cemented ortstein layers make up less than 30 percent of the subsoil. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 8. In some pedons loamy material is at a depth of 40 to 60 inches.

Cunard Series

The Cunard series consists of moderately deep, well drained, moderately permeable soils on moraines, glacial lake benches, and terraces. These soils formed in loamy material over limestone bedrock. The slope ranges from 1 to 12 percent.

Typical pedon of Cunard fine sandy loam, 1 to 6 percent slopes, 2,100 feet south and 1,325 feet west of the northeast corner of sec. 30, T. 35 N., R. 2 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; about 2 percent gravel and cobbles; neutral; abrupt irregular boundary.
B/E—4 to 9 inches; about 80 percent yellowish brown (10YR 5/4) sandy loam (B); pale brown (10YR 6/3) sandy loam (E); weak fine subangular blocky structure; friable; about 3 percent gravel and cobbles; neutral; clear wavy boundary.
Bw1—9 to 17 inches; yellowish brown (10YR 5/6) sandy loam; weak fine subangular blocky structure; friable; about 3 percent gravel and cobbles; neutral; clear wavy boundary.
Bw2—17 to 21 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; about 3 percent gravel and cobbles; mildly alkaline; abrupt wavy boundary.
Bt—21 to 24 inches; dark brown (7.5YR 3/4) loam; moderate medium subangular blocky structure; friable; many faint clay films on faces of peds and in pores; about 5 percent gravel and cobbles; slight effervescence; moderately alkaline; abrupt wavy boundary.
C—24 to 25 inches; pale brown (10YR 6/3) fine sandy loam; massive; friable; about 10 percent gravel and channers; strong effervescence; moderately alkaline.
R—25 inches; fractured limestone bedrock.

The thickness of the solum and the depth to limestone range from 20 to 40 inches. The content of gravel, channers, flagstones, and cobbles ranges from 1 to 15 percent throughout the profile.

The A or Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 0 to 3. The E horizon, if

it occurs, has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is fine sandy loam, loam, or sandy loam. The B/E horizon has colors and textures similar to those of the Bw and E horizons. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is loam, sandy loam, or fine sandy loam. The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. It is sandy loam, loam, or the gravelly analogs of those textures. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly fine sandy loam, loam, sandy loam, or the gravelly analogs of those textures. In some pedons, however, it has thin strata of loamy sand or sand. Thin layers of residuum are directly above the bedrock in some pedons.

Dawson Series

The Dawson series consists of very deep, very poorly drained soils in depressions or drainageways on outwash plains, lake plains, and moraines. These soils formed in organic material 16 to 50 inches deep over sandy material. Permeability is moderately rapid to moderately slow in the organic material and rapid in the sandy material. The slope ranges from 0 to 2 percent.

Typical pedon of Dawson peat, 925 feet north and 100 feet west of the southeast corner of sec. 19, T. 34 N., R. 3 E.

Oi—0 to 4 inches; peat, pale olive (5Y 6/3) broken face and rubbed; about 100 percent fiber, 95 percent rubbed; massive; primarily sphagnum moss fibers; many fine roots; extremely acid; abrupt smooth boundary.

Oa1—4 to 20 inches; muck, black (5YR 2/1) broken face, black (10YR 2/1) rubbed; about 30 percent fiber, 5 percent rubbed; massive; primarily herbaceous fibers; extremely acid; abrupt smooth boundary.

Oa2—20 to 24 inches; muck, black (5YR 2/1) broken face, dark reddish brown (5YR 2/2) rubbed; about 10 percent fiber, 1 percent rubbed; massive; primarily herbaceous fibers; very strongly acid; abrupt smooth boundary.

C—24 to 60 inches; brown (7.5YR 4/4) sand; single grained; loose; very strongly acid.

Depth to the sandy C horizon ranges from 16 to 50 inches. The fiber content of the surface tier ranges from 75 to 100 percent before rubbing and from 40 to 90 percent after rubbing. The subsurface tiers are dominantly muck. In some pedons, however, they have thin layers of peat or mucky peat.

The organic layers have hue of 5YR, 7.5YR, or 10YR, value of 2 to 6, and chroma of 1 to 3. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 1 to 4. It is sand, fine sand, or loamy fine sand.

Deer Park Series

The Deer Park series consists of very deep, excessively drained, rapidly permeable soils on beach ridges and sand dunes. These soils formed in sandy material. The slope ranges from 0 to 45 percent.

Typical pedon of Deer Park sand, 15 to 45 percent slopes, 1,450 feet north and 400 feet west of the southeast corner of sec. 22, T. 36 N., R. 4 E.

A—0 to 2 inches; black (N 2/0) sand, very dark brown (10YR 2/2) dry; weak fine granular structure; very friable; many fine to coarse roots; strongly acid; abrupt wavy boundary.

E—2 to 8 inches; pale brown (10YR 6/3) sand; single grained; loose; many fine to coarse roots; medium acid; clear wavy boundary.

Bs1—8 to 15 inches; brown (7.5YR 5/4) sand; single grained; loose; many fine to coarse roots; medium acid; gradual wavy boundary.

Bs2—15 to 28 inches; yellowish brown (10YR 5/6) sand; single grained; loose; common fine to coarse roots; medium acid; clear wavy boundary.

C—28 to 60 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; few fine and medium roots; medium acid.

The thickness of the solum ranges from 18 to 36 inches. The solum is dominantly sand, but the range includes fine sand.

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 value of 5 or 6 and chroma of 1 to 3. The Bs horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. The C horizon has hue of 10YR or 7.5YR and chroma of 3 or 4. It is sand or fine sand.

Detour Series

The Detour series consists of very deep, somewhat poorly drained, very slowly permeable soils in depressions, in drainageways, and on flats on ground moraines and glacial lake benches. These soils formed in loamy glacial till. The slope ranges from 0 to 3 percent.

Typical pedon of Detour flaggy loam, 0 to 3 percent slopes, 650 feet south and 50 feet west of the northeast corner of sec. 12, T. 33 N., R. 6 E.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) flaggy loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; many very fine and fine roots; about 35 percent flagstones; slight effervescence; mildly alkaline; abrupt wavy boundary.
Bw1—5 to 9 inches; brown (10YR 5/3) flaggy loam; few fine faint grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; friable; common very fine and fine roots; about 35 percent flagstones and cobbles; slight effervescence; mildly alkaline; clear broken boundary.
Bw2—9 to 14 inches; yellowish brown (10YR 5/4) flaggy loam; few fine prominent light reddish brown (2.5YR 6/4) and few medium distinct dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; about 30 percent flagstones and cobbles; slight effervescence; mildly alkaline; clear wavy boundary.
BC—14 to 26 inches; brown (10YR 5/3) flaggy sandy loam; many fine distinct yellowish brown (10YR 5/6) and few fine distinct brownish yellow (10YR 6/6) mottles; weak thick platy structure parting to very weak fine subangular blocky; friable; about 30 percent flagstones and cobbles; violent effervescence; moderately alkaline; clear wavy boundary.
Cd—26 to 60 inches; dark grayish brown (10YR 4/2) flaggy sandy loam; massive; platy fragments inherited from the parent material; very firm; about 25 percent flagstones and cobbles; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. The content of cobbles and flagstones ranges from 10 to 35 percent in the solum and from 10 to 60 percent in the substratum.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is the flaggy analogs of sandy loam, loam, or fine sandy loam. The C horizon has value of 4 to 6 and chroma of 2 to 4. It is flaggy sandy loam or very flaggy fine sandy loam.

East Lake Series

The East Lake series consists of very deep, somewhat excessively drained, rapidly permeable soils on outwash plains, beach ridges, and eskers. These soils formed in sandy and gravelly deposits. The slope ranges from 0 to 35 percent.

Typical pedon of East Lake sand, 0 to 8 percent slopes, 850 feet south and 1,850 feet east of the northwest corner of sec. 28, T. 36 N., R. 3 E.

Oe—1 inch to 0; black (10YR 2/1), partially decomposed leaves and twigs.
A—0 to 2 inches; very dark grayish brown (10YR 3/2) sand, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine and medium roots; about 10 percent gravel and cobbles; slightly acid; abrupt wavy boundary.
E—2 to 9 inches; brown (7.5YR 5/2) sand; single grained; loose; many fine and medium roots; about 10 percent gravel and cobbles; medium acid; clear wavy boundary.
Bs1—9 to 16 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; many fine and medium roots; about 10 percent gravel and cobbles; medium acid; gradual wavy boundary.
Bs2—16 to 32 inches; strong brown (7.5YR 5/6) sand; single grained; loose; common fine and medium roots; about 5 percent gravel and cobbles; slightly acid; gradual wavy boundary.
BC—32 to 36 inches; brownish yellow (10YR 6/6) sand; single grained; loose; few fine roots; about 5 percent gravel and cobbles; neutral; clear smooth boundary.
2C—36 to 60 inches; pale brown (10YR 6/3), stratified sand and gravel; single grained; loose; about 50 percent gravel; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. The content of gravel ranges from 0 to 20 percent in the solum and from 15 to 60 percent in the substratum. The content of cobbles ranges from 0 to 10 percent in the solum and from 0 to 5 percent in the substratum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 or 2. It is sand, loamy sand, or the gravelly analogs of those textures. The Bs horizon has hue of 7.5YR or 10YR, value of 3 to 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 2C horizon has value of 5 or 6 and chroma of 3 or 4. It is gravelly sand, very gravelly sand, or stratified sand and gravel.

Eastport Series

The Eastport series consists of very deep, excessively drained, rapidly permeable soils on beach ridges and outwash plains. These soils formed in sandy deposits. The slope ranges from 1 to 8 percent.

The Eastport soils in this county have a thinner subsurface layer than is defined as the range for the series. This difference, however, does not affect use or behavior of the soils.

Typical pedon of Eastport sand, 1 to 8 percent slopes, 1,320 feet east and 1,050 feet north of the southwest corner of sec. 19, T. 36 N., R. 4 E.

A—0 to 1 inch; black (10YR 2/1) sand, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; many fine and very fine roots; strongly acid; abrupt wavy boundary.
E—1 to 3 inches; grayish brown (10YR 5/2) sand; single grained; loose; common medium roots; about 2 percent gravel; very strongly acid; clear wavy boundary.
Bs1—3 to 8 inches; yellowish brown (10YR 5/4) sand; single grained; loose; common medium roots; about 2 percent gravel; strongly acid; clear wavy boundary.
Bs2—8 to 25 inches; strong brown (7.5YR 5/6) sand; single grained; loose; common fine roots; about 5 percent gravel; strongly acid; gradual wavy boundary.
BC—25 to 35 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; few fine roots; about 5 percent gravel; medium acid; gradual wavy boundary.
C—35 to 60 inches; very pale brown (10YR 7/3) sand; single grained; loose; about 1 percent gravel; slight effervescence; mildly alkaline.

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 or 7.5YR, value of 2 or 3, and chroma of 2. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. The Bs horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The BC horizon is sand or fine sand. The C horizon has value of 6 or 7 and chroma of 3 or 4.

Emmet Series

The Emmet series consists of very deep, well drained and moderately well drained, moderately permeable soils on ground moraines and drumlins. These soils formed in sandy loam glacial till. The slope ranges from 0 to 25 percent.

Typical pedon of Emmet sandy loam, 6 to 12 percent slopes, 545 feet south and 660 feet east of the northwest corner of sec. 26, T. 35 N., R. 4 E.

Ap—0 to 9 inches; dark brown (7.5YR 3/2) sandy loam, brown (7.5YR 5/2) dry; weak medium subangular blocky structure; friable; about 10 percent gravel and cobbles; medium acid; abrupt smooth boundary.
Bw—9 to 16 inches; reddish brown (5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; about 10 percent gravel and cobbles; medium acid; clear wavy boundary.
E/B—16 to 23 inches; about 60 percent brown (7.5YR 5/4) loamy sand (E); weak fine subangular blocky structure; very friable; remnant pieces of strong brown (7.5YR 4/6) sandy loam (Bt); weak medium subangular blocky structure; friable; few faint clay films on faces of peds and in pores; about 10 percent gravel and cobbles; medium acid; gradual wavy boundary.
B/E—23 to 28 inches; about 85 percent strong brown (7.5YR 4/6) sandy loam (Bt); brown (7.5YR 5/4) loamy sand (E) coating faces of peds; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds and in pores; about 10 percent gravel and cobbles; neutral; clear wavy boundary.
Bt—28 to 33 inches; reddish brown (5YR 4/4) sandy loam; strong medium subangular blocky structure; firm; few faint dark reddish brown (5YR 3/3) clay films on faces of peds and in pores; about 10 percent gravel and cobbles; neutral; clear wavy boundary.
C—33 to 60 inches; light reddish brown (5YR 6/4) sandy loam; massive; friable; about 15 percent gravel and cobbles; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 50 inches. The content of gravel and cobbles ranges from 2 to 15 percent in the solum and from 5 to 25 percent in the substratum.

The Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 or 2. Pedons in uncultivated areas have an A horizon, which is 1 to 3 inches thick. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 3. It is loamy sand or sandy loam. In most cultivated areas the E horizon has been incorporated into the plow layer. The Bw horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 to 6. The E part of the E/B and B/E horizons has value of 5 or 6 and chroma of 2 to 4. It is sandy loam or loamy sand. The B part of the E/B and B/E horizons and the Bt horizon have hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. They are sandy loam, loam, or sandy clay loam. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly sandy loam or gravelly sandy loam. In some pedons, however, it has

pockets of sand and gravel. Pedons in areas that have slopes of 0 to 2 percent have mottles in the lower part of the profile.

Ensign Series

The Ensign series consists of shallow, somewhat poorly drained, moderately permeable soils in drainageways, in depressions, and on flats on till plains and glacial lake benches. These soils formed in loamy glacial till over limestone bedrock. The slope ranges from 0 to 3 percent.

The Ensign soils in this county have a thicker and darker surface layer than is defined as the range for the series. This difference, however, does not affect use or behavior of the soils.

Typical pedon of Ensign flaggy loam, 0 to 3 percent slopes, 525 feet west and 525 feet south of the northeast corner of sec. 23, T. 34 N., R. 6 E.

Oi—1 inch to 0; partially decomposed leaf litter; friable; neutral; abrupt smooth boundary.
A—0 to 4 inches; black (10YR 2/1) flaggy loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; many fine and medium roots; about 18 percent flagstones and channers; slight effervescence; mildly alkaline; abrupt wavy boundary.
AB—4 to 9 inches; very dark grayish brown (10YR 3/2) flaggy loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; friable; many fine roots; about 30 percent flagstones and channers; strong effervescence; moderately alkaline; clear wavy boundary.
Bw—9 to 15 inches; dark brown (10YR 3/3) flaggy loam; few fine distinct light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; common fine roots; about 35 percent flagstones and channers; violent effervescence; moderately alkaline; abrupt smooth boundary.
R—15 inches; limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 10 to 20 inches. The content of coarse fragments ranges from 5 to 35 percent throughout the profile.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 to 6. It is the flaggy analogs of sandy loam, fine sandy loam, or loam. Some pedons have a thin Bt horizon, which is less than 2 inches thick. This horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, clay loam, or the flaggy analogs of those textures. Some pedons have a thin C horizon. This horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 or 4. It is sandy loam, loam, or the flaggy analogs of those textures. Some pedons have as much as 4 inches of bedrock residuum.

Esau Series

The Esau series consists of very deep, somewhat poorly drained, very rapidly permeable soils on low beach ridges, old shoals, and outwash plains. These soils formed in loamy and sandy, gravelly glaciofluvial deposits. The slope ranges from 0 to 3 percent.

Typical pedon of Esau flaggy sandy loam, 0 to 3 percent slopes, 1,600 feet south and 1,000 feet east of the northwest corner of sec. 29, T. 34 N., R. 7 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) flaggy sandy loam, dark brown (10YR 4/3) dry; moderate fine granular structure; friable; many fine roots; about 15 percent flagstones; slight effervescence; mildly alkaline; abrupt wavy boundary.
Bw—4 to 10 inches; dark brown (7.5YR 4/4) extremely flaggy sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 45 percent flagstones and 35 percent channers and coarse gravel; strong effervescence; moderately alkaline; clear wavy boundary.
2C1—10 to 38 inches; brown (10YR 5/3) extremely flaggy sand; common fine faint grayish brown (10YR 5/2) mottles; single grained; loose; few fine roots; about 45 percent flagstones and 35 percent channers and coarse gravel; violent effervescence; moderately alkaline; clear wavy boundary.
2C2—38 to 60 inches; brownish yellow (10YR 6/6) extremely flaggy sand; common medium distinct yellowish brown (10YR 5/8) and common medium prominent strong brown (7.5YR 4/6) mottles; single grained; loose; about 60 percent flagstones and 20 percent channers; violent effervescence; moderately alkaline.

The solum ranges from 4 to 10 inches in thickness. The content of coarse fragments ranges from 15 to 80 percent in the solum and from 65 to 90 percent in the 2C horizon.

The A horizon has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 1 or 2. The Bw horizon has value and chroma of 3 to 5. It is extremely flaggy sandy loam, extremely flaggy fine sandy loam, or extremely gravelly sand. The 2C horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 3 to 6. It is extremely flaggy sand or extremely gravelly sand. In some pedons

limestone bedrock is below a depth of 40 inches. In other pedons a thin layer of flaggy sandy loam is above the bedrock.

Evart Series

The Evart series consists of very deep, poorly drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. The slope ranges from 0 to 2 percent.

Typical pedon of Evart silt loam, 1,600 feet north and 500 feet west of the southeast corner of sec. 22, T. 35 N., R. 2 E.

A—0 to 12 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; many roots; mildly alkaline; abrupt wavy boundary.

C—12 to 28 inches; pale brown (10YR 6/3) sand; few fine distinct gray (10YR 5/1) mottles; few thin strata of A material; massive; very friable; common roots; mildly alkaline; clear wavy boundary.

Cg—28 to 60 inches; grayish brown (10YR 5/2) sand; single grained; loose; mildly alkaline.

Texture varies within short distances throughout the profile, but it is dominantly sandy. The content of organic carbon decreases irregularly with increasing depth. The content of cobbles ranges from 0 to 3 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is dominantly sand, loamy sand, or the gravelly analogs of those textures. In some pedons, however, it has thin strata of finer textured material.

Gladwin Series

The Gladwin series consists of very deep, somewhat poorly drained soils in depressions, in drainageways, and on flats on outwash plains. These soils formed in sandy and gravelly deposits. Permeability is moderately rapid in the solum and rapid or very rapid in the underlying sand and gravel. The slope ranges from 0 to 3 percent.

Typical pedon of Gladwin loamy sand, 0 to 3 percent slopes, 240 feet north and 100 feet west of the southeast corner of sec. 14, T. 35 N., R. 2 E.

A—0 to 8 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine to coarse roots; slightly acid; abrupt wavy boundary.

Bs1—8 to 14 inches; dark yellowish brown (10YR 4/4) sand; few fine distinct yellowish brown (10YR 5/6) mottles; very weak fine subangular blocky structure; very friable; few fine and medium roots; neutral; gradual wavy boundary.

Bs2—14 to 28 inches; yellowish brown (10YR 5/6) sand; few medium distinct very pale brown (10YR 7/3) and many medium distinct brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; very friable; few fine and medium roots; mildly alkaline; abrupt wavy boundary.

Bt—28 to 36 inches; brown (7.5YR 4/4) gravelly sandy loam; many medium distinct pinkish gray (7.5YR 6/2) and few fine distinct reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; about 20 percent gravel; mildly alkaline; abrupt wavy boundary.

C—36 to 60 inches; pale brown (10YR 6/3), stratified sand and gravel; single grained; loose; about 40 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. The content of gravel ranges from 2 to 20 percent in the solum and from 20 to 50 percent in the substratum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 or 3. It is sand or loamy sand. The Bs horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 to 6. It is sand or loamy sand. The Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is gravelly sandy loam or gravelly loamy sand. The C horizon has value of 5 to 7 and chroma of 3 or 4. It is gravelly sand, very gravelly sand, or stratified sand and gravel.

Glawe Series

The Glawe series consists of very deep, poorly drained, moderately permeable soils on lake plains and outwash plains. These soils formed in stratified, medium textured water-laid deposits. The slope ranges from 0 to 2 percent.

Typical pedon of Glawe mucky very fine sandy loam, 1,320 feet north and 660 feet west of the southeast corner of sec. 34, T. 36 N., R. 3 E.

Ap—0 to 10 inches; black (10YR 2/1) mucky very fine sandy loam, dark gray (10YR 4/1) dry; moderate coarse subangular blocky structure; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

Cg1—10 to 12 inches; gray (5YR 6/1) loamy very fine

sand; few fine prominent red (2.5YR 5/6) mottles; weak medium platy structure parting to weak very fine subangular blocky; friable; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cg2—12 to 30 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; few fine prominent red (2.5YR 5/6) mottles; weak medium platy structure; friable; violent effervescence; moderately alkaline; clear wavy boundary.

C—30 to 60 inches; pale brown (10YR 6/3), stratified silt loam, very fine sandy loam, and loamy very fine sand; few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; violent effervescence; moderately alkaline.

The content of gravel is less than 2 percent throughout the profile. The Ap horizon has value of 2 or 3 and chroma of 1 to 3. The C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 1 to 4. It is stratified silt loam, very fine sandy loam, loamy very fine sand, and very fine sand.

Grace Series

The Grace series consists of very deep, moderately well drained and well drained, moderately permeable soils on lake plains, outwash plains, and deltas. These soils formed in stratified, medium textured glaciofluvial deposits. The slope ranges from 0 to 6 percent.

Typical pedon of Grace very fine sandy loam, moderately wet, 0 to 2 percent slopes, 300 feet east and 800 feet south of the northwest corner of sec. 2, T. 35 N., R. 3 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.

B/E—9 to 16 inches; about 85 percent dark yellowish brown (10YR 4/4) very fine sandy loam (Bt); surrounded by thin coatings and interfingerings of pale brown (10YR 6/3) loamy very fine sand (E); moderate medium subangular blocky structure parting to moderate medium platy; friable; neutral; clear wavy boundary.

Bt—16 to 19 inches; dark brown (7.5YR 4/4) very fine sandy loam; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; mildly alkaline; gradual wavy boundary.

B/C—19 to 36 inches; dark brown (7.5YR 4/4) very fine sandy loam (Bt) tonguing into light yellowish brown (10YR 6/4) very fine sandy loam (C); moderate coarse subangular blocky structure; friable; slight effervescence; mildly alkaline; diffuse wavy boundary.

C—36 to 60 inches; light brown (7.5YR 6/4), stratified very fine sandy loam and loamy very fine sand; few medium distinct reddish yellow (7.5YR 6/6) mottles; very thin to very thick platy fragments; very friable; mildly alkaline; strong effervescence; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness. The Ap horizon has value of 2 to 4 and chroma of 1 to 3. The E part of the B/E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 or 3. It is loamy very fine sand or fine sandy loam. The B part has colors and textures similar to those of the Bt horizon. Some pedons have an E/B horizon. The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 or 4, and chroma of 3 to 6. It is silt loam or very fine sandy loam. The C horizon has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 3 to 6. It is stratified silt loam, very fine sandy loam, loamy very fine sand, or very fine sand. Some pedons do not have mottles.

Graycalm Series

The Graycalm series consists of very deep, somewhat excessively drained, rapidly permeable soils on moraines, drumlins, and outwash plains. These soils formed in sandy deposits. The slope ranges from 0 to 35 percent.

Typical pedon of Graycalm sand, 8 to 15 percent slopes, 2,350 feet west and 200 feet north of the southeast corner of sec. 36, T. 35 N., R. 3 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine and medium roots; medium acid; abrupt wavy boundary.

Bw1—3 to 6 inches; brownish yellow (10YR 6/6) sand; weak fine granular structure; very friable; common medium roots; medium acid; clear wavy boundary.

Bw2—6 to 22 inches; yellowish brown (10YR 5/8) sand; weak fine subangular blocky structure; very friable; common medium roots; medium acid; abrupt wavy boundary.

E—22 to 41 inches; light yellowish brown (10YR 6/4) sand; very weak fine subangular blocky structure; very friable; few fine and medium roots; medium acid; abrupt wavy boundary.

E/B—41 to 60 inches; light yellowish brown (10YR 6/4) sand (E); very weak fine subangular blocky structure parting to single grained; very friable; few fine roots; lamellae of strong brown (7.5YR 5/6) loamy sand (Bt); bands are 1/10 to 1/4 inch thick and

have a total thickness of 4 inches; weak fine subangular blocky structure; very friable; slightly acid.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to the first textural band ranges from 25 to 48 inches. The content of gravel ranges from 0 to 10 percent.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Pedons in cultivated areas have an Ap horizon, which has value of 3 or 4 and chroma of 2 or 3. Some pedons have an E horizon 1 to 4 inches thick. This horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 3. It is sand or loamy sand. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is sand or loamy sand. The Bt part of the E/B horizon occurs as bands 1/16 inch to 2 inches thick. It has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is loamy sand or sandy loam. The total thickness of the bands within a depth of 60 inches is less than 6 inches. The E part of the E/B horizon is between the bands. It has value of 5 or 6 and chroma of 2 to 4. It is sand or loamy sand. Some pedons have a C horizon.

Grayling Series

The Grayling series consists of very deep, excessively drained, rapidly permeable soils on outwash plains and moraines. These soils formed in sandy material. The slope ranges from 0 to 15 percent.

Typical pedon of Grayling sand, 0 to 8 percent slopes, 530 feet north and 25 feet west of the southeast corner of sec. 27, T. 33 N., R. 2 E.

A—0 to 1 inch; black (10YR 2/1) sand, dark gray (10YR 4/1) dry; weak fine granular structure; many fine roots; about 1 percent gravel; very strongly acid; abrupt wavy boundary.

Bw1—1 to 10 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; very friable; few fine and medium roots; about 1 percent gravel; strongly acid; gradual wavy boundary.

Bw2—10 to 25 inches; yellowish brown (10YR 5/6) sand; weak medium subangular blocky structure; very friable; few fine roots; about 1 percent gravel; strongly acid; gradual wavy boundary.

C—25 to 60 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; about 1 percent gravel; medium acid.

The thickness of the solum ranges from 15 to 35 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 to 4 and chroma of 0 to 2. Some pedons have a thin O horizon that is 0.5 inch to 1.5 inches thick. This horizon is composed of partially decomposed oak leaves or jack pine needles and twigs. The Bw horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The C horizon has value of 6 or 7 and chroma of 4 or 5.

Greenwood Series

The Greenwood series consists of very deep, very poorly drained soils in depressions and lake basins on outwash plains. These soils formed in acid organic material. Permeability is moderate or moderately rapid. The slope ranges from 0 to 2 percent.

Typical pedon of Greenwood peat, 2,700 feet south and 2,100 feet east of the northwest corner of sec. 33, T. 34 N., R. 4 E.

Oi1—0 to 6 inches; peat, light yellowish brown (10YR 6/4) broken face, yellowish brown (10YR 5/4) rubbed; about 100 percent fiber, 95 percent rubbed; massive; primarily sphagnum moss fibers; many fine roots; extremely acid; clear wavy boundary.

Oi2—6 to 12 inches; peat, yellowish brown (10YR 5/4) broken face, dark yellowish brown (10YR 4/4) rubbed; about 95 percent fiber, 75 percent rubbed; massive; primarily sphagnum moss fibers; many fine roots; extremely acid; clear smooth boundary.

Oe1—12 to 30 inches; mucky peat, dark reddish brown (5YR 3/3) broken face, dark reddish brown (5YR 2/2) rubbed; about 50 percent fiber, 20 percent rubbed; massive; primarily herbaceous fibers; common fine roots; extremely acid; gradual smooth boundary.

Oe2—30 to 60 inches; mucky peat, dark reddish brown (5YR 3/2) broken face and rubbed; about 40 percent fiber, 20 percent rubbed; massive; primarily herbaceous fibers; extremely acid.

The organic layers are more than 51 inches thick. They have hue of 10YR, 7.5YR, or 5YR, value of 2 to 6, and chroma of 1 to 4. The surface tier is dominantly peat derived from sphagnum moss. The underlying layers are dominantly mucky peat derived from sphagnum moss. Some pedons have stratified muck, mucky peat, and peat derived from both herbaceous plants and sphagnum moss.

Hagensville Series

The Hagensville series consists of very deep, somewhat poorly drained, moderately permeable soils in depressions, in drainageways, and on flats on ground moraines and between drumlins. These soils formed in

loamy glacial till. The slope ranges from 0 to 6 percent.

Typical pedon of Hagensville fine sandy loam, 0 to 2 percent slopes, 780 feet west and 40 feet south of the northeast corner of sec. 6, T. 33 N., R. 6 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine and very fine roots; about 3 percent gravel and cobbles; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bw—8 to 12 inches; yellowish brown (10YR 5/4) fine sandy loam; common fine distinct brownish yellow (10YR 6/8) mottles; weak medium subangular blocky structure; friable; few fine roots; about 3 percent gravel and cobbles; slight effervescence; mildly alkaline; clear wavy boundary.

C1—12 to 38 inches; brown (10YR 5/3) sandy loam; common medium faint light brownish gray (10YR 6/2) and common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; about 10 percent gravel and cobbles; violent effervescence; moderately alkaline; clear wavy boundary.

C2—38 to 60 inches; yellowish brown (10YR 5/4) sandy loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; about 10 percent gravel and cobbles; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 24 inches. The thickness of the mollic epipedon ranges from 8 to 12 inches. The content of gravel and cobbles ranges from 1 to 10 percent in the solum and from 5 to 20 percent in the substratum.

The Ap horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The Bw horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is loam, fine sandy loam, or very fine sandy loam. Some pedons have a BA or a BC horizon. The C horizon has hue of 2.5Y, 10YR, or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is sandy loam, fine sandy loam, or the gravelly analogs of those textures. In some pedons thin lenses of sand, loamy sand, or gravelly sand are in the substratum.

Hessel Series

The Hessel series consists of deep and very deep, poorly drained, moderately slowly permeable soils in depressions, in drainageways, and on low flats on ground moraines and glacial lake benches. These soils formed in loamy glacial till. The slope ranges from 0 to 2 percent.

Typical pedon of Hessel mucky flaggy loam, bedrock substratum, 1,700 feet south and 30 feet east of the northwest corner of sec. 29, T. 34 N., R. 7 E.

A—0 to 6 inches; black (10YR 2/1) mucky flaggy loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine roots; about 20 percent limestone flagstones; slight effervescence; moderately alkaline; abrupt wavy boundary.

Bw—6 to 16 inches; light olive brown (2.5Y 5/4) flaggy loam; few fine faint grayish brown (2.5Y 5/2) and common fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; common fine roots; about 35 percent limestone flagstones; slight effervescence; moderately alkaline; gradual wavy boundary.

Cg1—16 to 28 inches; brown (7.5YR 5/2) flaggy loam; common medium prominent yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; massive; firm; about 35 percent limestone flagstones; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cg2—28 to 50 inches; grayish brown (10YR 5/2) gravelly sandy loam; massive; friable; about 25 percent gravel and 10 percent flagstones; violent effervescence; moderately alkaline.

R—50 to 60 inches; limestone bedrock.

The thickness of the solum ranges from 10 to 22 inches. The content of gravel, cobble, and flagstones ranges from 3 to 35 percent throughout the profile. Limestone bedrock is at a depth of 40 to more than 60 inches.

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. It is loam or mucky flaggy loam. The Bw horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 3 or 4. Some pedons have a Bg horizon. This horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 5 or 6 and chroma of 0 to 2. The B horizon is loam, sandy loam, fine sandy loam, or the flaggy analogs of those textures. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 to 7, and chroma of 2 to 4. It is loam, sandy loam, or the flaggy or gravelly analogs of those textures. In some pedons it has strata or pockets of sand or gravelly loamy sand.

Hettinger Series

The Hettinger series consists of very deep, poorly drained, slowly permeable soils in depressions, in drainageways, and on low flats on lake plains. These soils formed in loamy and silty lacustrine deposits. The slope ranges from 0 to 2 percent.

Typical pedon of Hettinger loam, 2,245 feet west and

330 feet north of the southeast corner of sec. 25, T. 34 N., R. 4 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; mildly alkaline; abrupt smooth boundary.
Bg—7 to 15 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; strong medium subangular blocky structure; firm; moderately alkaline; gradual wavy boundary.
BCg—15 to 26 inches; light brownish gray (2.5Y 6/2) silt loam; many coarse prominent strong brown (7.5YR 5/6) mottles; weak medium and thick platy structure parting to moderate fine subangular blocky; firm; moderately alkaline; gradual wavy boundary.
C—26 to 60 inches; light brown (7.5YR 6/4), stratified silt loam, silty clay loam, and very fine sandy loam; thin varves of clay; common medium prominent light brownish gray (2.5Y 6/2) and few medium distinct strong brown (7.5YR 5/6) mottles; massive; firm; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 28 inches. The Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is dominantly silty clay loam or clay loam, but in some pedons it has thin strata of silty clay, silt, or silt loam. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 4. It has thin lenses of clay to very fine sand.

Ingalls Series

The Ingalls series consists of very deep, somewhat poorly drained soils in depressions, on flats, and in drainageways on lake plains, on terraces, and in low areas between drumlins and moraines. These soils formed in sandy deposits over stratified, loamy lacustrine sediments. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. The slope ranges from 0 to 3 percent.

Typical pedon of Ingalls sand, 0 to 3 percent slopes, 2,010 feet west and 525 feet south of the northeast corner of sec. 14, T. 35 N., R. 2 E.

Oe—1 inch to 0; black (N 2/0), partially decomposed leaf litter; many fine roots; abrupt smooth boundary.
A—0 to 3 inches; black (N 2/0) sand, very dark gray (N 3/0) dry; weak fine granular structure; very friable; many fine and medium roots; medium acid; abrupt wavy boundary.
E—3 to 11 inches; pinkish gray (7.5YR 6/2) sand; weak medium platy structure; very friable; few medium and coarse roots; medium acid; abrupt wavy boundary.
Bs1—11 to 14 inches; dark reddish brown (5YR 3/4) loamy sand; few fine distinct yellowish red (5YR 5/8) mottles; weak fine subangular blocky structure; friable; few medium and coarse roots; few medium chunks of strongly cemented, dark reddish brown (5YR 3/2) ortstein; medium acid; abrupt broken boundary.
Bs2—14 to 25 inches; strong brown (7.5YR 5/6) sand; few medium prominent light brownish gray (10YR 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; few fine roots; medium acid; clear wavy boundary.
BC—25 to 32 inches; yellowish brown (10YR 5/4) sand; few fine distinct yellowish brown (10YR 5/8) mottles; single grained; loose; slightly acid; abrupt wavy boundary.
2C—32 to 50 inches; dark brown (7.5YR 4/4) and brown (7.5YR 5/4), stratified silt loam and very fine sandy loam; weak thin to thick platy structure; firm; mildly alkaline; abrupt smooth boundary.
2Cg—50 to 60 inches; pinkish gray (7.5YR 6/2), stratified silt loam and very fine sandy loam; weak thin to thick platy structure; firm; strong effervescence; moderately alkaline.

Depth to the 2C horizon ranges from 20 to 40 inches. 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 3. The Ap horizon, if it occurs, has hue of 10YR and value and chroma of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is sand, loamy sand, or loamy fine sand. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 6, and chroma of 4 to 6. It is sand, loamy sand, or loamy fine sand. In some pedons it has chunks or tongues of ortstein. Some pedons have a C horizon. This horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 3 or 4. It is sand, loamy sand, or loamy fine sand. The 2C horizon has hue of 7.5YR or 5YR, value of 4 to 6, and chroma of 2 to 4. It is stratified silt loam and very fine sandy loam and has a few strata of fine sand to clay.

Iosco Series

The Iosco series consists of very deep, somewhat poorly drained soils in depressions, in drainageways, and on flats on moraines and drumlins. These soils

formed in sandy deposits over loamy glacial till. Permeability is rapid in the upper part of the profile and moderate in the lower part. The slope ranges from 0 to 3 percent.

Typical pedon of Iosco loamy sand, 0 to 3 percent slopes, 2,000 feet north and 25 feet west of the southeast corner of sec. 26, T. 35 N., R. 2 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.
E—8 to 13 inches; light gray (10YR 7/2) fine sand; very weak fine granular structure; very friable; slightly acid; clear wavy boundary.
Bs—13 to 26 inches; dark brown (7.5YR 4/4) loamy sand; common medium distinct strong brown (7.5YR 5/8) and common medium prominent light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.
E′—26 to 32 inches; pale brown (10YR 6/3) loamy fine sand; common medium distinct yellowish brown (10YR 5/6) and common medium faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.
2Bt—32 to 38 inches; reddish brown (5YR 4/4) sandy clay loam; common medium faint yellowish red (5YR 4/6) and reddish brown (5YR 5/3) mottles; weak thick platy structure parting to weak fine subangular blocky; firm; few faint clay films on faces of peds; neutral; clear irregular boundary.
2C—38 to 60 inches; light reddish brown (5YR 6/3) sandy loam; common medium faint pinkish gray (5YR 6/2) and common medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; strong effervescence; moderately alkaline.

Depth to the 2Bt horizon ranges from 20 to 40 inches. The Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. It is loamy sand, loamy fine sand, or sand. The Bs horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 4 to 6. It is sand, fine sand, or loamy fine sand. In some pedons it has chunks or tongues of ortstein. The E′ horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. It is sand, loamy sand, or loamy fine sand. Some pedons have a B/E horizon. The E material occurs as thick coatings on peds and as fillings in cracks and root channels in the upper part of the 2Bt horizon. The 2Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy clay loam or sandy loam. The 2C horizon has hue of 10YR, 7.5YR, or 5YR, value of 5 or 6, and chroma of 1 to 4. It is sandy loam or loam.

Johnswood Series

The Johnswood series consists of very deep, moderately well drained, slowly permeable soils on glacial lake benches and terraces. These soils formed in loamy glacial till. The slope ranges from 1 to 6 percent.

Typical pedon of Johnswood very flaggy loam, 1 to 6 percent slopes, 200 feet east and 20 feet south of the northwest corner sec. 7, T. 33 N., R. 8 E.

Oi—2 inches to 0; dark brown (7.5YR 4/2), partially decomposed twigs and leaves; friable; many fine roots; abrupt wavy boundary.
A—0 to 5 inches; black (10YR 2/1) very flaggy loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many fine roots; about 40 percent flagstones; neutral; abrupt wavy boundary.
Bt—5 to 13 inches; dark yellowish brown (10YR 4/4) very flaggy clay loam; few fine prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; common medium and few fine roots; common distinct clay films on faces of peds; about 50 percent flagstones and channers; mildly alkaline; abrupt wavy boundary.
Cd—13 to 60 inches; dark grayish brown (10YR 4/2) very flaggy loam; massive; firm; few fine roots; about 60 percent flagstones and channers; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 20 inches. The content of coarse fragments ranges from 35 to 70 percent, by volume. The fragments are mainly flagstones, channers, and gravel.

The A or Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is very flaggy loam or very flaggy sandy loam. The Bt horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. It is very flaggy or extremely flaggy loam or clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is very flaggy or extremely flaggy sandy loam or loam. Limestone bedrock is at a depth of more than 40 inches in some pedons.

Kalkaska Series

The Kalkaska series consists of very deep, somewhat excessively drained, rapidly permeable soils on moraines and outwash plains. These soils formed in

sandy deposits. The slope ranges from 0 to 15 percent.

The Kalkaska soils in this county have a thinner Bhs horizon and a yellower Bs horizon than are defined as the range for the series. These differences, however, do not affect use or behavior of the soils.

Typical pedon of Kalkaska sand, 0 to 8 percent slopes, 2,775 feet south and 130 feet east of the northwest corner of sec. 33, T. 35 N., R. 4 E.

Oa—3 inches to 0; very dark gray (N 3/0), decomposed and partially decomposed deciduous leaves and twigs; friable; common fine and medium roots; extremely acid; abrupt wavy boundary.
E—0 to 8 inches; brown (7.5YR 5/2) sand; single grained; loose; common medium roots; extremely acid; abrupt wavy boundary.
Bhs—8 to 10 inches; dark reddish brown (5YR 3/3) sand; weak fine subangular blocky structure; very friable; common medium roots; about 15 percent weakly cemented ortstein; very strongly acid; abrupt irregular boundary.
Bs1—10 to 15 inches; dark yellowish brown (10YR 4/6) sand; very weak fine subangular blocky structure; very friable; common fine and medium roots; very strongly acid; clear irregular boundary.
Bs2—15 to 38 inches; yellowish brown (10YR 5/6) sand; very weak fine subangular blocky structure; very friable; few medium roots; very strongly acid; clear irregular boundary.
C—38 to 60 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; few medium roots; strongly acid.

The thickness of the solum ranges from 24 to 50 inches. The content of gravel ranges from 0 to 5 percent. The content of cemented material ranges from 5 to 30 percent in the solum.

Some pedons have an A horizon as much as 2 inches thick. This horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. The E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 or 2. It is sand or loamy sand. The Bhs horizon has hue of 7.5YR or 5YR, value of 2 or 3, and chroma of 1 to 3. It is sand or loamy sand. The Bs horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The C horizon has value of 5 to 7 and chroma of 4 to 6.

Kinross Series

The Kinross series consists of very deep, poorly drained, rapidly permeable soils in depressions and on low flats on outwash plains. These soils formed in sandy material. The slope ranges from 0 to 2 percent.

Typical pedon of Kinross muck, 900 feet east of the center of sec. 22, T. 34 N., R. 4 E.

Oa—0 to 4 inches; black (N 2/0) muck; about 10 percent sand mixed into the lower part; weak medium platy structure; very friable; many fine roots; extremely acid; abrupt smooth boundary.
E—4 to 9 inches; pinkish gray (7.5YR 6/2) fine sand; few fine faint brown (7.5YR 4/2) mottles; weak fine subangular blocky structure parting to weak medium granular; very friable; few fine roots; extremely acid; clear wavy boundary.
Bhs—9 to 13 inches; dark reddish brown (5YR 3/3) fine sand; few medium faint dark reddish gray (5YR 4/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; very strongly acid; gradual wavy boundary.
Bs1—13 to 17 inches; dark brown (7.5YR 4/4) fine sand; moderate fine subangular blocky structure; very friable; few roots; very strongly acid; gradual wavy boundary.
Bs2—17 to 22 inches; brown (7.5YR 5/4) fine sand; weak fine subangular blocky structure; very friable; strongly acid; clear wavy boundary.
C—22 to 60 inches; light yellowish brown (10YR 6/4) fine sand; single grained; loose; strongly acid.

The thickness of the solum ranges from 18 to 40 inches. The Oa horizon has hue of 5YR, 7.5YR, or 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 1 to 4 inches thick. This horizon has hue of 7.5YR or 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 to 7, and chroma of 1 to 3. It is fine sand or sand. The Bhs horizon has hue of 5YR or 7.5YR and value and chroma of 2 or 3. It is fine sand, sand, or loamy sand. The Bs horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is fine sand, sand, or loamy sand. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 to 6. It is sand or fine sand.

Kiva Series

The Kiva series consists of very deep, well drained soils on outwash plains and eskers. These soils formed in loamy deposits over sand and gravel. Permeability is moderate in the loamy material and very rapid in the underlying sand and gravel. The slope ranges from 0 to 6 percent.

Typical pedon of Kiva fine sandy loam, in an area of Kiva-Alpena complex, 1 to 6 percent slopes; 400 feet west and 525 feet north of the southeast corner of sec. 4, T. 33 N., R. 8 E.

A—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; many fine and very fine roots; about 3 percent gravel; mildly alkaline; abrupt wavy boundary.

Bs—7 to 22 inches; dark brown (7.5YR 3/4) gravelly sandy loam; weak fine subangular blocky structure; friable; common fine and very fine roots; about 20 percent gravel; mildly alkaline; abrupt wavy boundary.

2C—22 to 60 inches; brown (10YR 5/3) very gravelly coarse sand; single grained; loose; about 50 percent gravel; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 10 to 24 inches. The content of gravel and cobbles ranges from 0 to 25 percent in the solum and from 15 to 50 percent in the substratum.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 or 3. It is sandy loam, loamy sand, or the gravelly analogs of those textures. The Bs horizon has hue of 7.5YR or 10YR and value and chroma of 3 or 4. It is sandy loam or gravelly sandy loam. Some pedons have a BC horizon. This horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 or 5. The 2C horizon has value of 5 or 6 and chroma of 3 or 4. It is gravelly sand, very gravelly coarse sand, or very gravelly sand.

Klacking Series

The Klacking series consists very deep, well drained, moderately rapidly permeable soils on moraines, drumlins, and outwash plains. These soils formed in sandy deposits. The slope ranges from 0 to 12 percent.

Typical pedon of Klacking sand, 0 to 6 percent slopes, 30 feet north and 20 feet east of the center of sec. 36, T. 34 N., R. 3 E.

A—0 to 2 inches; very dark gray (10YR 3/1) sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; many fine and medium roots; about 1 percent gravel; medium acid; abrupt wavy boundary.

E—2 to 5 inches; light brownish gray (10YR 6/2) sand; very weak fine granular structure; very friable; many fine roots; about 1 percent gravel; strongly acid; abrupt irregular boundary.

Bw—5 to 18 inches; yellowish brown (10YR 5/6) sand; weak fine granular structure; very friable; common fine roots; about 1 percent gravel; medium acid; clear wavy boundary.

E′—18 to 27 inches; very pale brown (10YR 7/3) fine sand; very weak thin platy structure; very friable; common fine roots; about 1 percent gravel; medium acid; clear wavy boundary.

E&Bt—27 to 44 inches; about 80 percent very pale brown (10YR 7/3) loamy fine sand (E); very weak very fine subangular blocky structure parting to single grained; very friable; common fine roots; lamellae of brown (7.5YR 5/4) fine sandy loam (Bt) 1/10 to 1/4 inch thick; weak very fine subangular blocky structure; friable; common fine roots; about 3 percent gravel; medium acid; clear wavy boundary.

Bt—44 to 48 inches; dark brown (7.5YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; few fine roots; about 5 percent gravel; medium acid; abrupt wavy boundary.

C—48 to 60 inches; pale brown (10YR 6/3) sand; single grained; loose; about 2 percent gravel; mildly alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. The content of gravel and cobbles 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. Pedons in cultivated areas have an Ap horizon, which has value of 3 or 4 and chroma of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 5 or 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 loamy sand or sand. The E′ horizon has value of 5 to 7 and chroma of 2 or 3. It is sand, fine sand, loamy sand, or loamy fine sand. The Bt horizon consists of lamellae 1/16 inch to 4 inches thick. It has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is loamy sand, sandy loam, or fine sandy loam. The total thickness of the lamellae within a depth of 60 inches is more than 6 inches. The C horizon has value of 5 or 6 and chroma of 3 to 6.

Krakow Series

The Krakow series consists of very deep, well drained, moderately permeable soils on ground moraines, glacial lake benches, and drumlins. These soils formed in loamy glacial till. The slope ranges from 1 to 18 percent.

Typical pedon of Krakow flaggy fine sandy loam, 1 to 6 percent slopes, 500 feet north and 650 feet east of the southwest corner of sec. 2, T. 33 N., R. 6 E.

A—0 to 2 inches; dark grayish brown (10YR 4/2) flaggy fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine and

medium roots; about 30 percent flagstones; slight effervescence; mildly alkaline; abrupt wavy boundary.
E—2 to 11 inches; yellowish brown (10YR 5/4) flaggy fine sandy loam; weak fine subangular blocky structure; friable; many fine roots; about 30 percent flagstones; neutral; abrupt wavy boundary.
Bt—11 to 16 inches; dark reddish brown (5YR 3/4) very flaggy clay loam; moderate medium subangular blocky structure parting to weak fine subangular blocky; firm; common fine roots; common distinct clay films on faces of peds; about 50 percent flagstones and channers; slight effervescence; mildly alkaline; abrupt irregular boundary.
C1—16 to 38 inches; dark brown (10YR 4/3) very flaggy loam; massive; friable; few fine roots; about 55 percent flagstones and channers; violent effervescence; moderately alkaline; diffuse irregular boundary.
C2—38 to 60 inches; brown (10YR 5/3) very flaggy loam; massive; friable; about 60 percent flagstones and channers; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 24 inches. The content of flagstones and channers ranges from 20 to 35 percent in the A and E horizons and from 35 to 60 percent in the B and C horizons.

The A or Ap horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 to 4 and chroma of 0 to 3. In most cultivated areas many of the flagstones and channers have been removed from the surface layer. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 to 4. It is flaggy fine sandy loam, sandy loam, or loam. The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 or 5. It is very flaggy loam, very flaggy clay loam, or very flaggy sandy clay loam. The C horizon has value of 3 to 6 and chroma of 3 or 4. It is very flaggy sandy loam or very flaggy loam.

Lupton Series

The Lupton series consists of very deep, very poorly drained organic soils in depressions, in drainageways, and on low flats on ground moraines, lake plains, and outwash plains. These soils formed in organic deposits. Permeability is moderately slow to moderately rapid. The slope ranges from 0 to 2 percent.

Typical pedon of Lupton muck, 1,700 feet south and 50 feet west of the northeast corner of sec. 28, T. 34 N., R. 3 E.

Oa1—0 to 5 inches; muck, black (5YR 2/1) broken face and rubbed; about 20 percent fiber, 5 percent rubbed; weak medium granular structure; friable; woody and herbaceous fibers; many fine and medium roots; neutral; clear smooth boundary.
Oa2—5 to 9 inches; muck, black (5YR 2/1) broken face and rubbed; about 10 percent fiber, 2 percent rubbed; weak fine granular structure; herbaceous and woody fibers; many fine roots; neutral; clear smooth boundary.
Oa3—9 to 15 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; about 40 percent fiber, 5 percent rubbed; massive; herbaceous and woody fibers; slightly acid; clear smooth boundary.
Oa4—15 to 60 inches; muck, very dark grayish brown (10YR 3/2) broken face, very dark gray (10YR 3/1) rubbed; about 60 percent fiber, 5 percent rubbed; massive; primarily herbaceous fibers; slightly acid.

In some pedons woody fragments in the form of twigs, branches, or logs make up as much as 30 percent, by volume, of the profile. The organic layers have hue of 5YR, 7.5YR, or 10YR, value of 2 or 3, and chroma of 1 to 3. The subsurface tiers are dominantly muck, but in some pedons they have thin layers of peat or mucky peat.

Mancelona Series

The Mancelona series consists of very deep, somewhat excessively drained soils on outwash plains, beach ridges, and eskers. These soils formed in sandy and gravelly deposits. Permeability is moderately rapid in the solum and very rapid in the underlying sand and gravel. The slope ranges from 2 to 35 percent.

Typical pedon of Mancelona loamy sand, 2 to 6 percent slopes, 800 feet east and 170 feet south of the northwest corner of sec. 24, T. 33 N., R. 6 E.

Ap—0 to 10 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak very fine granular structure; very friable; about 5 percent gravel; neutral; abrupt smooth boundary.
Bs—10 to 12 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak very fine subangular blocky structure; very friable; about 15 percent gravel; neutral; abrupt wavy boundary.
Bt—12 to 17 inches; reddish brown (5YR 4/4) gravelly sandy loam; weak fine subangular blocky structure; friable; common faint clay films on faces of peds; about 25 percent gravel and cobbles; slight effervescence; mildly alkaline; abrupt wavy boundary.
BC—17 to 24 inches; yellowish brown (10YR 5/6) sand; single grained; loose; about 10 percent gravel; mildly alkaline; abrupt wavy boundary.
2C—24 to 60 inches; light yellowish brown (10YR 6/4)

very gravelly sand; single grained; loose; about 50 percent gravel; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 40 inches. The content of gravel ranges from 3 to 30 percent in the solum and from 10 to 55 percent in the substratum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. It is loamy sand, sand, or the gravelly analogs of those textures. The Bs horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 6. It is gravelly loamy sand, loamy sand, or sand. The Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 to 5. It is loamy sand, sandy loam, sandy clay loam, or the gravelly analogs of those textures. The 2C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. It is very gravelly sand, gravelly sand, or stratified sand and gravel.

Melita Series

The Melita series consists of very deep, somewhat excessively drained soils that formed in sandy deposits over loamy material on ground moraines, outwash plains, lake plains, and old stream terraces. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. The slope ranges from 0 to 6 percent.

Typical pedon of Melita loamy sand, 0 to 6 percent slopes, 800 feet east and 150 feet south of the northwest corner of sec. 15, T. 34 N., R. 3 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

Bs—10 to 14 inches; dark brown (7.5YR 3/4) loamy sand; very weak fine subangular blocky structure; very friable; medium acid; abrupt wavy boundary.

Bw1—14 to 28 inches; yellowish brown (10YR 5/8) sand; very weak medium subangular blocky structure; very friable; medium acid; clear wavy boundary.

Bw2—28 to 52 inches; brownish yellow (10YR 6/6) sand; very weak fine subangular blocky structure; very friable; medium acid; abrupt smooth boundary.

2B/E—52 to 54 inches; about 75 percent reddish brown (5YR 4/3) silty clay loam (Bt); light brownish gray (10YR 6/2) sandy loam (E) coatings on peds of Bt material; weak fine subangular blocky structure; firm; mildly alkaline; gradual wavy boundary.

2Bt—54 to 60 inches; reddish brown (5YR 4/3) silty clay loam; weak fine subangular blocky structure; firm; common faint clay films on faces of peds; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 45 to 60 inches. The solum is dominantly sand or loamy sand above the argillic horizon, but the range includes loamy fine sand.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. Pedons in undisturbed areas have an A horizon, which has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon, if it occurs, has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2. The Bs horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 4 to 8. In some pedons it has a few chunks or tongues of ortstein. The Bw horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. The E part of the 2B/E horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. The 2Bt horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 3 to 6. It is silty clay loam or clay loam. The 2C horizon, if it occurs, has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is silty clay loam or clay loam. In some pedons the substratum has thin strata of very fine sand to clay.

Menominee Series

The Menominee series consists of very deep, well drained soils on lake plains and terraces. These soils formed in sandy deposits over stratified silty and clayey lacustrine material. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. The slope ranges from 2 to 6 percent.

Typical pedon of Menominee loamy sand, 2 to 6 percent slopes, 450 feet north and 1,050 feet west of the southeast corner of sec. 11, T. 33 N., R. 2 E.

Oi—1 inch to 0; black (N 2/0), partially decomposed leaves and twigs; many very fine and fine roots; medium acid; clear wavy boundary.

E—0 to 6 inches; brown (7.5YR 5/2) loamy sand; very weak fine subangular blocky structure; very friable; many fine roots; slightly acid; abrupt wavy boundary.

Bs1—6 to 15 inches; dark brown (7.5YR 4/4) fine sand; very weak fine subangular blocky structure; very friable; common fine roots; about 1 percent gravel; neutral; clear wavy boundary.

Bs2—15 to 20 inches; yellowish brown (10YR 5/6) fine sand; weak medium subangular blocky structure; very friable; few fine and medium roots; about 1 percent gravel; neutral; clear wavy boundary.

E′—20 to 25 inches; light yellowish brown (10YR 6/4) loamy fine sand; weak medium subangular blocky structure; friable; few fine and medium roots; about 1 percent gravel; neutral; clear wavy boundary.
2Bt—25 to 34 inches; reddish brown (5YR 4/4) clay loam; strong coarse subangular blocky structure; firm; few fine and medium roots; common faint clay films on faces of peds; mildly alkaline; clear wavy boundary.
2C—34 to 60 inches; reddish brown (5YR 5/4) silty clay loam; strata of very fine sandy loam; massive; firm; violent effervescence; moderately alkaline.

The sandy upper layers range from 20 to 40 inches in thickness. The A horizon, if it occurs, has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The Ap horizon, if it occurs, has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. It is loamy sand, sand, or loamy fine sand. The Bs horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 2 to 6. It is fine sand, loamy sand, sand, or loamy fine sand. In some pedons it has a few chunks of ortstein. The E′ horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 2 to 4. It is sand or loamy fine sand. Some pedons have an E/B or a B/E horizon directly above the 2Bt horizon. The 2Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or silty clay loam. Some pedons have a 2BC horizon. The 2C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. In some pedons it has thin strata of very fine sand to clay.

Moltke Series

The Moltke series consists of very deep, somewhat poorly drained, moderately permeable soils on lake plains and outwash plains. These soils formed in loamy glaciofluvial deposits. The slope ranges from 0 to 3 percent.

Typical pedon of Moltke very fine sandy loam, 0 to 3 percent slopes, 1,715 feet west and 660 feet north of the southeast corner of sec. 5, T. 35 N., R. 3 E.

A—0 to 4 inches; dark brown (7.5YR 3/2) very fine sandy loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; many very fine and medium roots; slightly acid; abrupt wavy boundary.
E—4 to 9 inches; light brownish gray (10YR 6/2) loamy very fine sand; weak fine subangular blocky structure; very friable; many fine and common medium roots; medium acid; abrupt wavy boundary.
B/E—9 to 13 inches; about 85 percent dark brown (7.5YR 4/4) very fine sandy loam (Bt); surrounded by pale brown (10YR 6/3) loamy very fine sand (E); common medium distinct strong brown (7.5YR 4/6) and pinkish gray (7.5YR 6/2) mottles; moderate fine subangular blocky structure; firm; many fine and few medium roots; few faint brown (7.5YR 5/4) clay films in root channels; medium acid; clear wavy boundary.
Bt1—13 to 21 inches; brown (7.5YR 4/4) very fine sandy loam; few fine distinct strong brown (7.5YR 5/6) and brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; firm; common fine and medium roots; few faint brown (7.5YR 5/4) clay films on faces of peds and in root channels; neutral; gradual wavy boundary.
Bt2—21 to 33 inches; yellowish brown (10YR 5/4) very fine sandy loam; many fine prominent strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; moderate very coarse subangular blocky structure; friable; few fine and medium roots; few faint reddish brown (5YR 4/3) clay films in root channels; slight effervescence; mildly alkaline; gradual wavy boundary.
C—33 to 60 inches; light yellowish brown (10YR 6/4), stratified very fine sandy loam and loamy very fine sand; few fine prominent strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/6) mottles; massive; friable; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 36 inches. The A or Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has value of 5 or 6 and chroma of 2 to 4. It is loamy very fine sand or very fine sand. The E part of the B/E horizon has colors and textures similar to those of the E horizon. The B part has colors and textures similar to those of the Bt horizon. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is very fine sandy loam or silt loam. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. It is dominantly stratified very fine sandy loam and loamy very fine sand but has thin strata ranging from very fine sand to silt loam.

Nunica Series

The Nunica series consists of very deep, moderately well drained, moderately slowly permeable soils on lake plains. These soils formed in loamy and silty lacustrine deposits. The slope ranges from 2 to 6 percent.

Typical pedon of Nunica silt loam, 2 to 6 percent slopes, 1,300 feet north and 300 feet west of the southeast corner of sec. 3, T. 34 N., R. 3 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; friable; neutral; abrupt smooth boundary.
B/E—8 to 13 inches; about 70 percent reddish brown (5YR 4/3) silty clay loam (Bt); grayish brown (10YR 5/2) very fine sandy loam (E) coating faces of peds; strong medium subangular blocky structure; firm; few faint clay films on faces of peds; neutral; clear irregular boundary.
Bt1—13 to 17 inches; reddish brown (5YR 4/3) silty clay loam; strong medium subangular blocky structure; firm; common faint clay films on faces of peds; neutral; clear wavy boundary.
Bt2—17 to 22 inches; brown (7.5YR 4/4) silty clay loam; strong medium subangular blocky structure; firm; common distinct clay films on faces of peds; neutral; clear wavy boundary.
C—22 to 60 inches; light brown (7.5YR 6/4), stratified silt loam, silty clay loam, and silt; few fine distinct strong brown (7.5YR 5/8) mottles; weak medium platy structure; friable; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. The E part of the B/E horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6, and chroma of 2 or 3. It is very fine sandy loam, loam, or silt loam. The B part has colors and textures similar to those of the Bt horizon. The Bt horizon has hue of 7.5YR or 5YR and chroma of 3 or 4. Some pedons have a BC horizon. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 2 to 4. In some pedons it has thin strata of very fine sand or clay.

Ocqueoc Series

The Ocqueoc series consists of very deep, well drained soils on lake plains and stream terraces. These soils formed in sandy deposits over stratified, loamy lacustrine material. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. The slope ranges from 0 to 6 percent.

Typical pedon of Ocqueoc fine sand, 0 to 6 percent slopes, 2,375 feet west and 140 feet south of the northeast corner of sec. 14, T. 35 N., R. 2 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; slightly acid; abrupt wavy boundary.
Bs1—6 to 12 inches; dark brown (7.5YR 3/4) fine sand; weak fine subangular blocky structure; friable; slightly acid; clear wavy boundary.
Bs2—12 to 18 inches; strong brown (7.5YR 4/6) fine sand; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.
Bs3—18 to 28 inches; dark yellowish brown (10YR 4/6) sand; weak coarse subangular blocky structure; very friable; few weakly cemented, strong brown (7.5YR 4/6) fragments of ortstein; slightly acid; abrupt wavy boundary.
C1—28 to 31 inches; yellowish brown (10YR 5/4) loamy fine sand; massive; friable; slightly acid; clear wavy boundary.
2C2—31 to 52 inches; reddish brown (5YR 4/4) fine sandy loam; massive; friable; mildly alkaline; clear wavy boundary.
2C3—52 to 60 inches; brown (7.5YR 5/4) silt loam; massive; friable; mildly alkaline.

The thickness of the solum ranges from 15 to 30 inches. The thickness of the sandy upper layers ranges from 20 to 40 inches. The upper layers are dominantly fine sand, but the range includes sand and loamy fine sand.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The A horizon, if it occurs, 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, if it occurs, has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 or 2. The Bs horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 4 to 6. In some pedons it has a few chunks of ortstein. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. The 2C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 3 or 4. It is silt loam, fine sandy loam, or loamy very fine sand. In some pedons it has thin strata of very fine sand to clay.

Omena Series

The Omena series consists of very deep, well drained, moderately permeable soils on ground moraines and drumlins. These soils formed in loamy glacial till. The slope ranges from 0 to 18 percent.

Typical pedon of Omena fine sandy loam, 2 to 6 percent slopes, 380 feet west and 2,670 feet south of the northeast corner of sec. 13, T. 33 N., R. 6 E.

Ap—0 to 8 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium granular structure; friable; about 7 percent gravel and 5 percent cobbles; very slight effervescence; mildly alkaline; abrupt smooth boundary.
Bt—8 to 11 inches; strong brown (7.5YR 4/6) sandy

loam; moderate fine subangular blocky structure; firm; few faint clay films on faces of peds; about 7 percent gravel and 5 percent cobbles; mildly alkaline; abrupt broken boundary.

BC—11 to 13 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; about 7 percent gravel and 5 percent cobbles; slight effervescence; mildly alkaline; abrupt wavy boundary.

C—13 to 60 inches; yellowish brown (10YR 5/4) gravelly sandy loam; weak medium platy structure; friable; about 15 percent gravel and 7 percent cobbles; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 10 to 24 inches. The content of gravel and cobbles ranges from 3 to 15 percent in the solum and from 5 to 20 percent in the substratum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Pedons in undisturbed areas have an A horizon, which has hue of 10YR, value of 2, and chroma of 1 or 2. The E horizon, if it occurs, has value of 5 or 6 and chroma of 1 or 2. It is fine sandy loam or sandy loam. Some pedons have a B/E horizon. The E material occurs as coatings on peds in the upper 1 or 2 inches of the Bt horizon. The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 3 to 6. It is sandy loam or loam. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 5. It is sandy loam or gravelly sandy loam.

Onaway Series

The Onaway series consists of very deep, well drained or moderately well drained, moderately slowly permeable soils on ground moraines and drumlins. These soils formed in loamy glacial till. The slope ranges from 0 to 25 percent.

Typical pedon of Onaway fine sandy loam, 2 to 6 percent slopes, 500 feet west and 675 feet south of the center of sec. 13, T. 33 N., R. 6 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; about 3 percent gravel and cobbles; mildly alkaline; abrupt smooth boundary.

Bs—8 to 10 inches; dark brown (7.5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; about 3 percent gravel and cobbles; mildly alkaline; abrupt wavy boundary.

E—10 to 13 inches; brown (7.5YR 5/2) fine sandy loam; very weak fine subangular blocky structure; friable; about 3 percent gravel and cobbles; mildly alkaline; abrupt wavy boundary.

Bt—13 to 28 inches; strong brown (7.5YR 4/6) clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; common distinct clay films on faces of peds; about 3 percent gravel and cobbles; mildly alkaline; abrupt wavy boundary.

C—28 to 60 inches; yellowish brown (10YR 5/4) gravelly sandy loam; weak medium platy structure; friable; about 20 percent gravel and 10 percent cobbles; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 15 to 30 inches. The content of gravel, channers, and cobbles ranges from 5 to 15 percent in the solum and from 5 to 30 percent in the substratum.

The A or Ap 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 3. The Bs horizon has value of 3 to 5 and chroma of 3 to 6. It is fine sandy loam or sandy loam. The E horizon has value of 5 to 7 and chroma of 1 to 3. It is fine sandy loam, sandy loam, or loam. In pedons in undisturbed areas, it generally has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. Some pedons have a B/E horizon, in which the E material occurs as coatings on peds of B material in the upper 1 or 2 inches of the Bt horizon. The Bt horizon has hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. It is clay loam, loam, or sandy clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 3 or 4. It is sandy loam or gravelly sandy loam. In some pedons it has pockets or layers of sand or loamy sand. Pedons in areas that have slopes of 0 to 2 percent have mottles in the lower part of the profile.

Pinconning Series

The Pinconning series consists of very deep, poorly drained soils on low flats, in depressions, and in drainageways on lake plains and terraces. These soils formed in sandy deposits over stratified silty and clayey lacustrine material. Permeability is rapid in the upper part of the profile and slow or very slow in the lower part. The slope ranges from 0 to 2 percent.

Typical pedon of Pinconning mucky sand, 650 feet south and 50 feet west of the northeast corner of sec. 15, T. 34 N., R. 3 E.

A—0 to 8 inches; black (10YR 2/1) mucky sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine and medium roots; neutral; abrupt wavy boundary.

Cg—8 to 10 inches; grayish brown (10YR 5/2) sand; common fine faint dark gray (10YR 4/1) mottles; weak fine subangular blocky structure; very friable;

many fine and medium roots; neutral; clear wavy boundary.

C—10 to 25 inches; brown (10YR 5/3) sand; many medium faint light brownish gray (10YR 6/2) and few fine distinct yellowish brown (10YR 5/6) mottles; single grained; loose; common fine and medium roots; mildly alkaline; clear wavy boundary.

C'g—25 to 32 inches; dark grayish brown (10YR 4/2) sand; common medium faint grayish brown (10YR 5/2) and common fine distinct yellowish brown (10YR 5/6) mottles; single grained; loose; common fine and medium roots; mildly alkaline; abrupt smooth boundary.

2Cg1—32 to 40 inches; grayish brown (10YR 5/2) silty clay loam; common medium faint gray (10YR 6/1) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; common fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

2Cg2—40 to 60 inches; brown (7.5YR 5/2) silty clay loam; common coarse distinct light brownish gray (10YR 6/2) mottles; massive; firm; violent effervescence; moderately alkaline.

The thickness of the sandy upper layers ranges from 20 to 40 inches. The A horizon has value of 2 or 3. The Ap horizon, if it occurs, has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The C horizon has value of 3 to 6 and chroma of 1 to 3. It is sand, fine sand, loamy sand, or loamy fine sand. The 2C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 4. It is silty clay or silty clay loam. In some pedons it has thin strata of clay and silt loam.

Roscommon Series

The Roscommon series consists of very deep, poorly drained, rapidly permeable soils in depressions, in drainageways, and on low flats on outwash plains. These soils formed in sandy deposits. The slope ranges from 0 to 2 percent.

The Roscommon soils in this county have brighter colors in the substratum than are defined as the range for the series. This difference, however, does not affect use or behavior of the soils.

Typical pedon of Roscommon muck, 1,320 feet east and 50 feet south of the northwest corner of sec. 2, T. 35 N., R. 2 E.

Oa—0 to 4 inches; black (N 2/0) muck; about 20 percent sand mixed throughout; weak thick platy structure parting to weak fine subangular blocky; friable; many fine and medium roots; medium acid; abrupt wavy boundary.

Cg—4 to 7 inches; dark grayish brown (10YR 4/2) sand; few fine faint brown (10YR 4/3) mottles; single grained; loose; common fine and medium roots; medium acid; abrupt wavy boundary.

C1—7 to 21 inches; brown (10YR 5/3) sand; few fine prominent strong brown (7.5YR 5/8) and few fine faint yellowish brown (10YR 5/4) mottles; single grained; loose; slightly acid; gradual wavy boundary.

C2—21 to 60 inches; pale brown (10YR 6/3) sand; single grained; loose; mildly alkaline.

Some pedons have an A horizon. This horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is sand or loamy sand. In some pedons it has thin layers of fine sand.

Rubicon Series

The Rubicon series consists of very deep, excessively drained, rapidly permeable soils on outwash plains and moraines. These soils formed in sandy deposits. The slope ranges from 0 to 35 percent.

Typical pedon of Rubicon sand, 0 to 8 percent slopes, 1,570 feet west and 200 feet north of the center of sec. 3, T. 35 N., R. 2 E.

Oi—2 inches to 0; dark reddish brown (5YR 3/2), partially decomposed deciduous leaves and twigs; friable; many fine roots; extremely acid; abrupt wavy boundary.

A—0 to 2 inches; black (N 2/0) sand, black (10YR 2/1) dry; weak fine granular structure; very friable; many fine to coarse roots; about 3 percent gravel; very strongly acid; abrupt wavy boundary.

E—2 to 6 inches; brown (7.5YR 5/2) sand; weak fine granular structure; very friable; many fine to coarse roots; about 3 percent gravel; very strongly acid; abrupt wavy boundary.

Bs1—6 to 11 inches; brown (7.5YR 4/4) sand; very weak fine subangular blocky structure; very friable; many fine roots; about 3 percent gravel; strongly acid; clear irregular boundary.

Bs2—11 to 16 inches; strong brown (7.5YR 4/6) sand; very weak fine subangular blocky structure; very friable; few fine roots; about 3 percent gravel; a few chunks of weakly cemented ortstein; medium acid; gradual irregular boundary.

BC—16 to 28 inches; brownish yellow (10YR 6/6) sand; very weak fine subangular blocky structure; very friable; few fine roots; about 3 percent gravel; medium acid; gradual wavy boundary.

C—28 to 60 inches; very pale brown (10YR 7/4) sand; single grained; loose; about 2 percent gravel; slightly acid.

The thickness of the solum ranges from 24 to 50 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The A horizon has hue of 10YR or 7.5YR or is neutral in hue. It has value of 2 to 4 and chroma of 0 to 3. The E horizon has hue of 10YR or 7.5YR, value of 4 to 7, and chroma of 1 to 3. The Bs horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 or 4, and chroma of 3 to 6. The content of weakly cemented ortstein ranges from 0 to 20 percent in this horizon. The BC horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The C horizon has value of 6 or 7 and chroma of 3 to 5.

Ruse Series

The Ruse series consists of shallow, poorly drained, moderately permeable or moderately rapidly permeable soils in depressions and on low flats on till plains and bedrock benches. These soils formed in loamy deposits over limestone bedrock. The slope ranges from 0 to 2 percent.

Typical pedon of Ruse loam, 1,320 feet south and 260 feet east of the northwest corner of sec. 16, T. 35 N., R. 2 E.

A—0 to 5 inches; very dark gray (10YR 3/1) loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; many fine to coarse roots; about 2 percent flagstones; strong effervescence; moderately alkaline; abrupt wavy boundary.

Bw1—5 to 10 inches; light olive brown (2.5Y 5/4) loam; grayish brown (2.5Y 5/2) gleying on faces of peds; moderate medium subangular blocky structure; firm; many fine and medium roots; about 2 percent flagstones; violent effervescence; moderately alkaline; clear wavy boundary.

Bw2—10 to 12 inches; light olive brown (2.5Y 5/4) fine sandy loam; many medium prominent gray (10YR 5/1) and few fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; many fine and medium roots; about 2 percent flagstones; violent effervescence; moderately alkaline; abrupt wavy boundary.

R—12 inches; fractured limestone bedrock; gray (10YR 5/1), loamy residuum between fractures.

The thickness of the solum and the depth to limestone bedrock range from 10 to 20 inches. The content of channers, flagstones, and cobbles ranges from 0 to 15 percent throughout the profile.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is loam, sandy loam, fine sandy loam, or the flaggy analogs of those textures. A thin layer of residuum is directly above the limestone bedrock in some pedons.

Summerville Series

The Summerville series consists of shallow, well drained, moderately permeable soils on till plains and bedrock benches. These soils formed in loamy deposits over limestone bedrock. The slope ranges from 0 to 18 percent.

The Summerville soils in this county have finer textures in the subsoil than are defined as the range for the series. This difference, however, does not affect use or behavior of the soils.

Typical pedon of Summerville flaggy fine sandy loam, 0 to 6 percent slopes, rocky, 30 feet south and 2,000 feet east of the northwest corner of sec. 21, T. 35 N., R. 2 E.

Oi—1 inch to 0; partially decomposed leaf litter.

A—0 to 4 inches; dark reddish brown (5YR 2/2) flaggy fine sandy loam, gray (5YR 5/1) dry; weak fine granular structure; friable; many fine and very fine roots; about 20 percent flagstones; strong effervescence; mildly alkaline; abrupt wavy boundary.

E—4 to 6 inches; reddish gray (5YR 5/2) flaggy fine sandy loam; very weak fine subangular blocky structure; very friable; common fine roots; about 20 percent flagstones; strong effervescence; mildly alkaline; abrupt wavy boundary.

B/E—6 to 11 inches; about 65 percent reddish brown (5YR 4/3) flaggy clay loam (Bt); surrounded by pinkish gray (5YR 6/2) flaggy fine sandy loam (E); moderate medium subangular blocky structure; firm; common fine roots; about 20 percent flagstones; strong effervescence; mildly alkaline; clear wavy boundary.

Bt—11 to 17 inches; dark reddish brown (5YR 3/3) flaggy clay loam; moderate fine subangular blocky structure; firm; few fine roots; many faint clay films on faces of peds; about 20 percent flagstones; strong effervescence; mildly alkaline; abrupt irregular boundary.

R—17 inches; fractured limestone bedrock.

The thickness of the solum and the depth to limestone bedrock range from 10 to 20 inches. The content of flagstones, channers, and cobbles ranges

from 15 to 35 percent throughout the profile.

The A horizon has hue of 10YR, 7.5YR, or 5YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. The E horizon and the E part of the B/E horizon have hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 2 or 3. They are flaggy fine sandy loam, flaggy sandy loam, or flaggy loam. Some pedons have an E/B horizon. The Bt horizon and the B part of the B/E horizon have hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 3 or 4. They are flaggy clay loam, flaggy sandy clay loam, or flaggy loam. Some pedons have a C horizon. This horizon has hue of 10YR, value of 3 to 6, and chroma of 2 to 4. It is flaggy sandy loam or flaggy loam. In some pedons a thin layer of residuum is above the limestone bedrock.

Tawas Series

The Tawas series consists of very deep, very poorly drained soils in depressions, on low flats, and in drainageways on outwash plains. These soils formed in organic material 16 to 50 inches thick over sandy deposits. Permeability is moderately slow to moderately rapid in the organic layers and rapid in the underlying sandy layers. The slope ranges from 0 to 2 percent.

Typical pedon of Tawas muck, 1,055 feet north and 660 feet east of the southwest corner of sec. 12, T. 35 N., R. 3 E.

Oa1—0 to 2 inches; muck, black (10YR 2/1) broken face and rubbed; about 25 percent fiber, less than 5 percent rubbed; weak medium granular structure; friable; many fine and medium roots; dominantly woody fibers; medium acid; clear smooth boundary.

Oa2—2 to 8 inches; muck, black (N 2/0) broken face and rubbed; about 10 percent fibers, 1 percent rubbed; weak medium granular structure; friable; many roots; dominantly woody fibers; a few pieces of charcoal; medium acid; clear smooth boundary.

Oa3—8 to 18 inches; muck, black (N 2/0) broken face and rubbed; about 10 percent fiber, 1 percent rubbed; massive; friable; few fine roots; dominantly woody fibers; a few pieces of charcoal; medium acid; abrupt smooth boundary.

C—18 to 34 inches; pale brown (10YR 6/3) sand; single grained; loose; slightly acid; abrupt wavy boundary.

Cg—34 to 60 inches; dark grayish brown (10YR 4/2) sand; single grained; loose; mildly alkaline.

Depth to the underlying mineral layer ranges from 16 to 50 inches. The surface tier has hue of 10YR, 7.5YR, or 5YR or is neutral in hue. It has chroma of 0 to 2. Some pedons have a thin mat of living fiber. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 3. They are dominantly muck but may have thin layers of mucky peat. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is sand, loamy sand, or loamy fine sand. In some pedons a thin layer of limnic material is directly above the C horizon.

Wallace Series

The Wallace series consists of very deep, well drained soils on old beach ridges and sand dunes. These soils formed in sandy deposits. Permeability is moderately slow in the ortstein material and rapid in the sandy material. The slope ranges from 2 to 15 percent.

Typical pedon of Wallace sand, 2 to 15 percent slopes (fig. 8), 365 feet south and 165 feet west of the center of sec. 10, T. 34 N., R. 4 E.

A—0 to 2 inches; black (10YR 2/1) sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine roots; very strongly acid; abrupt wavy boundary.

E—2 to 9 inches; light gray (10YR 7/2) sand; single grained; loose; common medium roots; very strongly acid; abrupt irregular boundary.

Bhs—9 to 14 inches; dark reddish brown (5YR 3/2) sand; massive; about 60 percent weakly cemented to strongly cemented ortstein; very friable in the remaining material; many fine roots around the ortstein; very strongly acid; abrupt irregular boundary.

Bs—14 to 27 inches; brown (7.5YR 5/4) sand; about 50 percent tongues of strong brown (7.5YR 4/6), strongly cemented ortstein; single grained; loose; many fine roots; strongly acid; clear wavy boundary.

BC—27 to 39 inches; yellowish brown (10YR 5/4) sand; few tongues of strong brown (7.5YR 5/8) ortstein; single grained; loose; medium acid; gradual wavy boundary.

C—39 to 60 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; slightly acid.

The thickness of the solum ranges from 20 to 60 inches. The content of gravel ranges from 0 to 5 percent throughout the profile. The profile is dominantly sand, but in some areas it is a combination of sand and fine sand.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. Some pedons have only a litter layer over an E horizon. The E horizon has hue of 10YR or 7.5YR, value of 5 to 7, and chroma of 1 or 2.

Figure 8.—Typical profile of Wallace sand, 2 to 15 percent slopes. Cemented soil material is between and below the tongues of E material.

The Bhs horizon has hue of 7.5YR or 5YR, value of 2 or 3, and chroma of 1 to 3. The Bs horizon has hue of 7.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. The C horizon has value of 5 or 6 and chroma of 4 or 5.

Wheatley Series

The Wheatley series consists of very deep, poorly drained, rapidly permeable soils in depressions, in drainageways, and on low flats on outwash plains. These soils formed in sandy and gravelly glaciofluvial deposits. The slope ranges from 0 to 2 percent.

Typical pedon of Wheatley muck, 2,110 feet south and 200 feet east of the northwest corner of sec. 22, T. 34 N., R. 6 E.

Oa—0 to 6 inches; black (5YR 2/1) muck; about 20 percent sand mixed throughout; moderate medium granular structure; friable; many fine and medium roots; mildly alkaline; abrupt wavy boundary.

A—6 to 8 inches; very dark gray (10YR 3/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; many fine and medium roots; about 1 percent cobbles; mildly alkaline; abrupt wavy boundary.

Cg1—8 to 12 inches; dark grayish brown (10YR 4/2) sand; single grained; loose; few fine roots; about 1 percent cobbles; mildly alkaline; clear wavy boundary.

Cg2—12 to 30 inches; dark grayish brown (10YR 4/2) gravelly sand; few fine prominent strong brown (7.5YR 5/8) and few fine distinct yellowish brown (10YR 5/4) mottles; single grained; loose; few fine roots; about 15 percent gravel and 3 percent cobbles; violent effervescence; moderately alkaline; clear wavy boundary.

Cg3—30 to 60 inches; grayish brown (10YR 5/2) very gravelly sand; single grained; loose; about 40 percent gravel and 7 percent cobbles; violent effervescence; moderately alkaline.

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. The C horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is sand, gravelly sand, or gravelly loamy sand in the upper part and gravelly sand or very gravelly sand in the lower part. In some pedons it has strata of sand and gravel.

Winterfield Series

The Winterfield series consists of very deep, somewhat poorly drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. The slope ranges from 0 to 3 percent.

Typical pedon of Winterfield loamy fine sand, 0 to 3 percent slopes, 345 feet west and 80 feet south of the center of sec. 21, T. 36 N., R. 3 E.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark brown (10YR 3/3) dry; weak fine granular structure; very friable; many roots; mildly alkaline; abrupt smooth boundary.

C1—6 to 21 inches; yellowish brown (10YR 5/4) fine sand; common medium distinct dark yellowish brown (10YR 4/6) and brownish yellow (10YR 6/8) mottles; few thin strata of A material; single grained; loose; common roots; mildly alkaline; abrupt wavy boundary.

C2—21 to 46 inches; light yellowish brown (10YR 6/4) fine sand; common medium distinct dark yellowish brown (10YR 4/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak medium platy structure; very friable; mildly alkaline; clear wavy boundary.

C3—46 to 60 inches; pale brown (10YR 6/3) loamy fine

sand; few thin, very dark gray (10YR 3/1) streaks of organic matter; massive; very friable; moderately alkaline.

Texture varies within short distances throughout the profile, but it is dominantly sandy. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The C horizon has hue of 10YR or 7.5YR, value of 2 to 6, and chroma of 2 to 4. It is sand, loamy sand, fine sand, loamy fine sand, or the gravelly analogs of those textures. In some pedons thin strata of finer textured material are below a depth of 40 inches.

Zimmerman Series

The Zimmerman series consists of very deep, excessively drained, rapidly permeable soils on outwash plains, lake plains, and beach ridges. These soils formed in sandy deposits. The slope ranges from 2 to 15 percent.

Typical pedon of Zimmerman fine sand, 2 to 8 percent slopes, 1,450 feet south and 525 feet east of the northwest corner of sec. 17, T. 35 N., R. 2 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) fine sand, light brownish gray (10YR 6/2) dry; very weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

Bw1—10 to 14 inches; strong brown (7.5YR 4/6) fine sand; very weak medium subangular blocky structure; very friable; slightly acid; clear wavy boundary.

Bw2—14 to 18 inches; yellowish brown (10YR 5/6) fine sand; very weak fine subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

E—18 to 24 inches; light yellowish brown (10YR 6/4) fine sand; single grained; loose; slightly acid; abrupt wavy boundary.

E/B—24 to 60 inches; about 90 percent light yellowish brown (10YR 6/4) fine sand (E); single grained; loose; lamellae of strong brown (7.5YR 5/6) loamy fine sand (Bt) 1/10 to 1/4 inch thick and 4 to 16 inches apart; weakly cemented; very friable; slightly acid.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to the first textural band ranges from 25 to 48 inches. The content of gravel ranges from 0 to 5 percent throughout the profile.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Pedons in uncultivated areas have an A horizon, which has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon 1 to 4 inches thick. This horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 4. The Bw horizon has hue of 10YR or 7.5YR, value of 6 or 7, and chroma of 3 to 6. The B part of the E/B horizon consists of bands 1/16 inch to 2 inches thick. It has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. The total thickness of the bands within a depth of 60 inches is less than 6 inches. The E material between the bands has value of 4 to 6 and chroma of 2 to 5. It is fine sand or loamy fine sand. Some pedons have a C horizon.

Formation of the Soils

This section relates the five factors of soil formation to the soils in the survey area. It also explains the processes of soil formation.

Factors of Soil Formation

Soil forms through the interaction of five major factors—the physical, chemical, and mineralogical 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 *(4)*.

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, called 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 profile 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 interrelated 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 other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It affects the limits of the chemical and mineralogical composition of the soil. In this survey area, nearly all of the parent materials were deposited by glaciers or glacial meltwater. These deposits lie on limestone bedrock at various depths. They were reworked and redeposited by subsequent actions of wind and water. The last glacial advance into the county was about 11,800 years ago *(3)*. Although most of the parent materials in Presque Isle County are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited.

The dominant parent materials in Presque Isle County were deposited as glacial till, outwash material, lacustrine material, alluvium, and organic material.

Glacial till was deposited directly by glaciers with minimal 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. The glacial till in Presque Isle County is generally calcareous loamy sand, sandy loam, loam, and clay loam. Onaway and Krakow soils are examples of soils that formed in glacial till.

Outwash material was deposited by running water from melting glaciers. The size of the particles depends on the speed of the stream that carried the material. The water deposited the coarser particles as it slowed down. Slowly moving water carried the finer particles, such as very fine sand, silt, and clay. Outwash deposits generally occur as layers of particles of similar size, such as sand, gravel, or other coarse particles. East Lake soils are examples of soils that formed in outwash deposits.

Lacustrine material was deposited from still, or ponded, glacial meltwater. It consists of fine soil particles, such as very fine sand, silt, and clay, that settled out in still water. In Presque Isle County, the soils that formed in lacustrine deposits are coarse textured to fine textured. Grace and Bowers soils are examples. They are on lake plains.

Alluvium is material recently deposited by floodwater from streams. This material varies in texture, depending on the speed of the water from which it was deposited. Evart soils are examples of soils that formed in alluvium.

Organic material occurs as deposits of plant residue. After the glaciers withdrew from the area, water remained standing in depressions on outwash plains, flood plains, moraines, and till plains. Grasses and sedges grew around the edges of these lakes. When the plants died, their residue did not decompose because the areas were wet. 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 and Cathro soils are examples of soils that formed in organic material.

Plant and Animal Life

Green plants are the principal organisms that have influenced soil formation in Presque Isle County. Bacteria, fungi, earthworms, and human activities also have been important. Plants and animals add organic material and nitrogen to the soil. The kind of organic matter in the soil depends on the kind of plants that have grown in the past. The remains of plants accumulated on the surface, decayed, and eventually became organic matter. The roots of the plants also provided channels for the downward movement of water through the soil. Bacteria in the soil help to break down the organic matter into plant nutrients.

The native vegetation in Presque Isle County was a mixture of deciduous and coniferous trees. Differences in natural soil drainage and variations in parent material affected the composition of the forest species. The well drained upland soils, such as Emmet, Klacking, and Graycalm, were covered mainly by sugar maple, ash, northern red oak, hemlock, red pine, and white pine. The wet soils, such as Lupton, Hessel, and Au Gres, were covered mainly by soft maple, aspen, balsam fir, ash, eastern whitecedar, and white birch. The content of organic matter is considerable in these soils.

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 temperature, climate also determines the rate of chemical reaction in the soil.

The climate in Presque Isle County is cool and humid. Presumably, it is similar to that under which the soils formed. The climate is generally uniform in all areas, except for those within a few miles of Lake Huron. Only minor differences among the soils in the county are the result of differences in climate.

Relief

Relief affects soil formation through its influence on drainage, runoff, erosion, plant cover, and soil temperature. Slopes typically range from 0 to 45 percent, but they are steeper in areas of bedrock escarpments. Runoff is most rapid on the steeper slopes. In low areas, water is temporarily ponded.

The soils in the county range from excessively drained on uplands to very poorly drained in the depressions. Through its effect on soil aeration, drainage determines the color of the soil. Water and air move freely through well drained soils and slowly through very poorly drained soils. In Rubicon and other soils that are excessively drained to well drained and well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. Roscommon and other soils that are poorly drained and poorly aerated are dull gray and mottled. Roscommon and Rubicon soils formed in similar kinds of parent material.

Time

Generally, a long time is needed for the development of distinct horizons. The degree of profile development commonly reflects the length of time that the parent material has been in place. Some soils form rapidly; others form slowly.

The soils in Presque Isle County range from young to mature. Most of the soils that formed in glacial deposits have been exposed to the soil-forming factors long enough for the development of distinct horizons. Emmet soils are examples. They have distinct horizons, and lime has been leached from the solum. The soils that formed in recent alluvial materials have not been in place long enough for distinct horizons to develop. Evart soils are examples.

Processes of Soil Formation

The processes responsible for the development of the soil horizons in the unconsolidated parent material are referred to as soil genesis. The physical, chemical, and biological properties of the horizons are known as soil morphology.

Several processes were involved in the development of horizons in the soils of Presque Isle County. These are the accumulation of organic matter, the leaching of lime and other bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. More than one of these processes have helped to differentiate horizons in most of the soils.

As organic matter accumulates at the surface, an A horizon forms. This horizon is mixed into a plow layer, or Ap horizon, if the soil is plowed. The surface layer of the soils in Presque Isle County ranges from high to low in organic matter content. The content is high, for example, in Roscommon soils and low in Grayling soils.

Carbonates and other bases have been leached from most of the soils. The leaching of bases generally precedes the translocation of silicate clay minerals. Many of the soils are moderately leached or strongly leached. Graycalm soils, for example, are leached of carbonates to a depth of more than 60 inches, and Nunica soils are leached to a depth of 22 inches. The

degree of leaching is affected by time, relief, and parent material.

Gleying, or the reduction and transfer of iron, is evident in somewhat poorly drained, poorly drained, and very poorly drained soils. A gray subsoil indicates the reduction and loss of iron. Glawe soils are examples of strongly gleyed soils.

The translocation of clay minerals has contributed to horizon development in some soils. An eluviated, or leached, E horizon typically is lower in content of clay and lighter in color than the illuviated B horizon. The B horizon typically has an accumulation of clay, or clay films, in pores and on the faces of peds. The soils were probably leached of carbonates and soluble salts to a considerable extent before the translocation of silicate clay minerals. Nunica soils are examples of soils in which translocated silicate clay minerals in the form of clay films have accumulated in the B horizon.

In some soils in Presque Isle County, iron, aluminum, and humus have been transferred from the surface layer to the B horizon. The B horizon in these soils is dark brown. Kalkaska and Wallace soils are examples.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 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 in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

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 outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to

be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; granular, prismatic, or blocky structure; redder or browner colors than those in the A horizon; or a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no

natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

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.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized for simple slopes:

Nearly level	0 to 2 percent
Very gently sloping	2 to 4 percent
Gently sloping	4 to 6 percent
Moderately sloping	6 to 12 percent
Strongly sloping	12 to 18 percent
Moderately steep	18 to 25 percent
Steep	25 to 45 percent
Very steep	more than 45 percent

The following slope classes are recognized for complex slopes:

Nearly level	0 to 2 percent
Gently undulating	2 to 4 percent
Undulating	4 to 6 percent
Gently rolling	6 to 12 percent
Rolling	12 to 18 percent
Hilly	18 to 25 percent
Steep or very hilly	25 to 45 percent
Very steep	more than 45 percent

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 substratum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to 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 grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

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 (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
ONAWAY:											
January----	26.7	9.7	18.2	48	-18	0	1.76	1.0	2.4	6	22.6
February---	29.1	8.7	18.9	50	-20	0	1.40	.7	2.0	5	15.8
March------	39.0	17.4	28.2	65	-15	1	1.96	1.0	2.8	5	15.3
April------	53.4	30.7	42.0	81	9	36	2.64	1.8	3.4	6	5.0
May--------	67.6	40.8	54.2	89	24	190	2.86	1.7	3.9	7	.2
June-------	76.5	49.9	63.2	93	33	404	3.08	1.5	4.4	6	.0
July-------	81.1	55.0	68.0	95	40	567	3.30	1.7	4.7	5	.0
August-----	78.9	53.9	66.4	94	37	516	3.21	1.9	4.4	7	.0
September--	70.0	47.2	58.6	91	29	278	3.75	1.9	5.4	8	.1
October----	59.5	38.7	49.1	84	22	103	2.38	1.2	3.4	6	.4
November---	43.5	28.9	36.2	69	5	7	2.55	1.7	3.4	7	9.6
December---	31.4	16.8	24.1	56	-11	0	2.09	1.4	2.7	7	20.0
Year-----	54.7	33.1	43.9	96	-23	2,102	30.98	27.2	34.7	75	89.0
PHELPS COLLINS AIRPORT:											
January----	26.6	9.2	17.9	50	-20	0	1.63	.9	2.3	5	19.5
February---	28.4	8.6	18.5	50	-22	0	1.32	.7	1.9	4	14.0
March------	37.2	17.4	27.3	66	-13	1	1.86	1.1	2.6	5	12.8
April------	51.5	30.0	40.7	81	9	27	2.55	1.7	3.4	6	3.6
May--------	65.0	39.1	52.0	90	23	149	2.78	1.8	3.7	6	.3
June-------	74.8	48.6	61.7	95	30	364	3.12	1.7	4.4	6	.0
July-------	79.6	53.6	66.6	96	38	522	3.11	1.8	4.3	5	.0
August-----	77.2	52.7	64.9	95	34	471	3.23	2.1	4.2	6	.0
September--	68.8	45.7	57.2	91	27	247	3.08	1.4	4.5	7	.0
October----	58.1	37.1	47.6	83	20	81	2.07	1.0	3.0	5	.6
November---	43.2	27.8	35.5	69	4	6	2.22	1.4	3.0	6	8.3
December---	31.2	16.4	23.8	55	-11	0	1.95	1.2	2.6	6	20.6
Year-----	53.5	32.2	42.8	98	-24	1,868	28.92	25.3	32.4	67	79.7

See footnote at end of table.

TABLE 1.--TEMPERATURE AND PRECIPITATION--Continued

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
ALPENA:											
January----	26.8	12.6	19.7	47	-9	0	1.40	0.8	1.9	5	16.3
February---	28.2	12.2	20.2	48	-13	0	1.14	.6	1.6	4	12.1
March------	35.7	20.7	28.2	62	-4	0	1.65	.9	2.3	5	11.0
April------	48.7	32.6	40.6	80	14	20	2.39	1.5	3.2	6	3.0
May--------	60.8	42.6	51.7	88	29	132	2.84	1.8	3.8	6	.3
June-------	70.9	52.3	61.6	93	38	357	2.95	1.7	4.1	6	.0
July-------	76.5	58.0	67.2	94	44	542	2.97	1.5	4.2	6	.0
August-----	74.9	57.1	66.0	93	42	504	3.16	2.0	4.2	6	.0
September--	67.1	49.8	58.4	89	33	272	2.97	1.3	4.4	7	.0
October----	56.2	40.8	48.5	81	24	82	2.08	1.0	3.0	6	.3
November---	42.9	30.7	36.8	67	9	5	2.20	1.4	2.9	6	6.9
December---	31.6	19.5	25.5	55	-3	0	1.85	1.2	2.5	5	17.4
Year-----	51.7	35.7	43.7	96	-14	1,914	27.60	24.3	30.9	68	67.3

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1930-79)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
ONAWAY:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 7	May 26	June 7
2 years in 10 later than--	May 2	May 21	June 2
5 years in 10 later than--	Apr. 23	May 12	May 23
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 12	Sept. 25	Sept. 7
2 years in 10 earlier than--	Oct. 18	Sept. 30	Sept. 12
5 years in 10 earlier than--	Oct. 29	Oct. 11	Sept. 23
PHELPS COLLINS AIRPORT:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 14	May 28	June 15
2 years in 10 later than--	May 9	May 24	June 9
5 years in 10 later than--	Apr. 29	May 16	May 29
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 2	Sept. 20	Sept. 2
2 years in 10 earlier than--	Oct. 9	Sept. 25	Sept. 8
5 years in 10 earlier than--	Oct. 22	Oct. 5	Sept. 18

TABLE 2.--FREEZE DATES IN SPRING AND FALL--Continued

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
ALPENA:			
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 21	May 3	May 21
2 years in 10 later than--	Apr. 17	Apr. 29	May 17
5 years in 10 later than--	Apr. 10	Apr. 21	May 8
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 25	Oct. 12	Oct. 27
2 years in 10 earlier than--	Oct. 31	Oct. 18	Oct. 2
5 years in 10 earlier than--	Nov. 11	Oct. 29	Oct. 12

TABLE 3.--GROWING SEASON

(Recorded in the period 1930-79 at Onaway and Alpena and 1951-78 at Phelps Collins Airport)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
ONAWAY:			
9 years in 10	164	128	99
8 years in 10	172	136	107
5 years in 10	189	151	122
2 years in 10	205	166	137
1 year in 10	214	174	145
PHELPS COLLINS AIRPORT:			
9 years in 10	150	120	87
8 years in 10	159	127	95
5 years in 10	176	141	111
2 years in 10	193	155	128
1 year in 10	202	163	136
ALPENA:			
9 years in 10	195	172	134
8 years in 10	202	178	142
5 years in 10	215	190	156
2 years in 10	228	202	170
1 year in 10	235	208	178

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
2	Lupton muck	17,636	4.0
3	Tawas muck	15,216	3.5
4B	Klacking sand, 0 to 6 percent slopes	2,833	0.6
4C	Klacking sand, 6 to 12 percent slopes	1,128	0.3
5B	Rubicon sand, 0 to 8 percent slopes	13,534	3.1
5C	Rubicon sand, 8 to 15 percent slopes	7,547	1.7
5E	Rubicon sand, 15 to 35 percent slopes	2,207	0.5
6B	Alpena very gravelly sandy loam, 0 to 8 percent slopes	7,006	1.6
6C	Alpena very gravelly sandy loam, 8 to 15 percent slopes	748	0.2
7A	Emmet sandy loam, moderately wet, 0 to 2 percent slopes	359	0.1
7B	Emmet sandy loam, 2 to 6 percent slopes	9,706	2.2
7C	Emmet sandy loam, 6 to 12 percent slopes	2,721	0.6
7C2	Emmet sandy loam, 6 to 12 percent slopes, eroded	454	0.1
7D	Emmet sandy loam, 12 to 18 percent slopes	433	0.1
7E	Emmet sandy loam, 18 to 25 percent slopes	234	0.1
8A	Onaway fine sandy loam, moderately wet, 0 to 2 percent slopes	1,257	0.3
8B	Onaway fine sandy loam, 2 to 6 percent slopes	12,540	2.8
8C	Onaway fine sandy loam, 6 to 12 percent slopes	2,762	0.6
8C2	Onaway fine sandy loam, 6 to 12 percent slopes, eroded	220	*
8D	Onaway fine sandy loam, 12 to 18 percent slopes	522	0.1
8E	Onaway fine sandy loam, 18 to 25 percent slopes	321	0.1
9B	Summerville flaggy fine sandy loam, 0 to 6 percent slopes, rocky	6,405	1.5
9C	Summerville flaggy fine sandy loam, 6 to 18 percent slopes, rocky	880	0.2
10B	Cunard fine sandy loam, 1 to 6 percent slopes	3,506	0.8
10C	Cunard fine sandy loam, 6 to 12 percent slopes	555	0.1
11A	Alstad loam, 0 to 3 percent slopes	3,662	0.8
12A	Bonduel loam, 0 to 3 percent slopes	1,967	0.4
13B	Croswell sand, 0 to 4 percent slopes	8,117	1.8
14B	Menominee loamy sand, 2 to 6 percent slopes	1,582	0.4
15B	Krakow flaggy fine sandy loam, 1 to 6 percent slopes	11,535	2.6
15C	Krakow flaggy fine sandy loam, 6 to 12 percent slopes	3,858	0.9
15D	Krakow flaggy fine sandy loam, 12 to 18 percent slopes	399	0.1
16A	Iosco loamy sand, 0 to 3 percent slopes	7,876	1.8
17	Roscommon muck	8,466	1.9
18	Brevort mucky loamy sand	10,261	2.3
20	Hessel mucky flaggy loam, bedrock substratum	17,355	3.9
21	Cathro muck	21,184	4.8
23	Greenwood peat	1,000	0.2
24B	Melita loamy sand, 0 to 6 percent slopes	12,375	2.8
24C	Melita loamy sand, 6 to 12 percent slopes	267	0.1
25A	Au Gres sand, 0 to 3 percent slopes	5,736	1.3
28A	Moltke very fine sandy loam, 0 to 3 percent slopes	2,990	0.7
29	Glawe mucky very fine sandy loam	2,508	0.6
30	Evart silt loam	5,259	1.2
31B	Mancelona loamy sand, 2 to 6 percent slopes	825	0.2
31C	Mancelona loamy sand, 6 to 15 percent slopes	356	0.1
31E	Mancelona loamy sand, 15 to 35 percent slopes	343	0.1
33A	Detour flaggy loam, 0 to 3 percent slopes	13,382	3.0
35A	Ingalls sand, 0 to 3 percent slopes	3,475	0.8
36	Burleigh mucky loamy fine sand	3,523	0.8
37A	Gladwin loamy sand, 0 to 3 percent slopes	1,822	0.4
38	Ruse loam	2,088	0.5
39B	Grayling sand, 0 to 8 percent slopes	1,953	0.4
39C	Grayling sand, 8 to 15 percent slopes	665	0.2
40B	Nunica silt loam, 2 to 6 percent slopes	1,822	0.4
41A	Bowers silt loam, 0 to 3 percent slopes	7,469	1.7
42	Hettinger loam	7,820	1.8
43B	Graycalm sand, 0 to 8 percent slopes	6,038	1.4
43C	Graycalm sand, 8 to 15 percent slopes	2,295	0.5
43E	Graycalm sand, 15 to 35 percent slopes	519	0.1
44A	Au Gres sand, loamy substratum, 0 to 2 percent slopes	4,191	1.0
45B	Croswell loamy sand, loamy substratum, 0 to 4 percent slopes	3,798	0.9

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
47B	Cheboygan loamy sand, 0 to 6 percent slopes	9,942	2.3
47C	Cheboygan loamy sand, 6 to 12 percent slopes	4,035	0.9
47D	Cheboygan loamy sand, 12 to 18 percent slopes	1,250	0.3
47E	Cheboygan loamy sand, 18 to 35 percent slopes	1,074	0.2
48B	Udipsamments, nearly level to undulating	227	0.1
49	Beaches	1,005	0.2
50	Aquents	460	0.1
51B	East Lake sand, 0 to 8 percent slopes	8,442	1.9
51C	East Lake sand, 8 to 15 percent slopes	2,525	0.6
51E	East Lake sand, 15 to 35 percent slopes	2,258	0.5
52A	Hagensville fine sandy loam, 0 to 2 percent slopes	4,578	1.0
52B	Hagensville fine sandy loam, 2 to 6 percent slopes	3,903	0.9
53	Hessel loam	7,460	1.7
55B	Johnswood very flaggy loam, 1 to 6 percent slopes	2,568	0.6
56C	Deer Park-Croswell-Au Gres complex, 0 to 12 percent slopes	3,451	0.8
57A	Grace very fine sandy loam, moderately wet, 0 to 2 percent slopes	1,687	0.4
57B	Grace very fine sandy loam, 2 to 6 percent slopes	853	0.2
58B	Kalkaska sand, 0 to 8 percent slopes	1,768	0.4
58C	Kalkaska sand, 8 to 15 percent slopes	618	0.1
59	Aquents and Histosols, ponded	2,268	0.5
60B	Deer Park sand, 1 to 8 percent slopes	3,931	0.9
60C	Deer Park sand, 8 to 15 percent slopes	266	0.1
60E	Deer Park sand, 15 to 45 percent slopes	265	0.1
62	Dawson peat	829	0.2
63	Pits, borrow	772	0.2
64A	Ensign flaggy loam, 0 to 3 percent slopes	2,176	0.5
65	Wheatley muck	3,275	0.7
66C	Wallace sand, 2 to 15 percent slopes	384	0.1
67B	Eastport sand, 1 to 8 percent slopes	937	0.2
69A	Winterfield loamy fine sand, 0 to 3 percent slopes	253	0.1
70A	Au Gres-Roscommon complex, 0 to 3 percent slopes	5,056	1.1
71	Roscommon-Tawas complex	3,881	0.9
73A	Omena fine sandy loam, 0 to 2 percent slopes	1,020	0.2
73B	Omena fine sandy loam, 2 to 6 percent slopes	8,820	2.0
73C	Omena fine sandy loam, 6 to 12 percent slopes	1,472	0.3
73C2	Omena fine sandy loam, 6 to 12 percent slopes, eroded	920	0.2
73D	Omena fine sandy loam, 12 to 18 percent slopes	206	*
73D3	Omena fine sandy loam, 12 to 18 percent slopes, severely eroded	213	*
75	Pinconning mucky sand	5,711	1.3
76A	Allendale sand, 0 to 3 percent slopes	4,116	0.9
81B	Croswell cobbly sand, 0 to 4 percent slopes	1,386	0.3
83B	Kiva-Alpena complex, 1 to 6 percent slopes	932	0.2
84	Pits, quarry	6,133	1.4
85A	Esau flaggy sandy loam, 0 to 3 percent slopes	2,204	0.5
86F	Udorthents and Udipsamments, very steep	38	*
87C	Udorthents, level to gently rolling	485	0.1
89B	Ocqueoc fine sand, 0 to 6 percent slopes	1,940	0.4
90B	Zimmerman fine sand, 2 to 8 percent slopes	929	0.2
91B	Alpena cobbly sandy loam, bedrock substratum, 0 to 8 percent slopes	648	0.1
92	Kinross muck	484	0.1
	Water	20,928	4.8
	Total	440,493	100.0

* Less than 0.05 percent. The combined extent of the soils assigned an asterisk in the "Percent" column is about 0.1 percent of the survey area.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
7A	Emmet sandy loam, moderately wet, 0 to 2 percent slopes
7B	Emmet sandy loam, 2 to 6 percent slopes
8A	Onaway fine sandy loam, moderately wet, 0 to 2 percent slopes
8B	Onaway fine sandy loam, 2 to 6 percent slopes
11A	Alstad loam, 0 to 3 percent slopes (where drained)
28A	Moltke very fine sandy loam, 0 to 3 percent slopes (where drained)
29	Glawe mucky very fine sandy loam (where drained)
40B	Nunica silt loam, 2 to 6 percent slopes
41A	Bowers silt loam, 0 to 3 percent slopes (where drained)
42	Hettinger loam (where drained)
52A	Hagensville fine sandy loam, 0 to 2 percent slopes (where drained)
52B	Hagensville fine sandy loam, 2 to 6 percent slopes (where drained)
53	Hessel loam (where drained)
57A	Grace very fine sandy loam, moderately wet, 0 to 2 percent slopes
57B	Grace very fine sandy loam, 2 to 6 percent slopes
73A	Omena fine sandy loam, 0 to 2 percent slopes
73B	Omena fine sandy loam, 2 to 6 percent slopes

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn		Irish potatoes		Dry beans		Bromegrass-alfalfa hay	Oats	Wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Cwt	Cwt	Cwt	Cwt	Tons	Bu	Bu
2---------- Lupton	VIw	---	---	---	---	---	---	---	---	---
3---------- Tawas	VIw	---	---	---	---	---	---	---	---	---
4B---------- Klacking	IIIs	---	---	---	---	---	---	---	60	---
4C---------- Klacking	IIIe	---	---	---	---	---	---	---	55	---
5B, 5C---------- Rubicon	VIs	---	---	---	---	---	---	---	---	---
5E---------- Rubicon	VIIs	---	---	---	---	---	---	---	---	---
6B, 6C---------- Alpena	VIs	---	---	---	---	---	---	---	---	---
7A---------- Emmet	IIs	95	---	300	350	15	18	3.5	90	45
7B---------- Emmet	IIe	90	---	290	345	13	15	3.5	80	40
7C---------- Emmet	IIIe	85	---	225	---	10	11	2.8	70	30
7C2---------- Emmet	IIIe	80	---	215	---	8	10	2.5	60	25
7D---------- Emmet	IVe	---	---	---	---	---	---	2.5	---	---
7E---------- Emmet	VIe	---	---	---	---	---	---	2.1	---	---
8A---------- Onaway	IIs	95	---	300	350	15	18	3.5	90	45
8B---------- Onaway	IIe	90	---	290	340	13	15	3.5	80	40
8C---------- Onaway	IIIe	85	---	225	300	10	11	2.8	70	30
8C2---------- Onaway	IIIe	80	---	210	---	8	10	2.8	65	25
8D---------- Onaway	IVe	---	---	---	---	---	---	2.8	60	---
8E---------- Onaway	VIe	---	---	---	---	---	---	2.3	---	---

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Irish potatoes		Dry beans		Bromegrass-alfalfa hay	Oats	Wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Cwt	Cwt	Cwt	Cwt	Tons	Bu	Bu
9B---------- Summerville	VIs	---	---	---	---	---	---	---	---	---
9C---------- Summerville	VIIs	---	---	---	---	---	---	---	---	---
10B---------- Cunard	IIe	90	---	---	---	15	18	3.5	80	35
10C---------- Cunard	IIIe	80	---	---	---	10	11	2.8	70	30
11A---------- Alstad	IIw	85	---	300	330	15	18	4.0	75	50
12A---------- Bonduel	IIw	80	---	300	330	15	18	4.0	75	40
13B---------- Croswell	IVs	50	---	190	340	8	13	2.5	40	25
14B---------- Menominee	IIIs	75	---	230	340	13	18	3.0	70	35
15B---------- Krakow	IIIs	80	---	290	340	13	15	3.5	75	35
15C---------- Krakow	VIs	75	---	225	300	10	11	3.2	70	30
15D---------- Krakow	VIs	---	---	---	---	---	---	---	---	---
16A---------- Iosco	IIIw	70	---	260	340	11	15	3.0	65	30
17---------- Roscommon	VIw	---	---	---	---	---	---	---	---	---
18---------- Brevort	Vw	---	---	---	---	---	---	---	---	---
20---------- Hessel	Vw	---	---	---	---	---	---	---	---	---
21---------- Cathro	VIw	---	---	---	---	---	---	---	---	---
23---------- Greenwood	VIIw	---	---	---	---	---	---	---	---	---
24B---------- Melita	IVs	50	---	140	290	---	---	2.5	40	25
24C---------- Melita	IVs	40	---	120	270	---	---	2.3	35	20
25A---------- Au Gres	IVw	55	---	150	300	8	13	2.0	45	25
28A---------- Moltke	IIw	90	---	275	340	18	20	3.5	80	45

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Irish potatoes		Dry beans		Bromegrass-alfalfa hay	Oats	Wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Cwt	Cwt	Cwt	Cwt	Tons	Bu	Bu
29---------- Glawe	Vw	---	---	---	---	---	---	---	---	---
30---------- Evart	VIIw	---	---	---	---	---	---	---	---	---
31B---------- Mancelona	IIIs	65	---	230	320	12	15	2.8	60	25
31C---------- Mancelona	IIIe	60	---	200	300	10	13	2.5	55	20
31E---------- Mancelona	VIIe	---	---	---	---	---	---	---	---	---
33A---------- Detour	VIw	---	---	---	---	---	---	---	---	---
35A---------- Ingalls	IIIw	75	---	240	320	11	13	2.5	60	25
36---------- Burleigh	Vw	---	---	---	---	---	---	---	---	---
37A---------- Gladwin	IIIw	70	---	---	---	---	---	2.3	65	---
38---------- Ruse	VIIw	---	---	---	---	---	---	---	---	---
39B, 39C-------- Grayling	VIs	---	---	---	---	---	---	---	---	---
40B---------- Nunica	IIe	95	---	300	---	18	---	3.5	80	40
41A---------- Bowers	IIw	95	---	300	---	18	---	3.5	80	40
42---------- Hettinger	Vw	---	---	---	---	---	---	---	---	---
43B---------- Graycalm	IVs	50	---	150	270	10	13	2.5	40	25
43C---------- Graycalm	VIs	45	---	110	250	8	10	2.3	38	22
43E---------- Graycalm	VIIs	---	---	---	---	---	---	---	---	---
44A---------- Au Gres	IVw	55	---	190	310	10	13	3.0	65	25
45B---------- Croswell	IVs	50	---	170	290	10	13	2.5	40	25
47B---------- Cheboygan	IIIs	90	---	240	365	15	18	3.5	75	35
47C---------- Cheboygan	IIIe	80	---	210	340	13	15	3.2	65	30

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Irish potatoes		Dry beans		Bromegrass-alfalfa hay	Oats	Wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Cwt	Cwt	Cwt	Cwt	Tons	Bu	Bu
47D---------- Cheboygan	IVe	---	---	---	---	---	---	3.0	60	---
47E---------- Cheboygan	VIIe	---	---	---	---	---	---	---	---	---
48B. Udipsamments										
49*. Beaches										
50. Aquents										
51B---------- East Lake	IVs	50	---	150	250	10	13	2.5	40	25
51C---------- East Lake	VIs	45	---	110	240	8	10	2.3	38	22
51E---------- East Lake	VIIs	---	---	---	---	---	---	---	---	---
52A---------- Hagensville	IIw	80	---	290	345	15	18	3.5	75	35
52B---------- Hagensville	IIe	75	---	290	350	15	18	3.5	75	30
53---------- Hessel	Vw	---	---	---	---	---	---	---	---	---
55B---------- Johnswood	VIs	---	---	---	---	---	---	---	---	---
56C*---------- Deer Park-Croswell-Au Gres	VIIs	---	---	---	---	---	---	---	---	---
57A---------- Grace	IIs	95	---	275	370	17	20	4.0	80	40
57B---------- Grace	IIe	90	---	270	365	17	20	4.0	80	35
58B---------- Kalkaska	IVs	50	---	---	---	---	---	2.0	40	20
58C---------- Kalkaska	VIs	---	---	---	---	---	---	1.6	---	---
59*. Aquents and Histosols										
60B, 60C, 60E--- Deer Park	VIIs	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Irish potatoes		Dry beans		Bromegrass-alfalfa hay	Oats	Wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Cwt	Cwt	Cwt	Cwt	Tons	Bu	Bu
62---------- Dawson	VIIw	---	---	---	---	---	---	---	---	---
63*. Pits, borrow										
64A---------- Ensign	VIIw	---	---	---	---	---	---	---	---	---
65---------- Wheatley	Vw	---	---	---	---	---	---	---	---	---
66C---------- Wallace	VIs	---	---	---	---	---	---	---	---	---
67B---------- Eastport	VIs	---	---	---	---	---	---	---	---	---
69A---------- Winterfield	VIIw	---	---	---	---	---	---	---	---	---
70A*---------- Au Gres-Roscommon	IVw	---	---	---	---	---	---	---	---	---
71*---------- Roscommon-Tawas	VIw	---	---	---	---	---	---	---	---	---
73A---------- Omena	IIs	95	---	255	360	15	18	3.5	75	40
73B---------- Omena	IIe	90	---	240	340	13	17	3.5	75	38
73C---------- Omena	IIIe	70	---	225	320	10	13	3.3	70	35
73C2---------- Omena	IIIe	65	---	210	300	8	10	3.0	65	30
73D---------- Omena	IVe	---	---	---	---	---	---	2.1	---	---
73D3---------- Omena	VIe	---	---	---	---	---	---	1.8	---	---
75---------- Pinconning	Vw	---	---	---	---	---	---	---	---	---
76A---------- Allendale	IIIw	85	---	200	---	8	---	3.0	60	30
81B---------- Croswell	VIs	---	---	---	---	---	---	---	---	---
83B*---------- Kiva-Alpena	IIIs	---	---	---	---	---	---	---	---	---
84*. Pits, quarry										

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability	Corn		Irish potatoes		Dry beans		Bromegrass-alfalfa hay	Oats	Wheat
		N	I	N	I	N	I	N	N	N
		Bu	Bu	Cwt	Cwt	Cwt	Cwt	Tons	Bu	Bu
85A---------- Esau	VIs	---	---	---	---	---	---	---	---	---
86F*. Udorthents and Udipsamments										
87C. Udorthents										
89B---------- Ocqueoc	IIIs	60	---	190	340	8	13	2.5	40	25
90B---------- Zimmerman	IVs	50	---	---	---	---	---	---	40	---
91B---------- Alpena	VIs	---	---	---	---	---	---	---	---	---
92---------- Kinross	VIw	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--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)
		Acres	Acres	Acres
I	---	---	---	---
II	83,927	41,150	39,474	3,303
III	61,007	14,169	17,249	29,589
IV	59,582	2,865	14,983	41,734
V	40,125	---	40,125	---
VI	136,787	768	80,339	55,680
VII	26,799	1,417	11,605	13,777
VIII	---	---	---	---

TABLE 8.--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	Windthrow hazard	Common trees	Site index	Volume*	
2---------- Lupton	2W	Slight	Severe	Severe	Severe	Black spruce	20	29	
						Balsam fir	46	86	
						Black ash	---	---	
						Northern whitecedar	---	---	
						Paper birch	---	---	
						Tamarack	---	---	
						Red maple	---	---	
						Quaking aspen	---	---	
						White spruce	---	---	
3---------- Tawas	5W	Slight	Severe	Severe	Severe	Balsam fir	40	71	
						Northern whitecedar	---	---	
						Quaking aspen	---	---	
						Black ash	---	---	
						Red maple	---	---	
4B, 4C---------- Klacking	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen	70	81	Eastern white pine, red pine.
						White oak	57	46	
						Northern red oak	60	51	
						Red maple	---	---	
						Black cherry	---	---	
5B, 5C---------- 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	
						Paper birch	---	---	
						Eastern white pine	45	75	
5E---------- Rubicon	4R	Moderate	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	
						Paper birch	---	---	
						Eastern white pine	45	75	
6B, 6C---------- Alpena	3F	Slight	Moderate	Moderate	Slight	Sugar maple	61	38	Red pine, jack pine.
						Balsam fir	---	---	
						Quaking aspen	---	---	
						Paper birch	---	---	
						White spruce	---	---	
						Northern whitecedar	---	---	
						Yellow birch	---	---	
7A, 7B, 7C, 7C2, 7D---------- Emmet	3L	Slight	Moderate	Slight	Slight	Sugar maple	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen	---	---	
						Yellow birch	---	---	
						Red pine	---	---	
						American basswood	---	---	
						American beech	---	---	
						Eastern white pine	---	---	
						Northern red oak	74	72	
						Eastern hemlock	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
7E--Emmet	3R	Moderate	Moderate	Slight	Slight	Sugar maple	66	41	White spruce, red pine, eastern white pine.
						Quaking aspen	---	---	
						Yellow birch	---	---	
						Red pine	---	---	
						American basswood	---	---	
						American beech	---	---	
						Eastern white pine	---	---	
						Northern red oak	74	72	
						Eastern hemlock	---	---	
8A, 8B, 8C, 8C2, 8D--Onaway	3L	Slight	Moderate	Slight	Slight	Sugar maple	65	40	White spruce, red pine, Norway spruce.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						Yellow birch	---	---	
						Northern red oak	---	---	
						Red pine	---	---	
						American basswood	65	59	
						White ash	---	---	
8E--Onaway	3R	Moderate	Moderate	Slight	Slight	Sugar maple	65	40	White spruce, red pine, Norway spruce.
						Quaking aspen	---	---	
						Balsam fir	---	---	
						Yellow birch	---	---	
						Northern red oak	---	---	
						Red pine	---	---	
						American basswood	65	59	
						White ash	---	---	
9B, 9C--Summerville	3D	Slight	Moderate	Moderate	Severe	Sugar maple	61	38	
						Paper birch	53	53	
						American beech	---	---	
						Quaking aspen	---	---	
						Northern whitecedar	---	---	
						Balsam fir	---	---	
						Red pine	---	---	
						Eastern white pine	---	---	
10B, 10C--Cunard	3D	Slight	Moderate	Slight	Moderate	Sugar maple	60	38	Red pine, white spruce, eastern white pine.
						American basswood	---	---	
						American beech	---	---	
						White ash	---	---	
						Northern red oak	---	---	
						Bigtooth aspen	---	---	
11A--Alstad	3W	Slight	Severe	Slight	Moderate	Red maple	65	40	Eastern white pine, white spruce, black spruce.
						American basswood	---	---	
						American elm	---	---	
						Quaking aspen	---	---	
						Northern red oak	64	57	
						Sugar maple	---	---	
						Bigtooth aspen	---	---	
12A--Bonduel	4W	Slight	Severe	Slight	Moderate	Northern whitecedar	35	51	Red maple, white spruce, white ash.
						Quaking aspen	---	---	
						Paper birch	---	---	
						Red maple	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
13B---------- 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	
14B---------- Menominee	6A	Slight	Slight	Slight	Slight	Quaking aspen-------	74	86	Red pine, white spruce, eastern white pine.
						Sugar maple---------	---	---	
						Red pine----------	---	---	
						Black cherry--------	---	---	
						Paper birch---------	---	---	
						Yellow birch--------	---	---	
						American basswood---	---	---	
15B, 15C, 15D--- Krakow	3F	Slight	Moderate	Slight	Slight	Sugar maple---------	62	39	White spruce, eastern white pine, red pine.
						Quaking aspen-------	---	---	
						American beech------	---	---	
						American basswood---	---	---	
						White ash----------	---	---	
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
16A---------- Iosco	4W	Slight	Severe	Slight	Moderate	Northern red oak----	65	59	Red pine, eastern white pine, white spruce.
						Sugar maple---------	---	---	
						Red pine----------	---	---	
						Yellow birch--------	---	---	
						White ash----------	---	---	
						Quaking aspen-------	---	---	
17---------- Roscommon	6W	Slight	Severe	Severe	Severe	Quaking aspen-------	74	86	Black spruce, northern whitecedar, tamarack.
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	
						Jack pine----------	---	---	
						Balsam fir----------	---	---	
						Red maple----------	---	---	
						Yellow birch--------	---	---	
18---------- Brevort	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	40	22	Eastern white pine, northern whitecedar.
						Balsam fir----------	---	---	
						Northern whitecedar-	---	---	
						American basswood---	---	---	
						Red maple----------	---	---	
						Black spruce--------	15	23	
20---------- Hessel	6W	Slight	Severe	Severe	Severe	Balsam fir----------	45	83	
						White spruce--------	---	---	
						Black ash----------	---	---	
						Eastern white pine--	---	---	
						Eastern hemlock-----	---	---	
						Northern whitecedar-	---	---	
						Black spruce--------	---	---	
						Quaking aspen-------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
21---------- Cathro	5W	Slight	Severe	Severe	Severe	Balsam fir----------	40	71	White spruce.
						Northern whitecedar-	15	20	
						Tamarack----------	35	23	
						Paper birch---------	---	---	
						Red maple----------	40	26	
						Black spruce--------	15	23	
						White spruce--------	---	---	
23---------- Greenwood	2W	Slight	Severe	Severe	Severe	Black spruce--------	15	23	
						Balsam fir----------	39	69	
						Tamarack----------	---	---	
24B, 24C-------- Melita	3A	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	Red pine,
						Quaking aspen-------	---	---	eastern white
						Red pine----------	---	---	pine.
						Red maple----------	---	---	
						Eastern white pine--	---	---	
						Yellow birch--------	---	---	
						American basswood---	---	---	
						Black cherry--------	---	---	
						American beech------	---	---	
25A---------- Au Gres	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	70	81	White spruce,
						Bigtooth aspen------	---	---	red pine,
						Balsam fir----------	---	---	eastern white
						Paper birch---------	---	---	pine, Norway
						Yellow birch--------	---	---	spruce.
						Red maple----------	---	---	
						Eastern hemlock-----	---	---	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
28A---------- Moltke	3W	Slight	Severe	Moderate	Severe	Sugar maple---------	60	38	White spruce,
						Red maple----------	---	---	eastern white
						American beech------	---	---	pine.
						American basswood---	---	---	
						White ash----------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
						White spruce--------	---	---	
						Eastern hemlock-----	---	---	
						Yellow birch--------	---	---	
						Northern whitecedar-	---	---	
29---------- Glawe	2W	Slight	Severe	Severe	Severe	Red maple----------	50	32	
						Quaking aspen-------	---	---	
						Balsam fir----------	---	---	
						Black spruce--------	---	---	
						Black ash----------	---	---	
						White spruce--------	---	---	
						Northern whitecedar-	---	---	
30---------- Evart	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	45	30	Black spruce,
						Red maple----------	40	28	tamarack.
						Northern whitecedar-	15	20	
						Black spruce--------	15	23	
						Balsam fir----------	40	71	
						Tamarack----------	35	23	
						Swamp white oak-----	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
31B, 31C-------- Mancelona	3A	Slight	Slight	Slight	Slight	Sugar maple--------- Northern red oak---- Red pine---------- Jack pine---------- Eastern white pine-- Yellow birch--------	58 --- --- --- --- ---	37 --- --- --- --- ---	Red pine, eastern white pine.
31E---------- Mancelona	3R	Moderate	Moderate	Slight	Slight	Sugar maple--------- Northern red oak---- Red pine---------- Jack pine---------- Eastern white pine-- Yellow birch--------	58 --- --- --- --- ---	37 --- --- --- --- ---	Red pine, eastern white pine.
33A---------- Detour	7W	Slight	Severe	Moderate	Severe	Balsam fir---------- White spruce-------- Northern whitecedar- Quaking aspen------- Black spruce-------- Paper birch--------- Yellow birch--------	50 50 --- --- --- --- ---	96 96 --- --- --- --- ---	White spruce, eastern white pine.
35A---------- Ingalls	4W	Slight	Severe	Moderate	Severe	Quaking aspen------- White ash---------- Red maple---------- Sugar maple--------- Jack pine---------- Northern pin oak---- Northern whitecedar- Balsam fir---------- Paper birch--------- Red maple---------- Bigtooth aspen------ Eastern hemlock----- Yellow birch--------	60 --- --- --- --- --- --- --- --- --- --- --- ---	64 --- --- --- --- --- --- --- --- --- --- --- ---	Eastern white pine, white spruce.
36---------- Burleigh	2W	Slight	Severe	Severe	Severe	Quaking aspen------- Bigtooth aspen------ Black ash---------- Red maple---------- Swamp white oak-----	40 --- --- --- ---	22 --- --- --- ---	
37A---------- Gladwin	4W	Slight	Severe	Moderate	Severe	Quaking aspen------- Sugar maple--------- Eastern hemlock----- Eastern white pine-- Red maple---------- Bigtooth aspen------ Balsam fir---------- Paper birch--------- White spruce--------	60 53 --- 53 56 60 53 55 53	64 34 --- 99 36 64 102 57 103	White spruce, eastern white pine.
38---------- Ruse	5W	Slight	Severe	Severe	Severe	Balsam fir---------- Black spruce-------- Northern whitecedar- White ash---------- Paper birch--------- Quaking aspen-------	40 --- --- --- --- ---	71 --- --- --- --- ---	Northern whitecedar.

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
39B, 39C--------- Grayling	4S	Slight	Moderate	Moderate	Slight	Jack pine---------- Northern pin oak---- White oak---------- Red pine---------- Quaking aspen-------	48 43 --- --- ---	84 28 --- --- ---	Jack pine, red pine.
40B---------- Nunica	3L	Slight	Severe	Slight	Slight	Sugar maple--------- Yellow birch-------- Eastern hemlock----- American basswood--- Paper birch--------- White spruce-------- Balsam fir----------	62 --- --- --- --- --- ---	39 --- --- --- --- --- ---	White spruce, red pine, eastern white pine.
41A---------- Bowers	7W	Slight	Moderate	Slight	Moderate	Balsam fir---------- American basswood--- White ash---------- Yellow birch-------- Northern red oak---- Quaking aspen-------	54 --- --- --- --- ---	105 --- --- --- --- ---	White spruce, eastern white pine, Norway spruce.
42---------- Hettinger	6W	Slight	Severe	Severe	Severe	Balsam fir---------- White spruce-------- Black ash---------- Silver maple-------- Quaking aspen------- Yellow birch-------- Northern whitecedar- American basswood--- White ash----------	45 45 --- --- --- --- --- --- ---	83 84 --- --- --- --- --- --- ---	
43B, 43C-------- Graycalm	6S	Slight	Moderate	Moderate	Slight	Bigtooth aspen------ Northern red oak---- Jack pine---------- Red pine---------- Paper birch--------- Eastern white pine-- American beech------	70 --- 56 64 --- --- ---	81 --- 78 112 --- --- ---	Red pine, eastern white pine.
43E---------- Graycalm	6R	Moderate	Moderate	Moderate	Slight	Bigtooth aspen------ Northern red oak---- Jack pine---------- Red pine---------- Paper birch--------- Eastern white pine-- American beech------	70 --- 56 64 --- --- ---	81 --- 78 112 --- --- ---	Red pine, eastern white pine.
44A---------- Au Gres	6W	Slight	Severe	Moderate	Moderate	Red pine---------- Eastern white pine-- Balsam fir---------- Paper birch--------- Northern pin oak---- Red maple----------	56 --- --- --- --- ---	90 --- --- --- --- ---	Red pine, eastern white pine, white spruce.

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
45B---------- Croswell	7A	Slight	Moderate	Moderate	Slight	Red pine----------	60	101	Red pine, eastern white pine, jack pine.
						Jack pine----------	---	---	
						Eastern white pine--	---	---	
						Northern pin oak----	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						Northern red oak----	---	---	
						Red maple----------	---	---	
						American basswood---	---	---	
						Paper birch---------	---	---	
47B, 47C, 47D--- Cheboygan	3A	Slight	Slight	Slight	Slight	Sugar maple---------	64	40	Red pine, white spruce, eastern white pine.
						Quaking aspen-------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Red maple----------	---	---	
						Eastern white pine--	---	---	
47E---------- Cheboygan	3R	Moderate	Moderate	Slight	Slight	Sugar maple---------	64	40	Red pine, white spruce, eastern white pine.
						Quaking aspen-------	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
						American beech------	---	---	
						Red maple----------	---	---	
						Eastern white pine--	---	---	
51B, 51C-------- East Lake	2S	Slight	Moderate	Moderate	Slight	Red maple----------	53	34	Red pine, jack pine, eastern white pine.
						Northern red oak----	---	---	
						Quaking aspen-------	---	---	
						Red pine----------	55	88	
						Jack pine----------	---	---	
						Paper birch---------	---	---	
51E---------- East Lake	2R	Moderate	Moderate	Moderate	Slight	Red maple----------	53	34	Red pine, jack pine, eastern white pine.
						Northern red oak----	---	---	
						Quaking aspen-------	---	---	
						Red pine----------	55	88	
						Jack pine----------	---	---	
						Paper birch---------	---	---	
52A, 52B-------- Hagensville	3W	Slight	Severe	Moderate	Severe	Red maple----------	65	40	White spruce, Norway spruce, eastern white pine.
						Paper birch---------	---	---	
						Balsam fir----------	---	---	
						Northern whitecedar-	---	---	
						Black ash----------	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
53---------- Hessel	6W	Slight	Severe	Severe	Severe	Balsam fir----------	45	83	
						White spruce--------	---	---	
						Black ash----------	---	---	
						Eastern white pine--	---	---	
						Eastern hemlock-----	---	---	
						Northern whitecedar-	---	---	
						Black spruce--------	---	---	
						Quaking aspen-------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
55B---------- Johnswood	3F	Slight	Moderate	Moderate	Severe	Sugar maple--------- American beech------ Balsam fir---------- American basswood--- Paper birch--------- Northern whitecedar- White ash---------- Eastern hemlock-----	65 --- --- --- --- --- --- ---	40 --- --- --- --- --- --- ---	Red pine, white spruce, Norway spruce.
56C**: Deer Park------	4S	Slight	Moderate	Moderate	Slight	Red pine---------- Jack pine---------- Eastern white pine-- Northern red oak---- American beech------ Quaking aspen------- Paper birch--------- Black cherry--------	45 46 --- --- --- --- --- ---	64 57 --- --- --- --- --- ---	Red pine, jack pine.
Croswell-------	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen------- Red pine---------- Jack pine---------- Northern red oak---- Black cherry-------- Eastern white pine-- Bigtooth aspen------ Red maple---------- Paper birch---------	68 55 53 --- --- --- 69 --- 54	78 88 73 --- --- --- 80 --- 55	Red pine, eastern white pine, white spruce.
Au Gres--------	6W	Slight	Severe	Moderate	Severe	Quaking aspen------- Bigtooth aspen------ Balsam fir---------- Paper birch--------- Yellow birch-------- Red maple---------- Eastern hemlock----- Eastern white pine-- Northern whitecedar-	70 --- --- --- --- --- --- --- ---	81 --- --- --- --- --- --- --- ---	White spruce, red pine, eastern white pine, Norway spruce.
57A, 57B-------- Grace	3L	Slight	Severe	Slight	Slight	Sugar maple--------- Red maple---------- American beech------ American basswood--- White ash---------- Yellow birch-------- Eastern white pine-- Eastern hemlock-----	67 --- --- --- --- --- --- ---	41 --- --- --- --- --- --- ---	Red pine, eastern white pine, white spruce.
58B, 58C-------- Kalkaska	3S	Slight	Moderate	Moderate	Slight	Sugar maple--------- Quaking aspen------- Red pine---------- Eastern white pine-- American beech------ Paper birch--------- Northern red oak---- Red maple---------- Bigtooth aspen------	64 --- --- --- --- --- --- 63 80	40 --- --- --- --- --- --- 39 94	Red pine.

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
60B, 60C-------- Deer Park	4S	Slight	Moderate	Moderate	Slight	Red pine---------- Jack pine---------- Eastern white pine-- Northern red oak---- American beech------ Quaking aspen------- Paper birch--------- Black cherry--------	45 46 --- --- --- --- --- ---	64 57 --- --- --- --- --- ---	Red pine, jack pine.
60E---------- Deer Park	4R	Moderate	Moderate	Moderate	Slight	Red pine---------- Jack pine---------- Eastern white pine-- Northern red oak---- American beech------ Quaking aspen------- Paper birch--------- Black cherry--------	45 46 --- --- --- --- --- ---	64 57 --- --- --- --- --- ---	Red pine, jack pine.
62---------- Dawson	2W	Slight	Severe	Severe	Severe	Black spruce-------- Tamarack----------	15 ---	23 ---	
64A---------- Ensign	2W	Slight	Severe	Moderate	Severe	Sugar maple--------- Quaking aspen------- Bigtooth aspen------ Balsam fir---------- Northern whitecedar- Red pine---------- Paper birch--------- American beech------	53 --- --- --- --- --- --- ---	34 --- --- --- --- --- --- ---	Northern whitecedar, eastern white pine.
65---------- Wheatley	2W	Slight	Severe	Severe	Severe	Quaking aspen------- Balsam fir---------- Northern whitecedar- Black spruce-------- Red maple---------- Eastern hemlock-----	45 40 15 15 40 ---	32 71 20 23 26 ---	White spruce, Norway spruce, eastern white pine.
66C---------- Wallace	6D	Slight	Moderate	Moderate	Slight	Red pine---------- Red maple---------- Eastern white pine-- Black spruce-------- Eastern hemlock----- Balsam fir---------- Paper birch--------- Quaking aspen------- Sugar maple---------	55 --- 52 --- --- --- 63 75 ---	88 --- 96 --- --- --- 70 87 ---	Red pine, white spruce.
67B---------- Eastport	7S	Slight	Moderate	Moderate	Slight	Red pine---------- Jack pine---------- Quaking aspen------- Eastern white pine-- Paper birch--------- Red maple----------	61 --- --- --- --- ---	104 --- --- --- --- ---	Red pine, jack pine, eastern white pine.

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
69A---------- Winterfield	6W	Slight	Severe	Moderate	Severe	Quaking aspen-------	70	81	White spruce, eastern white pine, northern whitecedar.
						Red maple----------	65	40	
						Yellow birch--------	---	---	
						White spruce--------	---	---	
						White ash----------	---	---	
						Balsam fir----------	---	---	
						Black spruce--------	---	---	
						Eastern white pine--	---	---	
70A**:									
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----------	---	---	
						Eastern hemlock-----	---	---	
						Eastern white pine--	---	---	
						Northern whitecedar-	---	---	
Roscommon------	6W	Slight	Severe	Severe	Severe	Quaking aspen-------	74	86	Black spruce, northern whitecedar, tamarack.
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	
						Jack pine----------	---	---	
						Balsam fir----------	---	---	
						Red maple----------	---	---	
						Yellow birch--------	---	---	
71**:									
Roscommon------	6W	Slight	Severe	Severe	Severe	Quaking aspen-------	74	86	Black spruce, northern whitecedar, tamarack.
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	
						Jack pine----------	---	---	
						Balsam fir----------	---	---	
						Red maple----------	---	---	
						Yellow birch--------	---	---	
Tawas----------	5W	Slight	Severe	Severe	Severe	Balsam fir----------	40	71	
						Northern whitecedar-	---	---	
						Quaking aspen-------	---	---	
						Black ash----------	---	---	
						Red maple----------	---	---	
73A, 73B, 73C, 73C2, 73D, 73D3---------- Omena	3L	Slight	Moderate	Slight	Slight	Sugar maple---------	61	38	Eastern white pine, white spruce, red pine.
						Yellow birch--------	---	---	
						Eastern white pine--	---	---	
						White ash----------	---	---	
						American basswood---	---	---	
75---------- Pinconning	3W	Slight	Severe	Severe	Severe	Quaking aspen-------	50	43	Northern whitecedar.
						Black ash----------	---	---	
						Black spruce--------	---	---	
						Northern whitecedar-	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
76A---------- 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-----------	---	---	
81B---------- Croswell	5S	Slight	Moderate	Moderate	Moderate	Quaking aspen-------	68	78	Red pine, eastern white pine, white spruce.
						Red pine------------	55	88	
						Balsam fir----------	53	102	
						Eastern white pine--	---	---	
						Bigtooth aspen------	69	80	
						Red maple-----------	---	---	
						Paper birch---------	54	55	
						Northern whitecedar-	54	82	
83B**:									
Kiva----------	3A	Slight	Slight	Slight	Slight	Sugar maple---------	61	38	Red pine, eastern white pine.
						American basswood---	---	---	
						Quaking aspen-------	---	---	
						Bigtooth aspen------	---	---	
						White spruce--------	---	---	
						Balsam fir----------	---	---	
						Northern red oak----	59	49	
Alpena---------	3F	Slight	Slight	Moderate	Slight	Sugar maple---------	61	53	Red pine, jack pine.
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Paper birch---------	---	---	
						White spruce--------	---	---	
						Northern whitecedar-	---	---	
						Yellow birch--------	---	---	
85A---------- Esau	4W	Slight	Severe	Moderate	Severe	Quaking aspen-------	55	53	White spruce, eastern white pine, northern whitecedar.
						Balsam fir----------	---	---	
						Northern whitecedar-	---	---	
						Red maple-----------	---	---	
						Paper birch---------	---	---	
						White spruce--------	---	---	
						Black ash-----------	---	---	
89B---------- Ocqueoc	3S	Slight	Moderate	Moderate	Slight	Sugar maple---------	63	39	Red pine, white spruce, eastern white pine.
						American beech------	---	---	
						Yellow birch--------	---	---	
						Quaking aspen-------	---	---	
						Eastern white pine--	---	---	
						Red pine------------	---	---	
						Jack pine-----------	---	---	
						Paper birch---------	---	---	
						Red maple-----------	---	---	
90B---------- Zimmerman	8S	Slight	Moderate	Moderate	Slight	Red pine------------	64	112	Red pine, jack pine, eastern white pine, white spruce.
						Quaking aspen-------	70	81	
						Red maple-----------	---	---	
						Jack pine-----------	65	94	
						Paper birch---------	---	---	

See footnotes at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
91B---------- Alpena	3F	Slight	Moderate	Moderate	Slight	Paper birch---------	45	43	Red pine, jack pine.
						Balsam fir----------	---	---	
						Quaking aspen-------	---	---	
						Northern whitecedar-	---	---	
						Red maple----------	61	38	
						Sugar maple---------	---	---	
						Green ash----------	---	---	
						White spruce--------	---	---	
92---------- Kinross	2W	Slight	Severe	Severe	Severe	Quaking aspen-------	45	32	
						Black spruce--------	---	---	
						Tamarack-----------	---	---	
						Northern whitecedar-	---	---	
						Balsam fir----------	---	---	
						Red maple----------	---	---	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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)

Map symbol and soil name	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
2 Lupton	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
3 Tawas	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
4B Klacking	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
4C Klacking	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
5B Rubicon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
5C Rubicon	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
5E Rubicon	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
6B Alpena	Slight	Slight	Slight	Year round.	Slight	Slight	Slight.
6C Alpena	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
7A Emmet	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Year round.	Slight	Slight	Slight.
7B Emmet	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Year round.	Slight	Slight	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
7C, 7C2---------- Emmet	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Year round.	Slight---------	Moderate: slope.	Slight.
7D---------- Emmet	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
7E---------- Emmet	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
8A---------- Onaway	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
8B---------- Onaway	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
8C, 8C2---------- Onaway	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Moderate: slope.	Slight.
8D---------- Onaway	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Moderate: slope.	Slight.
8E---------- Onaway	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, low strength.	Summer, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
9B---------- Summerville	Moderate: low strength.	Severe: depth to rock.	Severe: depth to rock.	Summer, fall, winter.	Slight---------	Severe: depth to rock.	Severe: depth to rock.
9C---------- Summerville	Moderate: low strength.	Severe: depth to rock.	Severe: depth to rock.	Summer, fall, winter.	Slight---------	Severe: depth to rock.	Severe: depth to rock.
10B---------- Cunard	Moderate: low strength.	Moderate: depth to rock, low strength.	Moderate: depth to rock, low strength.	Summer, fall, winter.	Slight---------	Moderate: depth to rock.	Moderate: depth to rock.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
10C---------- Cunard	Moderate: low strength.	Moderate: depth to rock, low strength, slope.	Moderate: depth to rock, low strength.	Summer, fall, winter.	Slight---------	Moderate: depth to rock, slope.	Moderate: depth to rock.
11A---------- Alstad	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
12A---------- Bonduel	Severe: wetness, low strength.	Severe: wetness, low strength, depth to rock.	Severe: wetness, low strength, depth to rock.	Summer, fall, winter.	Slight---------	Moderate: depth to rock.	Moderate: depth to rock.
13B---------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Slight--------	Slight.
14B---------- Menominee	Slight---------	Slight---------	Slight---------	Year round.	Slight---------	Slight--------	Slight.
15B---------- Krakow	Moderate: low strength.	Moderate: low strength, too flaggy.	Moderate: low strength, too flaggy.	Summer, fall, winter.	Slight---------	Moderate: too flaggy.	Moderate: too flaggy.
15C---------- Krakow	Moderate: low strength.	Moderate: low strength, too flaggy, slope.	Moderate: low strength, too flaggy.	Summer, fall, winter.	Slight---------	Moderate: too flaggy, slope.	Moderate: too flaggy.
15D---------- Krakow	Moderate: low strength, slope.	Moderate: low strength, too flaggy, slope.	Moderate: low strength, too flaggy, slope.	Summer, fall, winter.	Slight---------	Moderate: too flaggy, slope.	Moderate: too flaggy.
16A---------- Iosco	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
17---------- Roscommon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.
18---------- Brevort	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	Ratings for most limiting season(s)				Ratings for preferred operating season(s)		
	Logging areas and skid roads	Log landings	Haul roads	Preferred operating season(s)	Logging areas and skid roads	Log landings	Haul roads
20--- Hessel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter	Slight	Moderate: too flaggy.	Moderate: too flaggy.
21--- Cathro	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
23--- Greenwood	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
24B--- Melita	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
24C--- Melita	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
25A--- Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
28A--- Moltke	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
29--- Glawe	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter	Slight	Slight	Slight.
30--- Evart	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter	Slight	Slight	Slight.
31B--- Mancelona	Slight	Slight	Slight	Year round.	Slight	Slight	Slight.
31C--- Mancelona	Slight	Moderate: slope.	Slight	Year round.	Slight	Moderate: slope.	Slight.
31E--- Mancelona	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
33A--- Detour	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Moderate: too flaggy	Moderate: too flaggy.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
35A---------- Ingalls	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight--------	Slight.
36---------- Burleigh	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight----------	Slight--------	Slight.
37A---------- Gladwin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight----------	Slight--------	Slight.
38---------- Ruse	Severe: wetness.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Winter---	Slight----------	Severe: depth to rock.	Severe: depth to rock.
39B---------- Grayling	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight----------	Slight--------	Slight.
39C---------- Grayling	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight----------	Moderate: slope.	Slight.
40B---------- Nunica	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight----------	Slight--------	Slight.
41A---------- Bowers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight----------	Slight--------	Slight.
42---------- Hettinger	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight----------	Slight--------	Slight.
43B---------- Graycalm	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight----------	Slight--------	Slight.
43C---------- Graycalm	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight----------	Moderate: slope.	Slight.
43E---------- Graycalm	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
44A---------- Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
45B---------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Slight--------	Slight.
47B---------- Cheboygan	Slight---------	Slight---------	Slight---------	Year round.	Slight---------	Slight--------	Slight.
47C---------- Cheboygan	Slight---------	Moderate: slope.	Slight---------	Year round.	Slight---------	Moderate: slope.	Slight.
47D---------- Cheboygan	Slight---------	Moderate: slope.	Slight---------	Year round.	Slight---------	Moderate: slope.	Slight.
47E---------- Cheyboygan	Moderate: slope.	Severe: slope.	Moderate: slope.	Year round.	Moderate: slope.	Severe: slope.	Moderate: slope.
51B---------- East Lake	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Slight--------	Slight.
51C---------- East Lake	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Moderate: slope.	Slight.
51E---------- East Lake	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
52A---------- Hagensville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.
52B---------- Hagensville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.
53---------- Hessel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.
55B---------- Johnswood	Moderate: low strength.	Severe: too flaggy.	Severe: too flaggy.	Summer, fall, winter.	Slight---------	Severe: too flaggy.	Severe: too flaggy.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
56C*:							
Deer Park	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
Au Gres	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight	Slight	Slight.
57A Grace	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
57B Grace	Severe: low strength.	Severe: low strength.	Severe: low strength.	Summer, fall, winter.	Slight	Slight	Slight.
58B Kalkaska	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
58C Kalkaska	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
60B Deer Park	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight	Slight	Slight.
60C Deer Park	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight	Moderate: slope.	Slight.
60E Deer Park	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy, slope.	Spring, fall, winter.	Moderate: slope.	Severe: slope.	Moderate: slope.
62 Dawson	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 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
64A---------- Ensign	Severe: wetness, low strength.	Severe: wetness, low strength, depth to rock.	Severe: wetness, low strength, depth to rock.	Summer, winter.	Slight---------	Severe: depth to rock.	Severe: depth to rock.
65---------- Wheatley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.
66C---------- Wallace	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Moderate: slope.	Slight.
67B---------- Eastport	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Spring, fall, winter.	Slight---------	Slight--------	Slight.
69A---------- Winterfield	Severe: wetness.	Severe: wetness.	Moderate: wetness, flooding.	Winter---	Slight---------	Slight--------	Slight.
70A*:							
Au Gres----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
Roscommon--------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.
71*:							
Roscommon--------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.
Tawas----------	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Winter---	Moderate: low strength.	Severe: low strength.	Moderate: low strength.
73A---------- Omena	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
73B---------- Omena	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Slight--------	Slight.

See footnote at end of table.

TABLE 9.--EQUIPMENT LIMITATIONS ON WOODLAND--Continued

Map symbol and soil name	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
73C, 73C2--------- Omena	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Moderate: slope.	Slight.
73D, 73D3--------- Omena	Moderate: low strength.	Severe: slope.	Moderate: low strength.	Summer, fall, winter.	Slight---------	Severe: slope.	Slight.
75---------- Pinconning	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.
76A---------- Allendale	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.
81B---------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
83B*:							
Kiva----------	Slight---------	Slight---------	Slight---------	Year round.	Slight---------	Slight--------	Slight.
Alpena----------	Slight---------	Slight---------	Slight---------	Year round.	Slight---------	Slight--------	Slight.
85A---------- Esau	Severe: wetness.	Severe: wetness.	Severe: wetness.	Summer, winter.	Slight---------	Slight--------	Slight.
89B---------- Ocqueoc	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
90B---------- Zimmerman	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Summer, fall, winter.	Slight---------	Slight--------	Slight.
91B---------- Alpena	Slight---------	Slight---------	Slight---------	Year round.	Slight---------	Slight--------	Slight.
92---------- Kinross	Severe: wetness.	Severe: wetness.	Severe: wetness.	Winter---	Slight---------	Slight--------	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

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 dominantly wooded and windbreaks are not applicable.)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--			
	8-15	16-25	26-35	>35
2. Lupton				
3. Tawas				
4B, 4C---------- 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.
5B, 5C, 5E-------- Rubicon	Eastern redcedar, smooth sumac, silver buffaloberry, lilac, Siberian peashrub, staghorn sumac.	Red pine, eastern white pine, jack pine.	---	---
6B, 6C. Alpena				
7A, 7B, 7C, 7C2, 7D, 7E---------- Emmet	Arrowwood, lilac, nannyberry viburnum, Siberian peashrub.	White spruce, Siberian crabapple, Austrian pine, eastern redcedar.	Red pine, Norway spruce, eastern white pine.	Imperial Carolina poplar.
8A---------- Onaway	Lilac, silky dogwood, nannyberry viburnum, arrowwood, American cranberrybush.	White spruce, Siberian crabapple.	Red pine, Norway spruce, eastern white pine.	Imperial Carolina poplar.
8B, 8C, 8C2, 8D, 8E---------- Onaway	American cranberrybush, silky dogwood, arrowwood, nannyberry viburnum, lilac.	White spruce, Siberian crabapple.	Red pine, eastern white pine, Norway spruce, green ash.	Imperial Carolina poplar.
9B, 9C. Summerville				
10B, 10C---------- Cunard	Common ninebark, lilac, Amur privet.	Siberian crabapple, northern whitecedar, eastern redcedar, white spruce.	Red pine, Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
11A---------- Alstad	American cranberrybush, lilac, nannyberry viburnum, silky dogwood, common ninebark, redosier dogwood.	Northern whitecedar, white spruce, Manchurian crabapple, green ash.	Norway spruce, eastern white pine, red maple.	---

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
12A---------- Bonduel	Common ninebark, northern whitecedar, redosier dogwood, nannyberry viburnum, lilac, American cranberrybush, silky dogwood.	White spruce----------	Eastern white pine, white ash, silver maple, red maple.	---
13B---------- Croswell	Amur maple, lilac, eastern redcedar, Siberian peashrub.	Red pine, jack pine---	Eastern white pine----	---
14B---------- Menominee	Sargent crabapple, nannyberry viburnum, Amur maple, eastern redcedar.	Red pine, Norway spruce, white spruce, green ash, Siberian crabapple.	Eastern white pine----	Imperial Carolina poplar.
15B, 15C, 15D----- Krakow	American cranberrybush, lilac, silky dogwood, arrowwood.	Northern whitecedar, nannyberry viburnum, Amur maple.	Norway spruce, white spruce, eastern white pine, red pine, green ash.	---
16A---------- Iosco	Lilac, redosier dogwood, American cranberrybush, nannyberry viburnum, silky dogwood.	Siberian crabapple, white spruce, northern whitecedar.	Eastern white pine, red pine, green ash, Norway spruce.	---
17. Roscommon				
18. Brevort				
20. Hessel				
21. Cathro				
23. Greenwood				
24B, 24C---------- Melita	Eastern redcedar, Siberian peashrub, lilac, Amur maple.	Red pine, jack pine---	Eastern white pine----	---
25A---------- Au Gres	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
28A---------- Moltke	Silky dogwood, nannyberry viburnum, American cranberrybush, common ninebark, lilac, arrowwood.	Northern whitecedar, white spruce.	Norway spruce, eastern white pine, green ash.	---
29. Glawe				

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
30. Evart				
31B, 31C, 31E----- Mancelona	Amur maple, lilac, eastern redcedar, Siberian peashrub.	White spruce, Siberian crabapple, northern whitecedar.	Red pine, jack pine, eastern white pine, Norway spruce.	Imperial Carolina poplar.
33A. Detour				
35A---------- Ingalls	American cranberrybush, lilac, silky dogwood, Amur privet, common ninebark, Roselow sargent crabapple.	White spruce, northern whitecedar, Manchurian crabapple.	Norway spruce, eastern white pine, green ash.	---
36. Burleigh				
37A---------- Gladwin	Lilac, American cranberrybush, nannyberry viburnum, Roselow sargent crabapple, Amur maple, silky dogwood.	White spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, green ash.	Imperial Carolina poplar.
38. Ruse				
39B, 39C---------- Grayling	Lilac, silver buffaloberry, Siberian peashrub, smooth sumac, eastern redcedar, staghorn sumac.	Jack pine, eastern white pine, red pine.	---	---
40B---------- Nunica	American cranberrybush, common ninebark, lilac.	Northern whitecedar, white spruce, nannyberry viburnum, Amur maple, Siberian crabapple.	Norway spruce, eastern white pine, red pine, green ash.	---
41A---------- Bowers	Silky dogwood, American cranberrybush, Amur privet, lilac, common ninebark.	White spruce, northern whitecedar, Siberian crabapple.	Eastern white pine, Norway spruce, green ash, jack pine.	---
42. Hettinger				
43B, 43C, 43E----- Graycalm	Siberian peashrub, lilac, eastern redcedar, Amur maple.	Red pine, jack pine---	Eastern white pine----	---
44A---------- Au Gres	Silky dogwood, lilac, nannyberry viburnum, American cranberrybush.	Northern whitecedar, white spruce, eastern redcedar, Siberian crabapple.	Eastern white pine, red pine, green ash, Norway spruce.	---

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
45B---------- Croswell	Nannyberry viburnum, lilac, Siberian peashrub, eastern redcedar.	Manchurian crabapple, white spruce.	Eastern white pine, red pine, jack pine, Norway spruce, green ash.	Imperial Carolina poplar.
47B, 47C, 47D, 47E---------- Cheboygan	Common ninebark, lilac, nannyberry viburnum, Amur privet.	White spruce, Siberian crabapple, eastern redcedar.	Red pine, eastern white pine, Norway spruce, jack pine, red maple.	---
48B. Udipsamments				
49*. Beaches				
50. Aquents				
51B, 51C, 51E----- East Lake	Siberian peashrub, Amur maple, eastern redcedar, lilac.	Red pine, jack pine---	Eastern white pine----	---
52A, 52B---------- Hagensville	American cranberrybush, lilac, nannyberry viburnum, silky dogwood, common ninebark, redosier dogwood.	Northern whitecedar, white spruce, Siberian crabapple.	Norway spruce, eastern white pine, green ash.	---
53---------- Hessel	Silky dogwood, Amur privet, lilac.	Northern whitecedar, white spruce, Manchurian crabapple, green ash.	Norway spruce, eastern white pine, red maple.	---
55B. Johnswood				
56C*: Deer Park.				
Croswell---------	Amur maple, lilac, eastern redcedar, Siberian peashrub.	Red pine, jack pine---	Eastern white pine----	---
Au Gres----------	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
57A---------- Grace	Lilac, Amur maple, American cranberrybush, common ninebark, silky dogwood.	Northern whitecedar, white spruce, Siberian crabapple.	Red pine, eastern white pine, green ash, Norway spruce.	---

See footnote at end of table.

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
57B---------- Grace	Lilac, Amur maple, American cranberrybush, Siberian crabapple, common ninebark, silky dogwood.	Northern whitecedar, white spruce.	Red pine, eastern white pine, green ash, Norway spruce.	---
58B, 58C---------- Kalkaska	Silky dogwood, Amur maple, Siberian peashrub, Amur privet, Siberian crabapple, lilac.	Eastern redcedar------	Eastern white pine, red pine, jack pine.	---
59*: Aquents.				
Histosols.				
60B, 60C, 60E. Deer Park				
62. Dawson				
63*. Pits, borrow				
64A. Ensign				
65. Wheatley				
66C---------- Wallace	Siberian peashrub, northern whitecedar, Amur privet, lilac, silky dogwood, nannyberry viburnum, common ninebark.	Red pine, Siberian crabapple, white spruce.	Eastern white pine, green ash.	---
67B. Eastport				
69A. Winterfield				
70A*: Au Gres----------	Silky dogwood, American cranberrybush, Amur maple, common ninebark, nannyberry viburnum.	White spruce, jack pine, Manchurian crabapple.	Norway spruce, green ash, eastern white pine.	Imperial Carolina poplar.
Roscommon.				
71*: Roscommon.				
Tawas.				

See footnote at end of table.

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
73A, 73B, 73C, 73C2, 73D, 73D3--Omena	Lilac, Amur maple, nannyberry viburnum, Siberian peashrub.	White spruce, northern whitecedar, Siberian crabapple.	Green ash, Norway spruce, red pine, eastern white pine.	Imperial Carolina poplar.
75. Pinconning				
76A--Allendale	American cranberrybush, silky dogwood, Amur privet, lilac, nannyberry viburnum, Roselow sargent crabapple.	White spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, red maple, Norway spruce.	---
81B. Croswell				
83B*: Kiva	Amur privet, Siberian crabapple, arrowwood, American cranberrybush.	White spruce, eastern redcedar.	Red pine, eastern white pine, jack pine, Norway spruce.	Imperial Carolina poplar.
Alpena.				
84*. Pits, quarry				
85A. Esau				
86F*: Udorthents.				
Udipsamments.				
87C. Udorthents				
89B--Ocqueoc	Amur maple, eastern redcedar, Siberian peashrub, silky dogwood.	White spruce, Norway spruce, jack pine, green ash, red pine, Siberian crabapple.	Eastern white pine----	---
90B--Zimmerman	Eastern redcedar, Siberian crabapple, Amur privet, lilac, silky dogwood, Amur maple, Siberian peashrub.	---	Red pine, eastern white pine, jack pine.	---
91B. Alpena				
92. Kinross				

* See description of the map unit for composition and behavior characteristics of the map unit.

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
2---- Lupton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
3---- Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
4B---- Klacking	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
4C---- Klacking	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
5B---- Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
5C---- Rubicon	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
5E---- Rubicon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
6B---- Alpena	Slight	Slight	Severe: small stones.	Slight.
6C---- Alpena	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight.
7A---- Emmet	Slight	Slight	Moderate: small stones.	Slight.
7B---- Emmet	Slight	Slight	Moderate: slope, small stones.	Slight.
7C, 7C2---- Emmet	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
7D, 7E---- Emmet	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
8A---- Onaway	Slight	Slight	Moderate: small stones.	Slight.
8B---- Onaway	Slight	Slight	Moderate: slope, small stones.	Slight.
8C, 8C2---- Onaway	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
8D, 8E---- Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
9B Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: large stones.	Moderate: large stones.
9C Summerville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: large stones, slope.	Moderate: large stones.
10B Cunard	Slight	Slight	Moderate: slope, small stones.	Slight.
10C Cunard	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
11A Alstad	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
12A Bonduel	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
13B Croswell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
14B Menominee	Moderate	Moderate: too sandy.	Moderate: slope.	Moderate: too sandy.
15B Krakow	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.
15C Krakow	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope.	Moderate: large stones.
15D Krakow	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Moderate: large stones, slope.
16A Iosco	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.
17 Roscommon	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.
18 Brevort	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
20 Hessel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
21 Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
23 Greenwood	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
24B Melita	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
24C Melita	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
25A Au Gres	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
28A Moltke	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
29 Glawe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
30 Evart	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
31B Mancelona	Slight	Slight	Moderate: slope, small stones.	Slight.
31C Mancelona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
31E Mancelona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
33A Detour	Severe: wetness.	Severe: wetness.	Severe: large stones, small stones, wetness.	Severe: wetness.
35A Ingalls	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
36 Burleigh	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
37A Gladwin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
38 Ruse	Severe: ponding, thin layer, area reclaim.	Severe: ponding, thin layer, area reclaim.	Severe: ponding, thin layer, area reclaim.	Severe: ponding.
39B Grayling	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
39C Grayling	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
40B Nunica	Slight	Slight	Moderate: slope.	Slight.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
41A---------- Bowers	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
42---------- Hettinger	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
43B---------- Graycalm	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
43C---------- Graycalm	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
43E---------- Graycalm	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
44A---------- Au Gres	Severe: wetness, too sandy.	Severe: too sandy.	Severe: too sandy, wetness.	Severe: too sandy.
45B---------- Croswell	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.
47B---------- Cheboygan	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: too sandy.
47C---------- Cheboygan	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Moderate: too sandy.
47D---------- Cheboygan	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
47E---------- Cheboygan	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
48B. Udipsamments				
49*. Beaches				
50. Aquents				
51B---------- East Lake	Severe: too sandy.	Severe: too sandy.	Moderate: slope, small stones.	Severe: too sandy.
51C---------- East Lake	Severe: too sandy.	Severe: too sandy.	Severe: slope.	Severe: too sandy.
51E---------- East Lake	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope.	Severe: too sandy, slope.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
52A, 52B---------- Hagensville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
53---------- Hessel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
55B---------- Johnswood	Severe: large stones, wetness.	Severe: large stones.	Severe: large stones, wetness.	Severe: large stones.
56C*:				
Deer Park----------	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
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.
57A---------- Grace	Slight----------	Slight----------	Slight----------	Slight.
57B---------- Grace	Slight----------	Slight----------	Moderate: slope.	Slight.
58B---------- Kalkaska	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
58C---------- Kalkaska	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
59*:				
Aquents.				
Histosols.				
60B---------- Deer Park	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
60C---------- Deer Park	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
60E---------- Deer Park	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
62---------- Dawson	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
63*. Pits, borrow				

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
64A Ensign	Severe: wetness, thin layer, area reclaim.	Severe: wetness, thin layer, area reclaim.	Severe: large stones, wetness, thin layer.	Severe: wetness.
65 Wheatley	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.
66C Wallace	Severe: too sandy, cemented pan.	Severe: too sandy, cemented pan.	Severe: slope, too sandy, cemented pan.	Severe: too sandy.
67B Eastport	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
69A Winterfield	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
70A*: Au Gres	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.
Roscommon	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.
71*: Roscommon	Severe: ponding, excess humus.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Tawas	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
73A Omena	Slight	Slight	Moderate: small stones.	Slight.
73B Omena	Slight	Slight	Moderate: slope, small stones.	Slight.
73C, 73C2 Omena	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
73D, 73D3 Omena	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
75 Pinconning	Severe: ponding, percs slowly, too sandy.	Severe: ponding, too sandy, percs slowly.	Severe: too sandy, ponding, percs slowly.	Severe: ponding, too sandy.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
76A Allendale	Severe: wetness, percs slowly, too sandy.	Severe: too sandy, percs slowly.	Severe: too sandy, wetness, percs slowly.	Severe: too sandy.
81B Croswell	Severe: too sandy.	Severe: too sandy.	Severe: large stones, too sandy.	Severe: too sandy.
83B*: Kiva	Slight	Slight	Moderate: slope, small stones.	Slight.
Alpena	Slight	Slight	Severe: small stones.	Slight.
84*. Pits, quarry				
85A Esau	Severe: wetness.	Severe: wetness.	Severe: large stones, small stones, wetness.	Severe: wetness.
86F*: Udorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Udipsamments	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
87C Udorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
89B Ocqueoc	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
90B Zimmerman	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
91B Alpena	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.
92 Kinross	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
2---- Lupton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
3---- Tawas	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
4B---- Klacking	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
4C---- Klacking	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
5B---- Rubicon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
5C---- Rubicon	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
5E---- Rubicon	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
6B, 6C---- Alpena	Poor	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
7A---- Emmet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
7B---- Emmet	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
7C, 7C2---- Emmet	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
7D, 7E---- Emmet	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
8A, 8B---- Onaway	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
8C, 8C2---- Onaway	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
8D, 8E---- Onaway	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
9B---- Summerville	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
9C---- Summerville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
10B---- Cunard	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
10C---- Cunard	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
11A---------- Alstad	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
12A---------- Bonduel	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
13B---------- Croswell	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
14B---------- Menominee	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
15B---------- Krakow	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
15C, 15D---------- Krakow	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
16A---------- Iosco	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
17---------- Roscommon	Poor	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
18---------- Brevort	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
20---------- Hessel	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
21---------- Cathro	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
23---------- Greenwood	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
24B, 24C---------- Melita	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
25A---------- Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
28A---------- Moltke	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
29---------- Glawe	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
30---------- Evart	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
31B, 31C---------- Mancelona	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
31E---------- Mancelona	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
33A---------- Detour	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair.

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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
35A---- Ingalls	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
36---- Burleigh	Very poor.	Very poor.	Fair	Fair	Fair	Good	Good	Very poor.	Fair	Good.
37A---- Gladwin	Fair	Fair	Good	Good	Good	Fair	Poor	Fair	Good	Poor.
38---- Ruse	Poor	Poor	Fair	Poor	Fair	Good	Poor	Poor	Fair	Fair.
39B---- Grayling	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Poor	Poor	Very poor.
39C---- Grayling	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
40B---- Nunica	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
41A---- Bowers	Fair	Good	Good	Good	Good	Good	Fair	Good	Good	Fair.
42---- Hettinger	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
43B, 43C---- Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
43E---- Graycalm	Very poor.	Poor	Fair	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.
44A---- Au Gres	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
45B---- Croswell	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
47B, 47C, 47D---- Cheboygan	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
47E---- Cheboygan	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
48B. Udipsamments										
49*. Beaches										
50. Aquents										
51B---- East Lake	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.

See footnote at end of table.

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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
51C---East Lake	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
51E---East Lake	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
52A---Hagensville	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
52B---Hagensville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
53---Hessel	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
55B---Johnswood	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
56C*:										
Deer Park	Very poor.	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
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.
57A, 57B---Grace	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
58B---Kalkaska	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
58C---Kalkaska	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
59*:										
Aquents.										
Histosols.										
60B, 60C, 60E---Deer Park	Very poor.	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
62---Dawson	Very poor.	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
63*. Pits, borrow										
64A---Ensign	Very poor.	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor.
65---Wheatley	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
66C---Wallace	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

See footnote at end of table.

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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
67B---------- Eastport	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
69A---------- Winterfield	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
70A*:										
Au Gres----------	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Roscommon----------	Poor	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
71*:										
Roscommon----------	Poor	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
Tawas----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
73A, 73B---------- Omena	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
73C, 73C2---------- Omena	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
73D, 73D3---------- Omena	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
75---------- Pinconning	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
76A---------- Allendale	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
81B---------- Croswell	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
83B*:										
Kiva----------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Alpena----------	Poor	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
84*. Pits, quarry										
85A---------- Esau	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor.
86F*:										
Udorthents.										
Udipsamments.										
87C. Udorthents										
89B---------- Ocqueoc	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
90B---------- Zimmerman	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
91B---------- Alpena	Poor	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
92---------- Kinross	Very poor.	Poor	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

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
2 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.
3 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.
4B Klacking	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty, too sandy.
4C Klacking	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, too sandy.
5B Rubicon	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
5C Rubicon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
5E Rubicon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
6B Alpena	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: small stones, droughty.
6C Alpena	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: small stones, droughty.
7A Emmet	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: large stones.
7B Emmet	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
7C, 7C2 Emmet	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
7D, 7E Emmet	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
8A Onaway	Moderate: wetness, dense layer.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: large stones.
8B Onaway	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.

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
8C, 8C2---------- Onaway	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
8D, 8E---------- Onaway	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
9B---------- Summerville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, thin layer.
9C---------- Summerville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: large stones, thin layer.
10B---------- Cunard	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, large stones.
10C---------- Cunard	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.	Moderate: small stones, large stones, slope.
11A---------- Alstad	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
12A---------- Bonduel	Severe: depth to rock, wetness.	Severe: wetness.	Severe: wetness, depth to rock.	Severe: wetness.	Severe: frost action.	Moderate: wetness, thin layer, area reclaim.
13B---------- Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
14B---------- Menominee	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: small stones.
15B---------- Krakow	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
15C---------- Krakow	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: large stones.
15D---------- Krakow	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.
16A---------- Iosco	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
17---------- Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
18---------- Brevort	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

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
20--Hessel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
21--Cathro	Severe: excess humus, ponding.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, subsides.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
23--Greenwood	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: ponding, frost action, subsides.	Severe: ponding, excess humus.
24B--Melita	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
24C--Melita	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
25A--Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
28A--Moltke	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
29--Glawe	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
30--Evart	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
31B--Mancelona	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones, droughty.
31C--Mancelona	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
31E--Mancelona	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
33A--Detour	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness, droughty.
35A--Ingalls	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
36--Burleigh	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

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
37A---------- Gladwin	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
38---------- Ruse	Severe: depth to rock, ponding.	Severe: ponding, depth to rock.	Severe: ponding, depth to rock.	Severe: ponding, depth to rock.	Severe: depth to rock, ponding, frost action.	Severe: ponding, thin layer, area reclaim.
39B---------- Grayling	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
39C---------- Grayling	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
40B---------- Nunica	Moderate: wetness.	Slight---------	Moderate: wetness.	Moderate: slope.	Severe: low strength, frost action.	Slight.
41A---------- Bowers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
42---------- Hettinger	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
43B---------- Graycalm	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
43C---------- Graycalm	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
43E---------- Graycalm	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
44A---------- Au Gres	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty, too sandy.
45B---------- Croswell	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Slight---------	Moderate: droughty.
47B---------- Cheboygan	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Moderate: large stones, droughty.
47C---------- Cheboygan	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
47D, 47E---------- Cheboygan	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
48B---------- Udipsamments	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty, slope, 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
49*. Beaches						
50. Aquents						
51B---East Lake	Severe: cutbanks cave.	Slight---	Slight---	Slight---	Slight---	Moderate: large stones, droughty.
51C---East Lake	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
51E---East Lake	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
52A, 52B---Hagensville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
53---Hessel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
55B---Johnswood	Severe: large stones, wetness.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: large stones.	Severe: large stones, droughty.
56C*:						
Deer Park---	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Severe: droughty.
Croswell---	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness.	Moderate: droughty, too sandy.
Au Gres---	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
57A---Grace	Severe: cutbanks cave.	Slight---	Moderate: wetness.	Slight---	Severe: frost action.	Slight.
57B---Grace	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Severe: frost action.	Slight.
58B---Kalkaska	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Severe: droughty.
58C---Kalkaska	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
59*: Aquents.						

See footnote at end of table.

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
59*. Histosols						
60B---- Deer Park	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
60C---- Deer Park	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
60E---- Deer Park	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
62---- 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.
63*. Pits, borrow						
64A---- Ensign	Severe: depth to rock, wetness.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, depth to rock, frost action.	Severe: large stones, wetness, thin layer.
65---- Wheatley	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
66C---- Wallace	Severe: cemented pan, cutbanks cave.	Moderate: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Moderate: cemented pan, slope.	Severe: droughty, cemented pan.
67B---- Eastport	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty, too sandy.
69A---- Winterfield	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
70A*: Au Gres----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Roscommon----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.
71*: Roscommon----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.

See footnote at end of table.

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
71*:						
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.
73A Omena	Slight	Slight	Slight	Slight	Moderate: frost action.	Moderate: large stones, droughty.
73B Omena	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones, droughty.
73C, 73C2 Omena	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, droughty, slope.
73D, 73D3 Omena	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
75 Pinconning	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding.	Severe: ponding.
76A Allendale	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty, too sandy.
81B Croswell	Severe: cutbanks cave, wetness.	Moderate: wetness, large stones.	Severe: wetness.	Moderate: wetness, large stones.	Moderate: wetness, large stones.	Severe: large stones, droughty.
83B*:						
Kiva	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: large stones, droughty.
Alpena	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
84*. Pits, quarry						
85A Esau	Severe: cutbanks cave, large stones, wetness.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: wetness, large stones.	Severe: large stones, wetness, droughty.
86F*:						
Udorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Udipsamments	Severe: cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
87C Udorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

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
89B---------- Ocqueoc	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
90B---------- Zimmerman	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
91B---------- Alpena	Severe: cutbanks cave.	Moderate: large stones.	Moderate: depth to rock, large stones.	Moderate: slope, large stones.	Moderate: large stones.	Severe: large stones, droughty.
92---------- Kinross	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "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	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2 Lupton	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
3 Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
4B Klacking	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
4C Klacking	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
5B Rubicon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
5C Rubicon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
5E Rubicon	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
6B Alpena	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
6C Alpena	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
7A Emmet	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: small stones, wetness.
7B Emmet	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
7C, 7C2 Emmet	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope.
7D, 7E Emmet	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, 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
8A Onaway	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: small stones.
8B Onaway	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: small stones.
8C, 8C2 Onaway	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
8D, 8E Onaway	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
9B Summerville	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
9C Summerville	Severe: thin layer, seepage.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
10B Cunard	Severe: thin layer, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Moderate: seepage.	Poor: area reclaim, small stones.
10C Cunard	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Moderate: seepage, slope.	Poor: area reclaim, small stones.
11A Alstad	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
12A Bonduel	Severe: thin layer, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: wetness.	Poor: area reclaim, wetness, thin layer.
13B Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
14B Menominee	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
15B Krakow	Severe: large stones.	Severe: large stones.	Severe: large stones.	Slight	Poor: large stones.
15C Krakow	Severe: large stones.	Severe: slope, large stones.	Severe: large stones.	Moderate: slope.	Poor: large stones.
15D Krakow	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.	Poor: large stones, 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
16A---------- Iosco	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
17---------- Roscommon	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
18---------- Brevort	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
20---------- Hessel	Severe: ponding, percs slowly.	Severe: ponding.	Severe: depth to rock, ponding.	Severe: ponding.	Poor: small stones, ponding.
21---------- Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
23---------- Greenwood	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
24B---------- Melita	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
24C---------- Melita	Severe: percs slowly, poor filter.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
25A---------- Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
28A---------- Moltke	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
29---------- Glawe	Severe: ponding.	Severe: ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: ponding.
30---------- Evart	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
31B---------- Mancelona	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
31C---------- Mancelona	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

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
31E Mancelona	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
33A Detour	Severe: wetness, percs slowly.	Moderate: seepage, large stones.	Severe: wetness.	Severe: wetness.	Poor: small stones, wetness.
35A Ingalls	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
36 Burleigh	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding, too sandy.	Severe: seepage, ponding.	Poor: ponding.
37A Gladwin	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
38 Ruse	Severe: thin layer, seepage, ponding.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage, ponding.	Severe: seepage, ponding.	Poor: area reclaim, ponding, thin layer.
39B Grayling	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
39C Grayling	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
40B Nunica	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
41A Bowers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
42 Hettinger	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
43B Graycalm	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
43C Graycalm	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
43E Graycalm	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
44A---------- Au Gres	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
45B---------- Croswell	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
47B---------- Cheboygan	Severe: percs slowly.	Severe: seepage.	Slight----------	Severe: seepage.	Fair: small stones.
47C---------- Cheboygan	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
47D, 47E---------- Cheboygan	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: seepage, slope.	Poor: slope.
48B---------- Udipsamments	Slight----------	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
49*. Beaches					
50. Aquents					
51B---------- East Lake	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
51C---------- East Lake	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
51E---------- East Lake	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
52A, 52B---------- Hagensville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
53---------- Hessel	Severe: ponding, percs slowly.	Severe: ponding.	Severe: depth to rock, ponding.	Severe: ponding.	Poor: small stones, ponding.
55B---------- Johnswood	Severe: wetness, percs slowly, large stones.	Severe: large stones.	Severe: wetness, large stones.	Severe: wetness.	Poor: large stones, wetness.

See footnote at end of table.

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
56C*:					
Deer Park	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
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.
57A---------- Grace	Severe: wetness.	Severe: wetness.	Severe: wetness, too sandy.	Severe: wetness.	Fair: too sandy, wetness.
57B---------- Grace	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too sandy.	Slight	Fair: too sandy.
58B---------- Kalkaska	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
58C---------- Kalkaska	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
59*: Aquents.					
Histosols.					
60B---------- Deer Park	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
60C---------- Deer Park	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
60E---------- Deer Park	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
62---------- Dawson	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
63* Pits, borrow					

See footnote at end of table.

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
64A Ensign	Severe: thin layer, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: depth to rock, seepage, wetness.	Severe: seepage, wetness.	Poor: area reclaim, wetness, large stones.
65 Wheatley	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
66C Wallace	Severe: cemented pan, percs slowly, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage, too sandy.	Severe: cemented pan, seepage.	Poor: cemented pan, seepage, too sandy.
67B Eastport	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
69A Winterfield	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
70A*: Au Gres	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Roscommon	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
71*: Roscommon	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Tawas	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
73A, 73B Omena	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
73C, 73C2 Omena	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope.
73D, 73D3 Omena	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
75 Pinconning	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding, too clayey.	Severe: seepage, ponding.	Poor: too clayey, hard to pack, ponding.

See footnote at end of table.

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
76A---------- Allendale	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
81B---------- Croswell	Severe: wetness, poor filter.	Severe: seepage, wetness, large stones.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, large stones.
83B*:					
Kiva----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Alpena----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
84*. Pits, quarry					
85A---------- Esau	Severe: wetness, poor filter, large stones.	Severe: seepage, wetness, large stones.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, large stones.
86F*:					
Udorthents---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Udipsamments-------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
87C. Udorthents					
89B---------- Ocqueoc	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: too sandy.
90B---------- Zimmerman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
91B---------- Alpena	Severe: poor filter.	Severe: seepage.	Severe: depth to rock, seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
92---------- Kinross	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

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
2 Lupton	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
3 Tawas	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
4B, 4C Klacking	Good	Probable	Improbable: too sandy.	Poor: too sandy, small stones.
5B, 5C Rubicon	Good	Probable	Improbable: too sandy.	Poor: too sandy.
5E Rubicon	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
6B, 6C Alpena	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
7A Emmet	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
7B, 7C, 7C2 Emmet	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
7D, 7E Emmet	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
8A Onaway	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
8B, 8C, 8C2 Onaway	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
8D, 8E Onaway	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
9B, 9C Summerville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
10B, 10C Cunard	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
11A Alstad	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
12A Bonduel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
13B Croswell	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
14B Menominee	Good	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, small stones.
15B, 15C Krakow	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim.
15D Krakow	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
16A Iosco	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, small stones.
17 Roscommon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
18 Brevort	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones, wetness.
20 Hessel	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, wetness.
21 Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
23 Greenwood	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
24B, 24C Melita	Good	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
25A Au Gres	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
28A Moltke	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
29 Glawe	Poor: 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
30--Evart	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, small stones, wetness.
31B, 31C--Mancelona	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
31E--Mancelona	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
33A--Detour	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.
35A--Ingalls	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
36--Burleigh	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
37A--Gladwin	Poor: wetness.	Probable	Probable	Poor: small stones, area reclaim.
38--Ruse	Poor: area reclaim, wetness, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness.
39B, 39C--Grayling	Good	Probable	Improbable: too sandy.	Poor: too sandy.
40B--Nunica	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
41A--Bowers	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
42--Hettinger	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
43B, 43C--Graycalm	Good	Probable	Improbable: too sandy.	Poor: too sandy.
43E--Graycalm	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
44A--Au Gres	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
45B--Croswell	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
47B, 47C---------- Cheboygan	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
47D---------- Cheboygan	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
47E---------- Cheboygan	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
48B---------- Udipsamments	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
49*. Beaches				
50. Aquents				
51B, 51C---------- East Lake	Good----------	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
51E---------- East Lake	Poor: slope.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
52A, 52B---------- Hagensville	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
53---------- Hessel	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, wetness.
55B---------- Johnswood	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
56C*:				
Deer Park----------	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
Croswell----------	Fair: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy.
Au Gres----------	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
57A, 57B---------- Grace	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
58B, 58C---------- Kalkaska	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
59*:				
Aquents.				
Histosols.				
60B, 60C---------- Deer Park	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
60E---------- Deer Park	Poor: slope.	Probable----------	Improbable: too sandy.	Poor: too sandy, slope.
62---------- Dawson	Poor: wetness.	Probable----------	Probable----------	Poor: excess humus, wetness.
63* Pits, borrow				
64A---------- Ensign	Poor: area reclaim, wetness, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness, large stones.
65---------- Wheatley	Poor: wetness.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
66C---------- Wallace	Good----------	Probable----------	Improbable: too sandy.	Poor: cemented pan, area reclaim, too sandy.
67B---------- Eastport	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
69A---------- Winterfield	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
70A*:				
Au Gres----------	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
Roscommon----------	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
71*:				
Roscommon----------	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: too sandy, wetness.
Tawas----------	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: excess humus, wetness.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
73A, 73B, 73C, 73C2--- Omena	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
73D, 73D3--- Omena	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
75--- Pinconning	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
76A--- Allendale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
81B--- Croswell	Fair: large stones, wetness.	Probable	Improbable: too sandy.	Poor: too sandy, large stones.
83B*: Kiva	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Alpena	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
84*. Pits, quarry				
85A--- Esau	Poor: large stones, wetness.	Improbable: large stones.	Improbable: large stones.	Poor: too sandy, large stones, area reclaim.
86F*: Udorthents	---	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Udipsamments	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
87C--- Udorthents	---	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
89B--- Ocqueoc	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
90B--- Zimmerman	Good	Probable	Improbable: too sandy.	Poor: too sandy.
91B--- Alpena	Fair: depth to rock, thin layer, large stones.	Improbable: thin layer.	Improbable: thin layer.	Poor: too sandy, small stones, area reclaim.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
92--Kinross	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

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
2---- Lupton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
3---- Tawas	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
4B---- Klacking	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
4C---- Klacking	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
5B---- Rubicon	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
5C, 5E---- Rubicon	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
6B---- Alpena	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Droughty.
6C---- Alpena	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, droughty.
7A---- Emmet	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Favorable----	Wetness----	Rooting depth.
7B---- Emmet	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Rooting depth.
7C, 7C2, 7D, 7E--- Emmet	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, rooting depth.
8A---- Onaway	Moderate: seepage.	Severe: piping.	Severe: slow refill.	Favorable----	Soil blowing, wetness.	Large stones, rooting depth.
8B---- Onaway	Moderate: slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones.
8C, 8C2, 8D, 8E--- Onaway	Severe: slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Large stones, slope.
9B---- Summerville	Severe: depth to rock, seepage.	Severe: piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, 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
9C---------- Summerville	Severe: depth to rock, seepage, slope.	Severe: piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, slope, droughty.
10B---------- Cunard	Moderate: seepage, depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Droughty, depth to rock.
10C---------- Cunard	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, droughty, depth to rock.
11A---------- Alstad	Moderate: seepage.	Severe: thin layer.	Severe: no water.	Frost action---	Wetness, erodes easily.	Wetness, erodes easily.
12A---------- Bonduel	Moderate: seepage, depth to rock.	Severe: thin layer, wetness.	Severe: depth to rock.	Thin layer, frost action.	Wetness, thin layer.	Wetness, depth to rock, area reclaim.
13B---------- Croswell	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Droughty.
14B---------- Menominee	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
15B---------- Krakow	Moderate: seepage, slope.	Severe: piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
15C, 15D---------- Krakow	Severe: slope.	Severe: piping, large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, slope, droughty.
16A---------- Iosco	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness, droughty, fast intake.	Wetness, droughty.
17---------- Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
18---------- Brevort	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding--------	Ponding, droughty, fast intake.	Wetness, erodes easily, droughty.
20---------- Hessel	Moderate: depth to rock, seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Large stones, wetness, droughty.
21---------- Cathro	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
23---------- Greenwood	Severe: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	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
24B---------- Melita	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
24C---------- Melita	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
25A---------- Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
28A---------- Moltke	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness--------	Wetness, erodes easily.
29---------- Glawe	Moderate: seepage.	Severe: piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding--------	Wetness.
30---------- Evart	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, droughty.
31B---------- Mancelona	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
31C, 31E---------- Mancelona	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
33A---------- Detour	Slight---------	Severe: wetness.	Severe: slow refill.	Percs slowly, large stones, frost action.	Large stones, wetness.	Large stones, wetness, droughty.
35A---------- Ingalls	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, erodes easily, droughty.
36---------- Burleigh	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, erodes easily, droughty.
37A---------- Gladwin	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
38---------- Ruse	Severe: depth to rock, seepage.	Severe: piping, ponding, thin layer.	Severe: depth to rock.	Ponding, thin layer, frost action.	Ponding, thin layer.	Wetness, depth to rock, area reclaim.
39B---------- Grayling	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
39C---------- Grayling	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, 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
40B---------- Nunica	Moderate: seepage, slope.	Severe: piping.	Severe: slow refill.	Deep to water	Slope, erodes easily.	Erodes easily.
41A---------- Bowers	Slight---------	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness--------	Wetness, percs slowly.
42---------- Hettinger	Slight---------	Severe: piping, hard to pack, ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, percs slowly, rooting depth.	Wetness, erodes easily, rooting depth.
43B---------- Graycalm	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
43C, 43E---------- Graycalm	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
44A---------- Au Gres	Severe: seepage.	Severe: seepage.	Severe: no water.	Cutbanks cave	Wetness, droughty.	Wetness, droughty, rooting depth.
45B---------- Croswell	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Cutbanks cave	Wetness, droughty.	Droughty, rooting depth.
47B---------- Cheboygan	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty, rooting depth.
47C, 47D, 47E----- Cheboygan	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty, rooting depth.
48B. Udipsamments						
49*. Beaches						
50. Aquents						
51B---------- East Lake	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
51C, 51E---------- East Lake	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
52A---------- Hagensville	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness, droughty.	Wetness, droughty, rooting depth.
52B---------- Hagensville	Moderate: seepage, slope.	Severe: piping, wetness.	Moderate: slow refill.	Frost action, slope.	Slope, wetness, droughty.	Wetness, droughty, rooting depth.

See footnote at end of table.

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
53--Hessel	Moderate: depth to rock, seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, droughty.	Large stones, wetness, droughty.
55B--Johnswood	Moderate: slope.	Severe: seepage, piping, large stones.	Severe: no water.	Percs slowly, large stones, slope.	Slope, large stones, wetness.	Large stones, wetness.
56C*:						
Deer Park	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
Croswell	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Droughty.
Au Gres	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
57A--Grace	Moderate: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Soil blowing	Erodes easily.
57B--Grace	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Erodes easily.
58B--Kalkaska	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
58C--Kalkaska	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
59*:						
Aquents.						
Histosols.						
60B--Deer Park	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
60C, 60E--Deer Park	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty.
62--Dawson	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, rooting depth.	Wetness, rooting depth.
63*. Pits, borrow						

See footnote at end of table.

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
64A---------- Ensign	Severe: depth to rock, seepage.	Severe: thin layer, wetness, large stones.	Severe: depth to rock.	Thin layer, frost action.	Large stones, wetness, thin layer.	Large stones, wetness, depth to rock.
65---------- Wheatley	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
66C---------- Wallace	Severe: seepage, cemented pan, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, droughty, cemented pan.
67B---------- Eastport	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
69A---------- Winterfield	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, droughty.
70A*:						
Au Gres----------	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, droughty.
Roscommon--------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
71*:						
Roscommon--------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
Tawas----------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Wetness.
73A---------- Omena	Severe: seepage.	Moderate: seepage, piping, large stones.	Severe: no water.	Deep to water	Droughty, soil blowing.	Large stones, droughty.
73B---------- Omena	Severe: seepage.	Moderate: seepage, piping, large stones.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Large stones, droughty.
73C, 73C2, 73D, 73D3---------- Omena	Severe: seepage, slope.	Moderate: seepage, piping, large stones.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Large stones, slope, droughty.

See footnote at end of table.

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
75---------- Pinconning	Severe: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly.	Ponding, droughty, fast intake.	Wetness, droughty, percs slowly.
76A---------- Allendale	Severe: seepage.	Severe: hard to pack, wetness.	Severe: slow refill, cutbanks cave.	Percs slowly---	Wetness, droughty.	Wetness, droughty, percs slowly.
81B---------- Croswell	Severe: seepage.	Severe: seepage, piping, large stones.	Severe: cutbanks cave.	Large stones, cutbanks cave.	Large stones, wetness.	Large stones, droughty.
83B*:						
Kiva----------	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Large stones, droughty.
Alpena----------	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
84*. Pits, quarry						
85A---------- Esau	Severe: seepage.	Severe: seepage, piping, large stones.	Severe: large stones, cutbanks cave.	Large stones, cutbanks cave.	Large stones, wetness, droughty.	Large stones, wetness, droughty.
86F*:						
Udorthents.						
Udipsamments.						
87C. Udorthents						
89B---------- Ocqueoc	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Erodes easily, droughty.
90B---------- Zimmerman	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Droughty.
91B---------- Alpena	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Large stones, droughty.
92---------- Kinross	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding--------	Wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

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		Fragments >3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
2---------- Lupton	0-10	Muck----------	PT	A-8	0	---	---	---	---	---	---
	10-60	Muck----------	PT	A-8	0	---	---	---	---	---	---
3---------- Tawas	0-8	Muck----------	PT	A-8	0	---	---	---	---	---	---
	8-18	Muck----------	PT	A-8	0	---	---	---	---	---	---
	18-60	Sand, loamy fine sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4, A-4, A-1-b	0	80-100	60-100	30-80	0-40	---	NP
4B, 4C---------- Klacking	0-5	Sand----------	SP-SM, SM, SP	A-2, A-1, A-3	0-10	90-100	75-100	35-70	0-15	---	NP
	5-27	Sand, loamy sand	SP-SM, SM, SP	A-2, A-1, A-3	0-10	90-100	75-100	35-75	0-30	---	NP
	27-60	Sand, loamy sand, sandy loam.	SP-SM, SM, SP, SM-SC	A-2, A-4, A-1, A-3	0-10	90-100	75-100	35-70	0-40	<25	NP-7
5B, 5C, 5E------- Rubicon	0-6	Sand----------	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-70	0-15	---	NP
	6-28	Sand----------	SM, SP-SM, SP	A-2, A-3, A-1	0	95-100	75-100	35-70	0-15	---	NP
	28-60	Sand----------	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	75-100	30-70	0-15	---	NP
6B, 6C---------- Alpena	0-8	Very gravelly sandy loam.	SM, SP-SM, GM, GP-GM	A-2-4, A-1	0-10	50-85	35-50	5-45	5-35	<25	NP-7
	8-60	Stratified very gravelly sand to sand.	SP, SP-SM, GP, GP-GM	A-1	0-10	35-75	25-50	10-35	0-10	---	NP
7A, 7B, 7C------- Emmet	0-9	Sandy loam-------	SM, SM-SC, SC	A-2, A-1-b, A-4	0-8	90-100	75-100	45-70	20-50	<25	NP-10
	9-28	Sandy loam, loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4	0-10	95-100	75-100	35-70	10-50	<25	NP-10
	28-33	Loam, sandy loam, sandy clay loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-10	95-100	75-100	45-95	20-75	20-40	5-20
	33-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	0-10	85-95	60-95	45-70	20-50	<25	NP-10
7C2---------- Emmet	0-9	Sandy loam-------	SM, SM-SC, SC	A-2, A-1-b, A-4	0-8	90-100	75-100	45-70	20-50	<25	NP-10
	9-24	Sandy loam, loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4	0-10	95-100	75-100	35-70	10-50	<25	NP-10
	24-29	Loam, sandy loam, sandy clay loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-10	95-100	75-100	45-95	20-75	20-40	5-20
	29-60	Sandy loam, fine sandy loam, gravelly fine sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	0-10	85-95	60-95	45-70	20-50	<25	NP-10

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
7D---------- Emmet	0-9	Sandy loam-------	SM, SM-SC, SC	A-2, A-1-b, A-4	0-8	90-100	75-100	45-70	20-50	<25	NP-10
	9-26	Sandy loam, loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4	0-10	95-100	75-100	35-70	10-50	<25	NP-10
	26-31	Loam, sandy loam, sandy clay loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-10	95-100	75-100	45-95	20-75	20-40	5-20
	31-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	0-10	85-95	60-95	45-70	20-50	<25	NP-10
7E---------- Emmet	0-5	Sandy loam-------	SM, SM-SC, SC	A-2, A-1-b, A-4	0-8	90-100	75-100	45-70	20-50	<25	NP-10
	5-22	Sandy loam, loamy sand.	SM, SC, SM-SC, SP-SM	A-2, A-1-b, A-4	0-10	95-100	75-100	35-70	10-50	<25	NP-10
	22-27	Loam, sandy loam, sandy clay loam.	SM-SC, CL, CL-ML, SC	A-2, A-4, A-6, A-1-b	0-10	95-100	75-100	45-95	20-75	20-40	5-20
	27-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2, A-4, A-1-b	0-10	85-95	60-95	45-70	20-50	<25	NP-10
8A, 8B, 8C------- Onaway	0-8	Fine sandy loam	SM-SC, SC	A-2, A-4, A-6, A-1	0-10	90-100	75-95	45-80	20-50	20-30	4-11
	8-13	Sandy loam, fine sandy loam.	SM-SC, SC	A-2, A-4, A-6, A-1	0-10	90-100	75-95	45-80	20-50	20-30	4-11
	13-28	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6, A-7	0-20	85-100	75-95	55-95	35-80	25-45	7-22
	28-60	Sandy loam, gravelly sandy loam.	SM-SC, SC, CL, SM	A-4, A-6, A-2, A-1	5-20	70-95	60-95	35-70	15-50	15-35	NP-15
8C2---------- Onaway	0-8	Fine sandy loam	SM-SC, SC	A-2, A-4, A-1	0-10	90-100	75-95	45-80	20-50	20-30	4-11
	8-22	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6, A-7	0-20	85-100	75-95	55-95	35-80	25-45	7-22
	22-60	Sandy loam, loam, gravelly sandy loam.	SM-SC, SC, CL, SM	A-4, A-6, A-2, A-1	5-20	70-95	60-95	35-70	15-50	15-35	NP-15
8D, 8E---------- Onaway	0-8	Fine sandy loam	SM-SC, SC	A-2, A-4, A-1	0-10	90-100	75-95	45-80	20-50	20-30	4-11
	8-13	Sandy loam, fine sandy loam.	SM-SC, SC	A-2, A-4, A-6, A-1	0-10	90-100	75-95	45-80	20-50	20-30	4-11
	13-28	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6, A-7	0-20	85-100	75-95	55-95	35-80	25-45	7-22
	28-60	Sandy loam, loam, gravelly sandy loam.	SM-SC, SC, CL, SM	A-4, A-6, A-2, A-1	0-20	70-95	60-95	35-70	15-50	15-35	NP-15
9B, 9C---------- Summerville	0-6	Flaggy fine sandy loam.	SM-SC, SC	A-4	25-50	95-100	90-100	65-85	35-50	20-30	4-10
	6-17	Flaggy fine sandy loam, flaggy loam, flaggy fine sandy loam.	SM-SC, SC, CL, CL-ML	A-2-4, A-4, A-2-6, A-6	25-50	95-100	90-100	55-95	25-80	20-35	4-15
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
10B, 10C--------- Cunard	0-4	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-2-4, A-4, A-1-b	0-10	90-100	75-100	40-95	20-55	<25	NP-7
	4-21	Loam, fine sandy loam, gravelly sandy loam.	ML, SM-SC, SM, CL-ML	A-2-4, A-4, A-1-b	0-10	85-100	70-100	40-95	20-75	<30	NP-10
	21-25	Loam, fine sandy loam, gravelly sandy loam.	ML, SM-SC, SM, CL-ML	A-2-4, A-4, A-1-b	0-10	65-95	60-95	35-95	15-75	<30	NP-10
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
11A-------------- Alstad	0-12	Loam----------	CL, CL-ML, ML	A-4	0-7	95-100	95-100	80-100	55-90	<28	3-9
	12-14	Silt loam, loam, fine sandy loam.	ML, CL, SM, SC	A-2, A-4	0-7	95-100	95-100	55-100	25-90	<26	2-8
	14-20	Loam, silt loam, clay loam.	CL, SC	A-4, A-6, A-7	0-7	80-100	75-100	65-100	45-80	25-45	9-27
	20-27	Sandy clay loam, clay loam, loam.	CL, SC	A-6, A-4, A-2, A-7	0-7	80-100	75-100	60-100	25-80	20-45	9-28
	27-60	Loam, clay loam, sandy loam.	SC, CL, SM, ML	A-6, A-4, A-2, A-1	0-7	80-100	75-100	45-95	20-80	<45	2-20
12A-------------- Bonduel	0-8	Loam----------	ML, CL, CL-ML	A-4	5-10	90-100	90-100	80-95	50-80	20-30	3-10
	8-13	Sandy clay loam, clay loam, clay loam.	CL, SC	A-4, A-5, A-6, A-7	5-10	90-100	90-100	75-95	35-80	25-45	7-22
	13-23	Loam, clay loam, sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-2, A-1	5-10	85-95	85-95	40-95	20-80	<30	NP-12
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
13B-------------- Croswell	0-10	Sand----------	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	5-15	---	NP
	10-33	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
	33-60	Sand----------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	3-15	---	NP
14B-------------- Menominee	0-6	Loamy sand-------	SM	A-2-4	0-8	95-100	95-100	50-75	15-30	---	NP
	6-25	Fine sand, loamy fine sand, loamy sand.	SP, SM, SP-SM	A-2-4, A-3, A-1-b	0-8	85-100	70-100	35-75	0-40	---	NP
	25-34	Clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-10	85-95	85-95	80-95	60-90	35-40	15-20
	34-60	Silty clay loam	CL, CL-ML	A-6	0-10	95-100	85-95	80-95	70-90	35-40	15-20
15B, 15C, 15D---- Krakow	0-11	Flaggy fine sandy loam.	SM, SM-SC, SC	A-2-4, A-4	30-40	85-95	75-90	50-80	25-50	<30	NP-10
	11-16	Very flaggy loam, very flaggy clay loam, very flaggy sandy clay loam.	ML, CL, SM, SC	A-4, A-2-4	50-65	85-95	75-90	60-75	25-75	<30	NP-10
	16-60	Very flaggy sandy loam, very flaggy loam.	SM, SC, ML, CL	A-2-4, A-4	50-65	85-95	75-90	50-90	25-70	<30	NP-10

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
16A---------- Iosco	0-8	Loamy sand-------	SM, SC, SP-SM, SM-SC	A-4, A-1, A-2	0-5	90-100	75-100	35-85	10-45	<25	2-9
	8-32	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-3, A-2, A-4, A-1	0-5	90-100	75-100	35-80	5-45	---	NP
	32-38	Sandy loam, sandy clay loam.	CL, SC	A-4, A-6, A-2	0-10	85-100	75-100	45-95	20-75	26-35	8-15
	38-60	Loam, sandy loam	SC, CL, ML, SM	A-2, A-4, A-1	0-10	85-100	75-100	35-95	15-75	20-30	NP-10
17---------- Roscommon	0-4	Muck----------	PT	A-8	0	---	---	---	---	---	---
	4-60	Sand, loamy sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
18---------- Brevort	0-6	Mucky loamy sand	SP-SM, SM, SM-SC	A-1-b, A-2-4	0-8	85-100	75-100	35-75	10-30	<25	NP-7
	6-38	Sand, loamy sand, loamy fine sand.	SM, SP-SM, SM-SC	A-2-4, A-3, A-1-b	0-8	85-100	75-100	35-85	5-35	<20	NP-7
	38-60	Sandy loam, loam, fine sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7, A-2	0-8	85-100	75-100	50-100	30-95	20-45	5-25
20---------- Hessel	0-6	Mucky flaggy loam.	ML, CL, CL-ML	A-4	20-35	85-95	75-90	65-90	50-70	<25	NP-10
	6-28	Flaggy loam, flaggy fine sandy loam, sandy loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-2, A-1	10-30	80-95	75-90	40-90	20-70	20-40	4-20
	28-50	Loam, gravelly sandy loam, flaggy loam.	SM-SC, SC, CL-ML, CL	A-4, A-2, A-1	10-25	70-90	60-85	40-80	20-65	20-30	4-10
	50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
21---------- Cathro	0-6	Muck----------	PT	A-8	0	---	---	---	---	---	---
	6-34	Muck----------	PT	A-8	0	---	---	---	---	---	---
	34-60	Loam, silty clay loam, sandy loam.	SM-SC, CL-ML, SC, CL	A-4, A-6	0-5	80-100	75-100	70-100	35-90	20-40	4-20
23---------- Greenwood	0-12	Peat----------	PT	A-8	0	---	---	---	---	---	---
	12-60	Mucky peat-------	PT	A-8	0	---	---	---	---	---	---
24B, 24C---------- Melita	0-10	Loamy sand-------	SM, SP-SM	A-2, A-1	0-5	95-100	90-100	45-80	10-35	---	NP
	10-52	Sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3, A-1	0-5	95-100	90-100	45-80	5-35	---	NP
	52-60	Clay loam, silty clay loam.	ML, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-100	65-95	25-45	4-15
25A---------- Au Gres	0-4	Sand----------	SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	85-100	40-65	5-15	---	NP
	4-30	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	30-60	Sand----------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
28A---------- Moltke	0-4	Very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	<30	NP-10
	4-9	Loamy very fine sand, very fine sand.	SM, ML	A-4	0	100	100	75-95	35-60	---	NP
	9-13	Loamy very fine sand, very fine sandy loam.	ML, CL, SC, SM	A-4	0	100	100	85-95	40-65	<30	NP-10
	13-33	Very fine sandy loam, silt loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	<30	NP-10
	33-60	Stratified very fine sandy loam to loamy very fine sand.	ML, CL, SC, SM	A-4	0	100	100	85-95	40-65	<30	NP-10
29---------- Glawe	0-10	Mucky very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	85-95	50-65	<30	NP-10
	10-60	Stratified silt loam to very fine sand.	SM, ML, CL, ML	A-4	0	100	100	75-95	35-90	<30	NP-10
30---------- Evart	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0-5	95-100	90-100	75-95	55-85	<30	3-11
	12-60	Sand, loamy sand, gravelly sand.	SM, SP-SM, SM-SC, SP	A-1, A-3, A-2	0-5	95-100	60-100	30-75	0-30	<25	NP-7
31B, 31C, 31E---- Mancelona	0-10	Loamy sand-------	SM, SP-SM	A-2, A-1-b	0-8	90-100	75-95	35-80	10-35	---	NP
	10-12	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1-b, A-3	0-8	80-100	55-95	30-75	5-30	---	NP
	12-17	Gravelly loamy sand, sandy clay loam, gravelly sandy loam.	SM-SC, SC, SP-SC	A-2, A-4, A-6, A-1	0-8	85-100	55-95	35-80	10-50	20-35	4-15
	17-60	Very gravelly sand, gravelly sand, sand.	GP, SP, GW, SW	A-1, A-2, A-3	0-8	40-90	30-85	20-60	0-15	---	NP
33A---------- Detour	0-5	Flaggy loam------	ML, SM, SC, CL	A-4, A-2, A-1-b	20-30	80-90	75-90	70-85	45-70	<30	2-9
	5-26	Flaggy loam, flaggy sandy loam, flaggy fine sandy loam.	SC, CL	A-2, A-6	20-30	80-90	75-90	70-85	30-70	30-40	10-20
	26-60	Flaggy sandy loam, very flaggy fine sandy loam.	SC, CL	A-2, A-6	10-50	80-90	75-90	70-85	30-50	30-35	10-15
35A---------- Ingalls	0-11	Sand----------	SM, SP-SM	A-2, A-3, A-1	0-8	90-100	85-100	40-80	5-35	---	NP
	11-32	Loamy sand, sand, fine sand.	SM, SP-SM	A-2, A-3, A-1	0-8	90-100	85-100	40-80	5-35	---	NP
	32-60	Stratified silt to loamy fine sand.	CL, CL-ML, SC, SM-SC	A-6, A-4	0	95-100	90-100	65-100	45-95	20-35	4-15

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
36---------- Burleigh	0-5	Mucky loamy fine sand.	SM, SP-SM	A-2-4	0	100	100	50-75	10-30	---	NP
	5-26	Sand, loamy sand, loamy fine sand.	SP-SM, SM	A-3, A-2-4	0	100	100	50-70	5-35	---	NP
	26-60	Stratified very fine sand to silt loam.	ML, SM	A-4	0	100	100	75-100	35-90	20-40	NP-10
37A---------- Gladwin	0-8	Loamy sand-------	SM, SP-SM	A-2-4, A-1-b	0-5	95-100	75-95	45-70	10-30	<20	NP-4
	8-28	Sand, loamy sand	SM, SP-SM, SM-SC	A-1-b, A-2-4, A-3	0-5	95-100	75-95	35-70	5-30	<25	NP-5
	28-36	Gravelly loamy sand, gravelly sandy loam.	SM, SM-SC, SC	A-1-b, A-2-4	0-5	75-85	55-75	35-70	15-35	<30	NP-9
	36-60	Gravelly sand, sand, very gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	0-10	40-80	35-70	20-45	0-10	---	NP
38---------- Ruse	0-5	Loam----------	CL-ML, CL	A-4, A-6	0-10	90-100	75-100	65-95	50-75	20-30	4-11
	5-12	Sandy loam, fine sandy loam, flaggy loam.	SM-SC, SC, CL, CL-ML	A-2-4, A-4, A-6, A-2-6	0-30	90-100	75-100	50-95	20-75	20-35	5-15
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
39B, 39C---------- Grayling	0-1	Sand----------	SM, SP-SM, SP	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	1-25	Sand----------	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	45-70	3-15	---	NP
	25-60	Sand, coarse sand	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	90-100	40-70	0-15	---	NP
40B---------- Nunica	0-8	Silt loam--------	CL-ML, ML, CL	A-4, A-6	0	100	100	85-100	50-90	<30	3-11
	8-22	Silty clay loam, very fine sandy loam.	CL	A-6, A-7	0	100	100	95-100	85-95	28-45	10-20
	22-60	Stratified silty clay loam to silt.	CL-ML, CL, ML	A-4, A-6, A-7	0	100	100	85-100	80-95	15-45	NP-20
41A---------- Bowers	0-7	Silt loam--------	CL	A-6, A-4	0	100	100	85-100	60-90	25-40	7-16
	7-9	Silt loam, fine sandy loam, loam.	CL, SC	A-4, A-6	0	100	100	70-100	40-90	25-40	7-16
	9-18	Silty clay loam, clay loam.	CL	A-7	0	100	100	90-100	70-95	40-50	20-25
	18-60	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-50	15-25
42---------- Hettinger	0-7	Loam----------	ML, CL-ML, CL	A-4	0	100	100	85-100	60-90	20-30	2-10
	7-15	Silty clay loam, clay loam.	CL	A-6	0	100	100	90-100	75-95	25-40	10-25
	15-26	Stratified silt to clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	26-60	Stratified very fine sandy loam to clay.	CL, ML, CH, MH	A-4, A-6, A-7	0	100	100	85-100	60-95	30-60	5-35

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
43B, 43C, 43E---- Graycalm	0-3	Sand----------	SM, SP-SM, SP	A-2, A-1, A-3	0	95-100	75-100	35-55	0-15	---	NP
	3-22	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	95-100	75-100	30-75	0-30	---	NP
	22-60	Sand, loamy sand	SM, SP-SM, SP	A-2, A-1, A-3	0	95-100	75-100	30-75	0-30	---	NP
44A---------- Au Gres	0-10	Sand----------	SM, SP-SM	A-3, A-2, A-1	0	95-100	85-100	40-70	5-15	---	NP
	10-12	Sand----------	SM, SP-SM	A-3, A-2, A-1	0	95-100	85-100	40-70	5-15	---	NP
	12-40	Sand----------	SP-SM	A-3, A-2, A-1	0	95-100	85-100	40-70	5-10	---	NP
	40-60	Stratified very fine sand to silt.	CL, SC, SM-SC, CL-ML	A-6, A-4, A-2	0	100	90-100	65-95	20-85	20-34	4-14
45B---------- Croswell	0-6	Loamy sand-------	SM	A-2, A-1	0	90-100	85-100	40-75	15-30	<20	NP-4
	6-13	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	90-100	85-100	40-75	0-30	<20	NP-4
	13-49	Sand----------	SP-SM, SM, SP	A-3, A-2, A-1	0	90-100	85-100	40-70	0-25	---	NP
	49-60	Stratified fine sand to silt loam.	CL, SC, SM-SC, CL-ML	A-6, A-4, A-2	0	100	90-100	65-95	20-90	20-35	4-15
47B, 47C, 47D, 47E---------- Cheboygan	0-9	Loamy sand-------	SM, SM-SC	A-2-4	0-8	90-100	90-100	55-70	15-30	<25	NP-5
	9-22	Loamy sand, sand	SM, SM-SC	A-2-4	0-8	90-100	90-100	55-70	15-30	<25	NP-5
	22-28	Sandy clay loam, sandy loam, loam.	SM, ML, SC, CL	A-2, A-4, A-6	0-8	95-100	90-100	55-85	25-55	<35	NP-15
	28-60	Sandy loam-------	SM, SM-SC, SC	A-2-4	0-8	85-95	80-95	50-80	20-35	<25	NP-10
48B---------- Udipsamments	0-60	Sand----------	---	---	---	---	---	---	---	---	---
	60-80	Sand----------	---	---	---	---	---	---	---	---	---
49*. Beaches											
50---------- Aquents	0-60	Variable---------	---	---	---	---	---	---	---	---	---
51B, 51C, 51E---- East Lake	0-2	Sand----------	SM, SP-SM, SP	A-1, A-2-4, A-3	0-15	95-100	85-100	40-70	0-15	---	NP
	2-31	Sand, loamy sand, gravelly coarse sand.	SM, SP-SM, SP	A-1, A-2-4, A-3	0-7	85-100	70-100	35-75	0-30	---	NP
	31-60	Stratified very gravelly sand to sand.	GP, SP-SM, SP, GP-GM	A-1, A-3, A-2-4	0-7	40-90	25-80	20-55	0-10	---	NP
52A, 52B---------- Hagensville	0-8	Fine sandy loam	SC, SM-SC	A-2-4, A-4	0-7	90-100	85-100	55-80	30-50	20-30	4-10
	8-12	Fine sandy loam, very fine sandy loam, loam.	SC, CL, CL-ML, SM-SC	A-2-4, A-4	0-7	90-100	85-100	55-90	30-70	20-30	4-10
	12-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SC, SM-SC	A-2-4, A-4, A-1-b	0-10	80-95	70-90	40-80	20-50	20-30	4-10

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
53---------- Hessel	0-8	Loam----------	ML, CL, CL-ML	A-4	5-20	90-95	75-90	65-90	50-70	<25	NP-10
	8-12	Loam, fine sandy loam, sandy loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-2, A-1	10-30	80-95	60-90	40-90	20-70	20-40	4-20
	12-60	Loam, gravelly sandy loam, flaggy loam.	SM-SC, SC, CL-ML, CL	A-4, A-2, A-1	10-25	70-90	60-85	40-80	20-65	20-30	4-10
55B---------- Johnswood	0-5	Very flaggy loam	CL-ML, CL	A-4	50-80	80-100	75-90	65-90	50-70	20-30	4-10
	5-13	Flaggy loam, very flaggy clay loam, loam.	SM, CL, SC, ML	A-4, A-2, A-6, A-1	50-80	80-100	60-90	35-90	15-70	20-40	2-19
	13-60	Very flaggy loam, extremely flaggy loam, very flaggy sandy loam.	CL, SM, SM-SC, SC	A-4, A-6, A-1, A-2	50-80	80-100	60-90	35-90	15-70	15-30	3-15
56C*:											
Deer Park-------	0-8	Sand----------	SP-SM, SM	A-2, A-3	0	100	100	50-70	5-15	---	NP
	8-28	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-30	---	NP
	28-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	50-80	5-30	---	NP
Croswell--------	0-10	Sand----------	SP-SM, SM	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	5-15	---	NP
	10-33	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
	33-60	Sand----------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0	90-100	75-100	40-70	3-15	---	NP
Au Gres---------	0-4	Sand----------	SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	85-100	40-65	5-15	---	NP
	4-30	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	30-60	Sand----------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP
57A, 57B--------- Grace	0-9	Very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	95-100	85-95	50-65	<30	NP-10
	9-16	Very fine sandy loam, loamy very fine sand, fine sandy loam.	ML, CL, SM, SC	A-4	0	100	95-100	85-95	40-65	<30	NP-10
	16-36	Very fine sandy loam, silt loam, silt.	ML, CL-ML, CL	A-4	0	100	95-100	85-100	50-95	<30	NP-10
	36-60	Stratified silt loam to very fine sand.	ML, CL, SM, SC	A-4	0	100	95-100	75-100	35-90	<30	NP-10

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
58B, 58C--------- Kalkaska	0-8	Sand----------	SM, SP-SM	A-1, A-2, A-3	0	95-100	85-100	45-70	5-15	---	NP
	8-10	Sand, loamy sand	SM, SP-SM	A-1, A-2, A-3	0	95-100	85-100	45-75	5-30	---	NP
	10-38	Sand----------	SM, SP-SM	A-1, A-2, A-3	0	95-100	85-100	45-70	5-15	---	NP
	38-60	Sand----------	SP, SP-SM, SM	A-1, A-2, A-3	0	100	85-100	45-70	0-15	---	NP
59*:											
Aquents----------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
Histosols--------	0-40	Muck----------	PT	A-8	0	---	---	---	---	---	NP
	40-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	50-90	5-30	---	NP
60B, 60C, 60E---- Deer Park	0-8	Sand----------	SP-SM, SM	A-2, A-3	0	100	100	50-70	5-15	---	NP
	8-28	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-30	---	NP
	28-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	50-80	5-30	---	NP
62--------------- Dawson	0-4	Peat----------	PT	A-8	0	---	---	---	---	---	---
	4-24	Muck----------	PT	A-8	0	---	---	---	---	---	---
	24-60	Sand, fine sand, loamy fine sand.	SM-SC, SM, SC, SP-SM	A-2, A-3, A-1, A-4	0	45-100	35-100	15-90	0-45	<20	NP-10
63*. Pits, borrow											
64A-------------- Ensign	0-4	Flaggy loam------	CL, CL-ML	A-4, A-6	20-50	90-100	75-100	65-95	50-80	20-35	4-15
	4-15	Flaggy loam, flaggy fine sandy loam, flaggy sandy loam.	CL-ML, CL, SM-SC, SC	A-2, A-4, A-2-6, A-6	20-50	90-100	75-100	50-95	30-80	20-35	4-15
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
65--------------- Wheatley	0-6	Muck----------	PT	A-8	0	---	---	---	---	---	---
	6-30	Gravelly sand, gravelly loamy sand, sand.	SM, SP-SM	A-2-4, A-1-b, A-3	0-5	80-95	65-90	30-75	5-30	<20	NP-4
	30-60	Gravelly sand, very gravelly sand.	GW, SW, GP, SP	A-1-b, A-2-4, A-3	5-10	20-80	20-60	20-60	0-10	<20	NP-4
66C-------------- Wallace	0-9	Sand----------	SP, SP-SM	A-2, A-3, A-1-b	0	95-100	95-100	45-70	0-10	---	NP
	9-39	Sand----------	SM, SP-SM	A-2, A-3, A-1-b	0	95-100	90-100	45-75	5-15	---	NP
	39-60	Sand----------	SP, SP-SM	A-2, A-3, A-1-b	0	95-100	90-100	45-65	0-10	---	NP
67B-------------- Eastport	0-3	Sand----------	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	90-100	75-100	35-70	0-15	---	NP
	3-35	Sand----------	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	90-100	75-100	35-70	0-15	---	NP
	35-60	Sand----------	SP, SM, SP-SM	A-3, A-2-4, A-1-b	0	90-100	75-100	35-70	0-15	---	NP

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
69A---------- Winterfield	0-6	Loamy fine sand	SM, SM-SC	A-2-4, A-4	0	100	95-100	50-90	15-45	<25	NP-7
	6-21	Coarse sand, loamy sand, fine sand.	SM, SP-SM, SM-SC, SP	A-2-4, A-3, A-4	0	100	95-100	50-90	2-45	<25	NP-7
	21-60	Fine sand, gravelly sand, loamy fine sand.	SM, SP-SM, SP	A-3, A-1-b, A-2-4	0	85-100	70-100	35-80	0-35	---	NP
70A*: Au Gres----------	0-4	Sand----------	SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	85-100	40-65	5-15	---	NP
	4-30	Sand, loamy sand	SP-SM, SM, SM-SC	A-2-4, A-3, A-1-b	0	95-100	85-100	40-75	5-30	<25	NP-7
	30-60	Sand----------	SP-SM, SM	A-3, A-2-4, A-1-b	0	95-100	85-100	40-60	5-15	---	NP
Roscommon-------	0-4	Muck----------	PT	A-8	0	---	---	---	---	---	---
	4-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
71*: Roscommon-------	0-4	Muck----------	PT	A-8	0	---	---	---	---	---	---
	4-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-75	0-30	<20	NP-4
Tawas----------	0-8	Muck----------	PT	A-8	0	---	---	---	---	---	---
	8-18	Muck----------	PT	A-8	0	---	---	---	---	---	---
	18-60	Sand, loamy fine sand, gravelly sand.	SP, SM, SP-SM	A-3, A-2-4, A-4, A-1-b	0	80-100	60-100	30-80	0-40	---	NP
73A, 73B, 73C---- Omena	0-8	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-10	90-100	75-100	55-85	25-50	<25	2-8
	8-13	Loam, sandy loam	SC, SM, ML, CL	A-2-4, A-4	0-15	90-100	75-100	50-95	25-75	<20	2-10
	13-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2-4, A-1-b, A-4	5-15	80-95	70-90	40-65	20-40	<25	2-8
73C2---------- Omena	0-8	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-10	90-100	75-100	55-85	25-50	<25	2-8
	8-10	Loam, sandy loam	SC, SM, ML, CL	A-2-4, A-4	0-15	90-100	75-100	50-95	25-75	<20	2-10
	10-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2-4, A-1-b, A-4	5-15	80-95	70-90	40-65	20-40	<25	2-8
73D---------- Omena	0-8	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-10	90-100	75-100	55-85	25-50	<25	2-8
	8-11	Loam, sandy loam	SC, SM, ML, CL	A-2-4, A-4	0-15	90-100	75-100	50-95	25-75	<20	2-10
	11-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2-4, A-1-b, A-4	5-15	80-95	70-90	40-65	20-40	<25	2-8

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
73D3---------- Omena	0-8	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-10	90-100	75-100	55-85	25-50	<25	2-8
	8-60	Sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-2-4, A-1-b, A-4	5-15	80-95	70-90	40-65	20-40	<25	2-8
75---------- Pinconning	0-8	Mucky sand-------	SP-SM, SM	A-3, A-1-b, A-2-4	0	100	95-100	45-65	5-15	---	NP
	8-32	Sand, loamy sand, fine sand.	SP-SM, SM	A-3, A-2-4	0	100	95-100	50-80	5-35	---	NP
	32-60	Silty clay, silty clay loam.	CH, CL	A-7	0	100	95-100	90-100	75-95	40-60	25-35
76A---------- Allendale	0-8	Sand----------	SM, SW-SM, SP-SM	A-2-4, A-3, A-1-b	0	95-100	90-100	45-80	5-35	---	NP
	8-24	Sand, loamy sand, fine sand.	SM, SP-SM	A-2-4, A-3, A-4, A-1-b	0	95-100	90-100	45-80	5-40	---	NP
	24-60	Silty clay.	CH, MH	A-7	0	100	90-100	90-100	75-95	50-70	20-40
81B---------- Croswell	0-5	Cobbly sand------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	15-45	85-100	75-100	35-70	0-15	---	NP
	5-36	Cobbly loamy sand, cobbly sand, sand.	SP-SM, SM, SP	A-3, A-2-4, A-1-b	15-45	85-100	75-100	35-75	0-30	<20	NP-4
	36-60	Sand----------	SP-SM, SM, SP	A-3, A-2-4, A-1-b	0-5	85-100	75-100	35-70	0-15	---	NP
83B*: Kiva----------	0-7	Fine sandy loam	SM, SC, SM-SC	A-2-4, A-4, A-1-b	0-10	85-100	75-95	45-80	20-50	<25	NP-10
	7-22	Sandy loam, loam, gravelly sandy loam.	SM-SC, SC, CL-ML, CL	A-2-4, A-4, A-1-b	0-10	85-100	70-95	40-90	20-70	20-30	4-10
	22-60	Very gravelly coarse sand, gravelly sand, very gravelly sand.	SP-SM, SP, GP, GP-GM	A-1, A-3, A-2-4	0-15	50-90	40-80	20-60	0-10	---	NP
Alpena----------	0-8	Gravelly loamy sand.	SM, SM-SC, SP-SM	A-2-4, A-1, A-3	0-10	75-90	50-75	10-55	5-35	<25	NP-7
	8-60	Stratified very gravelly sand to sand.	SP, SP-SM, GP, GP-GM	A-1	0-10	35-75	25-50	10-35	0-10	---	NP
84*. Pits, quarry											

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>3 inches	4	10	40	200		
	In				Pct					Pct	
85A---------- Esau	0-4	Flaggy sandy loam	SM	A-2-4, A-4, A-1-b	15-50	80-95	70-90	40-65	20-40	<20	NP-4
	4-10	Extremely flaggy sandy loam, extremely flaggy fine sandy loam, extremely gravelly sand.	SM, GM, GW-GM, GP-GM	A-1-b, A-2-4, A-4, A-3	30-85	25-95	25-90	20-80	5-50	<20	NP-4
	10-60	Extremely flaggy sand, extremely gravelly sand.	SP-SM, GP, SP, GP-GM	A-1-b, A-2-4, A-3	35-85	25-95	25-90	20-80	0-25	<20	NP
86F*:											
Udorthents------	0-60	Variable---------	---	---	---	---	---	---	---	---	---
	60-80	Variable---------	---	---	---	---	---	---	---	---	---
Udipsamments----	0-60	Sand----------	---	---	---	---	---	---	---	---	---
	60-80	Sand----------	---	---	---	---	---	---	---	---	---
87C---------- Udorthents	0-60	Variable---------	---	---	---	---	---	---	---	---	---
	60-80	Variable---------	---	---	---	---	---	---	---	---	---
89B---------- Ocqueoc	0-6	Fine sand--------	SM, SP-SM	A-3, A-2	0	100	100	50-80	5-15	<20	NP-4
	6-31	Sand, fine sand, loamy fine sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	50-80	5-50	<25	NP-7
	31-60	Stratified fine sand to silt loam.	SM-SC, CL-ML, CL, SC	A-2, A-4, A-6	0	100	100	65-95	20-85	20-40	4-20
90B---------- Zimmerman	0-10	Fine sand--------	SM, SP-SM	A-2	0	100	100	95-100	10-25	<20	NP
	10-60	Fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	95-100	5-20	<20	NP
91B---------- Alpena	0-8	Cobbly sandy loam	SM, SM-SC	A-2-4, A-1-b, A-4	20-50	85-95	75-90	45-65	20-40	<25	NP-7
	8-44	Stratified very gravelly sand to sand.	SP, SP-SM, GP, GP-GM	A-1	0-20	35-75	25-50	10-35	0-10	---	NP
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
92---------- Kinross	0-4	Muck----------	PT	A-8	0	---	---	---	---	---	NP
	4-22	Sand, fine sand, loamy sand.	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-30	---	NP
	22-60	Sand, fine sand	SP-SM, SM	A-3, A-2-4	0	100	100	50-80	5-30	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

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
	In	Pct	g/cc	In/hr	In/in	pH		K	T		Pct
2	0-10	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8			5	2	70-90
Lupton	10-60	---	0.10-0.35	0.2-6.0	0.35-0.45	5.6-7.8					
3	0-8	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8			4	2	40-60
Tawas	8-18	---	0.30-0.55	0.2-6.0	0.24-0.45	4.5-7.8					
	18-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low	0.15			
4B, 4C	0-5	0-10	1.35-1.65	6.0-20	0.05-0.09	4.5-6.0	Low	0.15	5	1	1-2
Klacking	5-27	0-10	1.35-1.65	6.0-20	0.05-0.08	4.5-7.3	Low	0.15			
	27-60	2-15	1.55-1.70	2.0-6.0	0.05-0.11	4.5-7.8	Low	0.17			
5B, 5C, 5E	0-6	0-5	1.25-1.45	6.0-20	0.05-0.09	4.5-6.0	Low	0.15	5	1	.5-2
Rubicon	6-28	0-10	1.30-1.60	6.0-20	0.04-0.08	4.5-6.0	Low	0.15			
	28-60	0-5	1.40-1.65	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
6B, 6C	0-8	5-15	1.25-1.55	2.0-20	0.05-0.14	6.6-7.8	Low	0.10	2	8	2-4
Alpena	8-60	0-10	1.25-1.65	>20	0.02-0.04	7.9-8.4	Low	0.10			
7A, 7B, 7C	0-9	3-12	1.30-1.65	2.0-6.0	0.12-0.15	5.6-6.5	Low	0.24	5	3	1-3
Emmet	9-28	3-12	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low	0.24			
	28-33	10-18	1.50-1.75	0.6-2.0	0.11-0.18	6.6-7.8	Moderate	0.32			
	33-60	5-15	1.50-1.75	0.6-6.0	0.08-0.14	7.4-8.4	Low	0.28			
7C2	0-9	3-12	1.30-1.65	2.0-6.0	0.12-0.15	5.6-6.5	Low	0.24	5	3	1-3
Emmet	9-24	3-12	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low	0.24			
	24-29	10-18	1.50-1.75	0.6-2.0	0.11-0.18	6.6-7.8	Moderate	0.32			
	29-60	5-15	1.50-1.75	0.6-6.0	0.08-0.14	7.4-8.4	Low	0.28			
7D	0-9	3-12	1.30-1.65	2.0-6.0	0.12-0.15	5.6-6.5	Low	0.24	5	3	1-3
Emmet	9-26	3-12	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low	0.24			
	26-31	10-18	1.50-1.75	0.6-2.0	0.11-0.18	6.6-7.8	Moderate	0.32			
	31-60	5-15	1.50-1.75	0.6-6.0	0.08-0.14	7.4-8.4	Low	0.28			
7E	0-5	3-12	1.30-1.65	2.0-6.0	0.12-0.15	5.6-6.5	Low	0.24	5	3	1-3
Emmet	5-22	3-12	1.40-1.70	2.0-6.0	0.11-0.14	5.6-6.5	Low	0.24			
	22-27	10-18	1.50-1.75	0.6-2.0	0.11-0.18	6.6-7.8	Moderate	0.32			
	27-60	5-15	1.50-1.75	0.6-6.0	0.08-0.14	7.4-8.4	Low	0.28			
8A, 8B, 8C	0-8	10-20	1.30-1.55	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	4	3	1-3
Onaway	8-13	10-20	1.40-1.70	2.0-6.0	0.12-0.17	5.1-7.8	Low	0.24			
	13-28	18-35	1.40-1.70	0.2-0.6	0.12-0.19	5.6-7.8	Low	0.32			
	28-60	5-20	1.45-1.70	0.2-0.6	0.10-0.20	7.4-8.4	Low	0.32			
8C2	0-8	10-20	1.30-1.55	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	4	3	1-3
Onaway	8-22	18-35	1.40-1.70	0.2-0.6	0.12-0.19	5.6-7.8	Low	0.32			
	22-60	5-20	1.45-1.70	0.2-0.6	0.10-0.20	7.4-8.4	Low	0.32			
8D, 8E	0-8	10-20	1.30-1.55	2.0-6.0	0.08-0.16	5.1-7.8	Low	0.24	4	3	1-3
Onaway	8-13	10-20	1.40-1.70	2.0-6.0	0.12-0.17	5.1-7.8	Low	0.24			
	13-28	18-35	1.40-1.70	0.2-0.6	0.12-0.19	5.6-7.8	Low	0.32			
	28-60	5-20	1.45-1.70	0.2-0.6	0.10-0.20	7.4-8.4	Low	0.32			

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
9B, 9C----------	0-6	10-18	1.30-1.60	2.0-6.0	0.07-0.10	6.1-8.4	Low----------	0.20	2	3	1-2
Summerville	6-17	10-30	1.35-1.65	0.6-2.0	0.07-0.14	6.1-8.4	Low----------	0.20			
	17	---	---	---	---	---	----------	----			
10B, 10C---------	0-4	5-15	1.30-1.60	2.0-6.0	0.10-0.15	5.6-7.3	Low----------	0.24	4	3	1-3
Cunard	4-21	5-18	1.35-1.70	0.6-2.0	0.09-0.19	5.6-7.8	Low----------	0.24			
	21-25	5-18	1.60-1.70	0.6-2.0	0.08-0.18	7.4-8.4	Low----------	0.24			
	25	---	---	---	---	---	----------	----			
11A----------	0-12	7-18	1.35-1.60	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.37	5	5	2-4
Alstad	12-14	6-16	1.55-1.65	0.6-2.0	0.13-0.22	5.1-7.3	Low----------	0.32			
	14-20	18-35	1.55-1.65	0.6-2.0	0.14-0.22	5.1-7.3	Low----------	0.32			
	20-27	18-35	1.55-1.70	0.6-2.0	0.13-0.19	5.1-7.8	Low----------	0.32			
	27-60	8-35	1.60-1.80	0.2-0.6	0.09-0.19	5.6-8.4	Low----------	0.32			
12A----------	0-8	5-20	1.35-1.55	0.6-2.0	0.19-0.24	6.6-7.8	Low----------	0.32	4	5	2-3
Bonduel	8-13	18-35	1.55-1.65	0.6-2.0	0.15-0.22	6.6-7.8	Moderate-----	0.32			
	13-23	2-30	1.65-1.70	0.6-2.0	0.09-0.18	6.6-8.4	Low----------	0.32			
	23	---	---	---	---	---	----------	----			
13B----------	0-10	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low----------	0.15	5	1	.5-2
Croswell	10-33	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low----------	0.15			
	33-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-8.4	Low----------	0.15			
14B----------	0-6	2-15	1.35-1.65	2.0-6.0	0.10-0.12	4.5-6.5	Low----------	0.17	5	2	2-4
Menominee	6-25	5-15	1.30-1.70	6.0-20	0.04-0.10	4.5-7.8	Low----------	0.17			
	25-34	27-35	1.45-1.70	0.2-0.6	0.14-0.18	5.1-7.8	Moderate-----	0.32			
	34-60	27-35	1.45-1.70	0.2-0.6	0.13-0.18	6.1-8.4	Moderate-----	0.32			
15B, 15C, 15D----	0-11	5-18	1.40-1.60	2.0-6.0	0.09-0.12	6.6-7.8	Low----------	0.17	5	8	1-3
Krakow	11-16	10-20	1.40-1.60	0.6-2.0	0.08-0.13	6.6-7.8	Low----------	0.24			
	16-60	10-20	1.40-1.60	0.6-2.0	0.06-0.13	7.4-8.4	Low----------	0.28			
16A----------	0-8	5-15	1.35-1.70	2.0-6.0	0.10-0.13	5.1-6.5	Low----------	0.17	5	2	3-7
Iosco	8-32	2-5	1.45-1.60	6.0-20	0.06-0.11	5.1-6.5	Low----------	0.17			
	32-38	15-25	1.55-1.65	0.6-2.0	0.15-0.19	6.6-8.4	Low----------	0.32			
	38-60	8-20	1.30-1.70	0.6-2.0	0.10-0.19	7.9-8.4	Low----------	0.24			
17----------	0-4	---	0.20-0.30	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	5	2	40-60
Roscommon	4-60	0-10	1.45-1.70	6.0-20	0.05-0.09	5.6-8.4	Low----------	0.17			
18----------	0-6	2-15	0.90-1.30	2.0-6.0	0.12-0.17	6.1-7.8	Low----------	0.17	5	2	10-15
Brevort	6-38	2-15	1.40-1.55	2.0-20	0.05-0.11	6.1-8.4	Low----------	0.17			
	38-60	10-27	1.45-1.80	0.2-0.6	0.14-0.22	7.4-8.4	Moderate-----	0.43			
20----------	0-6	8-15	1.15-1.35	2.0-6.0	0.13-0.18	6.1-8.4	Low----------	0.24	3	8	8-12
Hessel	6-28	10-18	1.75-1.80	0.6-2.0	0.07-0.17	7.4-8.4	Low----------	0.24			
	28-50	12-18	1.75-1.95	0.2-0.6	0.04-0.16	7.9-8.4	Low----------	0.24			
	50	---	---	---	---	---	----------	----			
21----------	0-6	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	----------	----	5	2	60-85
Cathro	6-34	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	----------	----			
	34-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	5.6-8.4	Low----------	0.32			
23----------	0-12	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	----------	----	5	7	55-75
Greenwood	12-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	----------	----			
24B, 24C----------	0-10	0-15	1.35-1.60	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.17	5	2	3-4
Melita	10-52	0-15	1.35-1.60	6.0-20	0.04-0.10	5.1-7.3	Low----------	0.17			
	52-60	18-35	1.45-1.70	0.2-0.6	0.14-0.19	6.1-7.8	Low----------	0.32			

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
25A	0-4	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low	0.15	5	1	.5-8
Au Gres	4-30	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low	0.15			
	30-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low	0.15			
28A	0-4	5-18	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.8	Low	0.37	5	5	1-3
Moltke	4-9	2-5	1.40-1.65	0.6-2.0	0.10-0.14	6.1-7.8	Low	0.24			
	9-13	2-18	1.40-1.65	0.6-2.0	0.14-0.19	6.1-7.8	Low	0.24			
	13-33	5-18	1.40-1.65	0.6-2.0	0.17-0.22	6.1-7.8	Low	0.43			
	33-60	2-18	1.40-1.65	0.6-2.0	0.12-0.19	7.4-8.4	Low	0.32			
29	0-10	5-18	0.90-1.30	0.6-2.0	0.20-0.25	7.4-8.4	Low	0.28	5	3	5-15
Glawe	10-60	2-18	1.35-1.65	0.6-2.0	0.10-0.22	7.4-8.4	Low	0.24			
30	0-12	8-20	1.35-1.50	0.6-2.0	0.19-0.22	6.1-7.8	Low	0.28	5	5	1-6
Evart	12-60	0-15	1.40-1.65	6.0-20	0.05-0.10	6.1-8.4	Low	0.15			
31B, 31C, 31E	0-10	0-10	1.35-1.65	2.0-6.0	0.08-0.12	5.1-7.3	Low	0.17	4	2	.5-3
Mancelona	10-12	2-15	1.30-1.65	6.0-20	0.06-0.12	5.6-7.8	Low	0.17			
	12-17	10-25	1.30-1.65	2.0-6.0	0.06-0.16	6.1-7.8	Low	0.17			
	17-60	0-10	1.45-1.65	>20	0.02-0.04	7.4-8.4	Low	0.10			
33A	0-5	10-20	1.30-1.65	2.0-6.0	0.05-0.16	5.6-7.8	Low	0.17	3	8	2-3
Detour	5-26	18-30	1.40-1.80	0.6-2.0	0.10-0.14	6.6-8.4	Low	0.24			
	26-60	18-25	1.80-2.00	0.06-0.2	0.01-0.03	7.4-8.4	Low	0.24			
35A	0-11	0-5	1.25-1.40	6.0-20	0.05-0.10	5.1-7.3	Low	0.15	5	1	.5-3
Ingalls	11-32	3-15	1.35-1.45	6.0-20	0.05-0.10	5.1-7.3	Low	0.17			
	32-60	2-25	1.45-1.80	0.2-0.6	0.09-0.22	5.6-8.4	Low	0.43			
36	0-5	0-8	0.90-1.20	2.0-6.0	0.22-0.32	6.1-7.8	Low	0.17	5	2	10-15
Burleigh	5-26	2-10	1.40-1.55	6.0-20	0.06-0.09	6.1-7.8	Low	0.17			
	26-60	10-28	1.45-1.70	0.2-0.6	0.05-0.20	7.4-8.4	Low	0.43			
37A	0-8	0-12	1.25-1.65	6.0-20	0.08-0.12	5.1-7.8	Low	0.17	4	2	2-4
Gladwin	8-28	2-15	1.35-1.65	6.0-20	0.05-0.11	5.1-7.8	Low	0.17			
	28-36	5-18	1.35-1.65	2.0-6.0	0.05-0.13	5.6-7.8	Low	0.17			
	36-60	0-5	1.35-1.60	>20	0.02-0.04	7.9-8.4	Low	0.10			
38	0-5	10-20	1.20-1.50	0.6-2.0	0.16-0.22	6.1-8.4	Low	0.32	2	5	4-8
Ruse	5-12	10-25	1.50-1.70	0.6-6.0	0.10-0.20	6.1-8.4	Low	0.24			
	12	---	---	---	---	---	---	---			
39B, 39C	0-1	0-10	1.30-1.65	6.0-20	0.07-0.09	3.6-5.5	Low	0.15	5	1	1-3
Grayling	1-25	0-10	1.30-1.65	6.0-20	0.06-0.08	3.6-5.5	Low	0.15			
	25-60	0-10	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	Low	0.15			
40B	0-8	8-20	1.35-1.60	0.6-2.0	0.20-0.24	4.5-7.3	Low	0.37	5	5	1-3
Nunica	8-22	18-35	1.35-1.60	0.2-0.6	0.18-0.22	4.5-7.3	Low	0.37			
	22-60	10-35	1.30-1.60	0.2-2.0	0.14-0.20	5.6-8.4	Low	0.37			
41A	0-7	15-27	1.40-1.70	0.6-2.0	0.20-0.22	5.6-7.8	Low	0.32	4	6	1-3
Bowers	7-9	15-27	1.40-1.70	0.6-2.0	0.16-0.22	5.6-7.3	Low	0.32			
	9-18	35-40	1.45-1.60	0.06-0.2	0.18-0.20	6.1-7.3	Moderate	0.32			
	18-60	30-40	1.50-1.65	0.06-0.6	0.18-0.22	7.4-7.8	Moderate	0.32			
42	0-7	18-27	1.35-1.55	0.6-2.0	0.17-0.25	6.1-7.8	Low	0.32	3	6	2-5
Hettinger	7-15	27-35	1.35-1.55	0.2-0.6	0.18-0.20	6.1-8.4	Low	0.43			
	15-26	27-35	1.40-1.70	0.06-0.2	0.11-0.20	6.1-8.4	Low	0.43			
	26-60	27-50	1.50-1.75	0.06-0.2	0.10-0.20	7.9-8.4	Low	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 erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
43B, 43C, 43E----	0-3	0-10	1.30-1.55	6.0-20	0.04-0.10	4.5-6.5	Low----------	0.15	5	1	.5-2
Graycalm	3-22	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low----------	0.15			
	22-60	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15			
44A----------	0-10	0-5	1.35-1.75	6.0-20	0.07-0.09	4.5-5.5	Low----------	0.15	5	1	1-2
Au Gres	10-12	0-5	1.35-1.75	6.0-20	0.05-0.07	5.1-6.0	Low----------	0.15			
	12-40	0-5	1.45-1.70	6.0-20	0.04-0.06	5.1-6.5	Low----------	0.15			
	40-60	10-25	1.30-1.90	0.2-0.6	0.05-0.21	5.6-6.5	Low----------	0.24			
45B----------	0-6	0-10	1.20-1.65	6.0-20	0.09-0.12	4.5-6.0	Low----------	0.17	5	2	.5-1
Croswell	6-13	0-10	1.35-1.75	6.0-20	0.06-0.10	5.1-6.5	Low----------	0.15			
	13-49	0-5	1.45-1.70	6.0-20	0.04-0.06	5.1-6.5	Low----------	0.15			
	49-60	10-25	1.30-1.90	0.2-0.6	0.05-0.21	5.1-7.8	Low----------	0.24			
47B, 47C, 47D, 47E----------	0-9	5-15	1.20-1.65	6.0-20	0.10-0.12	5.1-7.3	Low----------	0.17	4	2	1-3
Cheboygan	9-22	0-15	1.60-1.75	2.0-6.0	0.06-0.11	5.6-6.5	Low----------	0.15			
	22-28	5-25	1.60-1.75	0.2-0.6	0.12-0.19	5.6-7.3	Low----------	0.28			
	28-60	8-18	1.80-1.95	<0.06	0.02-0.03	7.4-8.4	Low----------	0.28			
48B----------	0-60	1-15	1.50-1.70	2.0-6.0	0.05-0.10	---	Low----------	0.10	5	2	---
Udipsamments	60-80	1-10	1.50-1.70	2.0-6.0	0.04-0.09	---	Low----------	0.02			
49*.											
Beaches											
50.											
Aquents											
51B, 51C, 51E----	0-2	0-8	1.30-1.60	6.0-20	0.05-0.09	5.6-7.3	Low----------	0.15	4	1	.5-2
East Lake	2-31	0-10	1.30-1.60	6.0-20	0.07-0.10	5.6-7.3	Low----------	0.15			
	31-60	0-10	1.50-1.65	>20	0.02-0.06	7.4-8.4	Low----------	0.10			
52A, 52B----------	0-8	10-18	1.30-1.60	0.6-2.0	0.13-0.18	6.6-7.8	Low----------	0.20	5	3	2-3
Hagensville	8-12	10-18	1.35-1.65	0.6-2.0	0.12-0.20	6.6-7.8	Low----------	0.24			
	12-60	10-18	1.55-1.80	0.6-2.0	0.08-0.15	7.4-8.4	Low----------	0.28			
53----------	0-8	8-15	1.15-1.60	2.0-6.0	0.16-0.20	6.1-8.4	Low----------	0.32	3	5	3-12
Hessel	8-12	10-27	1.75-1.80	0.6-2.0	0.07-0.17	7.4-8.4	Low----------	0.24			
	12-60	12-18	1.75-1.95	0.2-0.6	0.04-0.16	7.9-8.4	Low----------	0.24			
55B----------	0-5	8-18	1.30-1.60	2.0-6.0	0.13-0.17	6.1-7.8	Low----------	0.20	3	8	1-3
Johnswood	5-13	8-30	1.35-1.70	0.6-2.0	0.04-0.12	6.1-7.8	Low----------	0.24			
	13-60	10-25	1.80-2.10	0.06-0.2	0.02-0.06	7.9-8.4	Low----------	0.24			
56C*:											
Deer Park-------	0-8	0-10	1.30-1.55	6.0-20	0.04-0.07	5.1-6.0	Low----------	0.15	5	1	.5-1
	8-28	0-10	1.40-1.60	6.0-20	0.03-0.06	5.1-6.5	Low----------	0.15			
	28-60	0-10	1.40-1.55	6.0-20	0.03-0.05	5.1-6.5	Low----------	0.15			
Croswell--------	0-10	0-10	1.30-1.55	6.0-20	0.06-0.09	3.6-6.5	Low----------	0.15	5	1	.5-2
	10-33	0-10	1.40-1.60	6.0-20	0.06-0.10	4.5-7.3	Low----------	0.15			
	33-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-8.4	Low----------	0.15			
Au Gres---------	0-4	0-8	1.30-1.55	6.0-20	0.07-0.10	3.6-7.3	Low----------	0.15	5	1	.5-8
	4-30	1-15	1.50-1.70	6.0-20	0.06-0.09	4.5-7.3	Low----------	0.15			
	30-60	0-8	1.50-1.70	6.0-20	0.05-0.07	5.1-7.3	Low----------	0.15			

See footnote at end of table.

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
57A, 57B--------- Grace	0-9 9-16 16-36 36-60	5-18 2-18 5-18 2-18	1.35-1.55 1.40-1.55 1.40-1.55 1.45-1.55	0.6-2.0 0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.22 0.11-0.19 0.17-0.22 0.07-0.22	6.1-7.3 6.1-8.4 6.1-8.4 7.4-8.4	Low---------- Low---------- Low---------- Low----------	0.37 0.43 0.43 0.32	5	3	1-3
58B, 58C--------- Kalkaska	0-8 8-10 10-38 38-60	0-10 0-15 0-10 0-10	1.25-1.45 1.35-1.45 1.35-1.45 1.35-1.50	6.0-20 6.0-20 6.0-20 6.0-20	0.05-0.09 0.06-0.08 0.06-0.08 0.04-0.06	3.6-6.0 3.6-6.0 4.5-6.0 4.5-6.5	Low---------- Low---------- Low---------- Low----------	0.15 0.15 0.15 0.15	5	1	1-4
59*: Aquents. Histosols.											
60B, 60C, 60E---- Deer Park	0-8 8-28 28-60	0-10 0-10 0-10	1.30-1.55 1.40-1.60 1.40-1.55	6.0-20 6.0-20 6.0-20	0.04-0.07 0.03-0.06 0.03-0.05	5.1-6.0 5.1-6.5 5.1-6.5	Low---------- Low---------- Low----------	0.15 0.15 0.15	5	1	.5-1
62--------------- Dawson	0-4 4-24 24-60	--- --- 0-10	0.15-0.30 0.15-0.40 1.55-1.75	>6.0 0.2-6.0 6.0-20	0.55-0.65 0.35-0.45 0.03-0.10	3.6-4.4 3.6-4.4 4.5-6.5	---------- ---------- Low----------	---- ---- 0.15	4	7	65-85
63*. Pits, borrow											
64A-------------- Ensign	0-4 4-15 15	15-20 10-25 ---	1.30-1.40 1.40-1.70 ---	0.6-2.0 0.6-2.0 ---	0.14-0.17 0.13-0.17 ---	6.1-7.8 6.1-8.4 ---	Low---------- Low---------- ----------	0.24 0.24 ----	2	8	2-3
65--------------- Wheatley	0-6 6-30 30-60	--- 2-10 0-10	0.30-0.40 1.45-1.70 1.55-1.70	0.2-6.0 6.0-20 >20	0.35-0.45 0.06-0.08 0.02-0.04	6.1-7.8 6.1-8.4 7.4-8.4	Low---------- Low---------- Low----------	---- 0.15 0.10	3	2	40-70
66C-------------- Wallace	0-9 9-39 39-60	0-8 2-10 0-8	1.35-1.45 1.75-2.05 1.45-1.60	6.0-20 0.2-0.6 6.0-20	0.05-0.12 0.02-0.04 0.04-0.05	4.5-5.5 4.5-6.0 5.1-6.5	Low---------- Low---------- Low----------	0.15 0.15 0.15	1	1	1-3
67B-------------- Eastport	0-3 3-35 35-60	0-10 0-10 0-4	1.40-1.60 1.40-1.60 1.40-1.55	6.0-20 6.0-20 6.0-20	0.07-0.09 0.06-0.08 0.03-0.06	4.5-7.3 5.1-7.8 6.6-8.4	Low---------- Low---------- Low----------	0.15 0.15 0.15	5	1	1-2
69A-------------- Winterfield	0-6 6-21 21-60	0-15 0-15 0-10	0.90-1.50 1.45-1.60 1.55-1.65	2.0-6.0 6.0-20 6.0-20	0.10-0.12 0.06-0.11 0.04-0.10	5.6-7.8 5.6-7.8 5.6-8.4	Low---------- Low---------- Low----------	0.17 0.17 0.17	5	2	1-3
70A*: Au Gres--------- Roscommon------- 71*: Roscommon-------	0-4 4-30 30-60 0-4 4-60 0-4 4-60	0-8 1-15 0-8 --- 0-10 --- 0-10	1.30-1.55 1.50-1.70 1.50-1.70 0.20-0.30 1.45-1.70 0.20-0.30 1.45-1.70	6.0-20 6.0-20 6.0-20 0.2-6.0 6.0-20 0.2-6.0 6.0-20	0.07-0.10 0.06-0.09 0.05-0.07 0.35-0.45 0.05-0.09 0.35-0.45 0.05-0.09	3.6-7.3 4.5-7.3 5.1-7.3 5.6-7.8 5.6-8.4 5.6-7.8 5.6-8.4	Low---------- Low---------- Low---------- ---------- Low---------- ---------- Low----------	0.15 0.15 0.15 ---- 0.17 ---- 0.17	5 5 5	1 2 2	.5-8 40-60 40-60

See footnote at end of table.

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
71*:											
Tawas	0-8	---	0.30-0.55	0.2-6.0	0.35-0.45	4.5-7.8	---	---	4	2	40-60
	8-18	---	0.30-0.55	0.2-6.0	0.24-0.45	4.5-7.8	---	---			
	18-60	0-10	1.40-1.65	6.0-20	0.03-0.10	5.6-8.4	Low	0.15			
73A, 73B, 73C	0-8	5-15	1.20-1.60	2.0-6.0	0.11-0.15	6.1-7.8	Low	0.24	3	3	1-2
Omena	8-13	8-18	1.40-1.70	0.6-2.0	0.10-0.15	6.1-7.8	Low	0.28			
	13-60	5-15	1.50-1.80	2.0-6.0	0.08-0.12	7.4-8.4	Low	0.24			
73C2	0-8	5-15	1.20-1.60	2.0-6.0	0.11-0.15	6.1-7.8	Low	0.24	3	3	1-2
Omena	8-10	8-18	1.40-1.70	0.6-2.0	0.10-0.15	6.1-7.8	Low	0.28			
	10-60	5-15	1.50-1.80	2.0-6.0	0.08-0.12	7.4-8.4	Low	0.24			
73D	0-8	5-15	1.20-1.60	2.0-6.0	0.11-0.15	6.1-7.8	Low	0.24	3	3	1-2
Omena	8-11	8-18	1.40-1.70	0.6-2.0	0.10-0.15	6.1-7.8	Low	0.28			
	11-60	5-15	1.50-1.80	2.0-6.0	0.08-0.12	7.4-8.4	Low	0.24			
73D3	0-8	5-15	1.20-1.60	2.0-6.0	0.11-0.15	6.1-7.8	Low	0.24	3	3	1-2
Omena	8-60	5-15	1.50-1.80	2.0-6.0	0.08-0.12	7.4-8.4	Low	0.24			
75	0-8	2-10	1.00-1.20	6.0-20	0.09-0.11	5.6-7.8	Low	0.15	4	1	10-15
Pinconning	8-32	2-12	1.40-1.55	6.0-20	0.06-0.11	6.1-7.8	Low	0.17			
	32-60	35-60	1.50-1.70	<0.2	0.08-0.12	7.4-8.4	High	0.32			
76A	0-8	0-10	1.25-1.40	6.0-20	0.07-0.09	4.5-7.3	Low	0.15	4	1	1-3
Allendale	8-24	0-15	1.35-1.45	6.0-20	0.06-0.10	4.5-7.3	Low	0.17			
	24-60	40-60	1.45-1.70	<0.06	0.08-0.12	6.1-8.4	Moderate	0.32			
81B	0-5	0-10	1.30-1.55	6.0-20	0.05-0.07	3.6-6.5	Low	0.10	5	8	.5-2
Croswell	5-36	0-10	1.40-1.60	6.0-20	0.04-0.09	4.5-7.3	Low	0.10			
	36-60	0-10	1.50-1.65	6.0-20	0.05-0.07	5.1-8.4	Low	0.15			
83B*:											
Kiva	0-7	10-18	1.20-1.60	0.6-2.0	0.10-0.15	6.1-7.8	Low	0.24	3	3	.5-2
	7-22	10-18	1.30-1.60	0.6-2.0	0.09-0.19	6.1-7.8	Low	0.28			
	22-60	0-5	1.50-1.70	>20	0.02-0.04	7.9-8.4	Low	0.10			
Alpena	0-8	5-15	1.25-1.55	2.0-20	0.05-0.14	6.6-7.8	Low	0.10	2	8	2-4
	8-60	0-10	1.25-1.65	>20	0.02-0.04	7.9-8.4	Low	0.10			
84*.											
Pits, quarry											
85A	0-4	5-10	1.25-1.55	2.0-20	0.08-0.13	6.6-7.8	Low	0.17	2	8	1-3
Esau	4-10	2-10	1.25-1.55	2.0-20	0.02-0.09	7.9-8.4	Low	0.17			
	10-60	0-5	1.25-1.65	>20	0.02-0.03	7.9-8.4	Low	0.10			
86F*:											
Udorthents	0-60	2-18	1.50-1.70	0.6-6.0	0.08-0.14	6.6-9.0	Low	0.24	5	3	<1
	60-80	---	---	---	---	---	---	---			
Udipsamments	0-60	1-15	1.50-1.70	2.0-6.0	0.05-0.10	---	Low	0.10	5	2	---
	60-80	1-10	1.50-1.70	2.0-6.0	0.04-0.09	---	Low	0.02			
87C	0-60	2-18	1.50-1.70	0.6-6.0	0.08-0.14	6.6-9.0	Low	0.24	5	3	<1
Udorthents	60-80	---	---	---	---	---	---	---			

See footnote at end of table.

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
89B----------	0-6	0-10	1.30-1.60	6.0-20	0.07-0.09	4.5-6.5	Low----------	0.15	4	1	1-3
Ocqueoc	6-31	0-15	1.30-1.60	6.0-20	0.06-0.12	4.5-6.5	Low----------	0.15			
	31-60	10-27	1.50-1.80	0.2-0.6	0.05-0.21	5.6-7.8	Low----------	0.37			
90B----------	0-10	0-10	1.27-1.56	6.0-20	0.07-0.09	4.5-6.5	Low----------	0.15	5	1	1-2
Zimmerman	10-60	0-12	1.60-1.70	6.0-20	0.06-0.10	6.1-7.3	Low----------	0.17			
91B----------	0-8	5-15	1.30-1.60	2.0-6.0	0.08-0.12	6.6-7.8	Low----------	0.17	2	8	1-3
Alpena	8-44	0-10	1.45-1.65	>20	0.02-0.04	7.9-8.4	Low----------	0.10			
	44	---	---	---	---	---	----------	----			
92----------	0-4	---	0.10-0.35	2.0-6.0	0.35-0.45	3.6-5.0	----------	----	5	2	>50
Kinross	4-22	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			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
2---------- Lupton	A/D	None	---	---	+1-1.0	Apparent	Sep-May	>60	---	High	High	Low.
3---------- Tawas	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
4B, 4C---------- Klacking	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
5B, 5C, 5E-------- Rubicon	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
6B, 6C---------- Alpena	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
7A---------- Emmet	B	None	---	---	2.5-6.0	Apparent	Nov-May	>60	---	Moderate	Low	Moderate.
7B, 7C, 7C2, 7D, 7E---------- Emmet	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
8A---------- Onaway	B	None	---	---	2.5-6.0	Apparent	Nov-May	>60	---	Moderate	Low	Moderate.
8B, 8C, 8C2, 8D, 8E---------- Onaway	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
9B, 9C---------- Summerville	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	Low	Low.
10B, 10C---------- Cunard	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Low.
11A---------- Alstad	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	Moderate	Moderate.
12A---------- Bonduel	C	None	---	---	1.0-3.0	Apparent	Sep-Jun	20-40	Hard	High	Moderate	Low.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
13B---------- Croswell	A	None--------	---	---	2.0-4.0	Apparent	Nov-May	>60	---	Low------	Low------	Moderate.
14B---------- Menominee	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
15B, 15C, 15D----- Krakow	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
16A---------- Iosco	B	None--------	---	---	1.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Low.
17---------- Roscommon	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	Moderate	High-----	Low.
18---------- Brevort	B/D	None--------	---	---	+1-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
20---------- Hessel	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>40	Hard	High-----	High-----	Low.
21---------- Cathro	A/D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
23---------- Greenwood	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	High.
24B, 24C---------- Melita	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
25A---------- Au Gres	B	None--------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low------	Moderate.
28A---------- Moltke	B	None--------	---	---	0.5-1.5	Apparent	Oct-May	>60	---	High-----	High-----	Low.
29---------- Glawe	B/D	None--------	---	---	+1-1.0	Apparent	Oct-May	>60	---	High-----	High-----	Low.
30---------- Evart	D	Frequent----	Brief to long.	Nov-Jun	0-1.0	Apparent	Jan-Dec	>60	---	Moderate	High-----	Low.
31B, 31C, 31E----- Mancelona	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
33A---------- Detour	B	None--------	---	---	0.5-2.0	Perched	Nov-May	>60	---	High-----	High-----	Low.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
35A---------- Ingalls	B	None---------	---	---	0.5-1.5	Perched	Nov-May	>60	---	Moderate	Moderate	Moderate.
36---------- Burleigh	A/D	None---------	---	---	+1-1.0	Perched	Oct-May	>60	---	Moderate	High-----	Low.
37A---------- Gladwin	A	None---------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low------	Low.
38---------- Ruse	D	None---------	---	---	+1-1.0	Apparent	Nov-May	10-20	Hard	High-----	High-----	Low.
39B, 39C---------- Grayling	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
40B---------- Nunica	C	None---------	---	---	3.0-5.0	Apparent	Nov-May	>60	---	High-----	Moderate	Low.
41A---------- Bowers	C	None---------	---	---	1.0-2.0	Apparent	Nov-Apr	>60	---	High-----	High-----	Low.
42---------- Hettinger	C/D	None---------	---	---	+1-1.0	Perched	Nov-May	>60	---	High-----	High-----	Low.
43B, 43C, 43E----- Graycalm	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
44A---------- Au Gres	B	None---------	---	---	1.0-2.0	Perched	Nov-May	>60	---	Low------	Low------	Moderate.
45B---------- Croswell	A	None---------	---	---	2.5-5.0	Perched	Nov-May	>60	---	Low------	Low------	Moderate.
47B, 47C, 47D, 47E---------- Cheboygan	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
48B---------- Udipsamments	A	None---------	---	---	>6.0	---	---	>60	---	---	---	---
49* Beaches												
50. Aquents												
51B, 51C, 51E----- East Lake	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
52A, 52B---------- Hagensville	C	None---------	---	---	0.5-2.0	Apparent	Nov-May	>60	---	High-----	Moderate	Low.
53---------- Hessel	B/D	None---------	---	---	+1-1.0	Apparent	Nov-Jun	>40	Hard	High-----	High-----	Low.
55B---------- Johnswood	B	None---------	---	---	1.0-2.0	Perched	Oct-May	>60	---	Moderate	Moderate	Low.
56C*:												
Deer Park--------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Croswell---------	A	None---------	---	---	2.0-4.0	Apparent	Nov-May	>60	---	Low------	Low------	Moderate.
Au Gres----------	B	None---------	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low------	Moderate.
57A---------- Grace	B	None---------	---	---	3.0-5.0	Apparent	Oct-May	>60	---	High-----	Moderate	Low.
57B---------- Grace	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
58B, 58C---------- Kalkaska	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	High.
59*:												
Aquents----------	D	None---------	---	---	+2-1.0	Apparent	Jan-Dec	>60	---	---	---	---
Histosols--------	D	None---------	---	---	+2-1.0	Apparent	Jan-Dec	>60	---	---	---	---
60B, 60C, 60E----- Deer Park	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
62---------- Dawson	A/D	None---------	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	High-----	High-----	High.
63*. Pits, borrow												
64A---------- Ensign	D	None---------	---	---	0.5-1.0	Apparent	Nov-May	10-20	Hard	High-----	High-----	Low.
65---------- Wheatley	A/D	None---------	---	---	+1-1.0	Apparent	Oct-May	>60	---	Moderate	High-----	Low.

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
66C---------- Wallace	B	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
67B---------- Eastport	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
69A---------- Winterfield	A/D	Frequent	Brief	Nov-May	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low	Low.
70A*:												
Au Gres----------	B	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low	Moderate.
Roscommon--------	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	Moderate	High	Low.
71*:												
Roscommon--------	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	Moderate	High	Low.
Tawas----------	A/D	None	---	---	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
73A, 73B, 73C, 73C2, 73D, 73D3-- Omena	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
75---------- Pinconning	B/D	None	---	---	+1-1.0	Perched	Oct-May	>60	---	Moderate	High	Moderate.
76A---------- Allendale	B	None	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High	Moderate.
81B---------- Croswell	A	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	Low	Low	Moderate.
83B*:												
Kiva----------	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Alpena----------	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
84*. Pits, quarry												
85A---------- Esau	A	None	---	---	0.5-1.5	Apparent	Nov-May	>60	---	Moderate	Low	Low.
86F*:												
Udorthents-------	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.

See footnote at end of table.

TABLE 19.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
86F*:												
Udipsamments	A	None	---	---	>6.0	---	---	>60	---	---	---	---
87C Udorthents	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
89B Ocqueoc	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
90B Zimmerman	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
91B Alpena	A	None	---	---	>6.0	---	---	>40	Hard	Low	Low	Low.
92 Kinross	A/D	None	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	Moderate	High	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Allendale	Sandy over clayey, mixed, frigid Alfic Haplaquods
Alpena	Sandy-skeletal, mixed Udorthentic Haploborolls
*Alstad	Fine-loamy, mixed Glossaquic Eutroboralfs
Aquents	Mixed, nonacid, frigid Aquents
Au Gres	Sandy, mixed, frigid Entic Haplaquods
*Bonduel	Fine-loamy, mixed Aquic Eutroboralfs
*Bowers	Fine, mixed Aquic Eutroboralfs
Brevort	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
Burleigh	Sandy over loamy, mixed, nonacid, frigid Mollic Haplaquents
Cathro	Loamy, mixed, euic Terric Borosaprists
Cheboygan	Coarse-loamy, mixed, frigid Alfic Haplorthods
Croswell	Sandy, mixed, frigid Entic Haplorthods
Cunard	Coarse-loamy, mixed Typic Eutroboralfs
Dawson	Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists
Deer Park	Mixed, frigid Spodic Udipsamments
Detour	Fine-loamy, mixed, frigid Aquic Eutrochrepts
East Lake	Sandy, mixed, frigid Entic Haplorthods
*Eastport	Mixed, frigid Spodic Udipsamments
Emmet	Coarse-loamy, mixed Typic Eutroboralfs
*Ensign	Loamy, mixed, nonacid, frigid Lithic Haplaquepts
Esau	Sandy-skeletal, mixed, frigid Aquic Udorthents
Evart	Sandy, mixed, frigid Fluvaquentic Haplaquolls
Gladwin	Sandy, mixed, frigid Alfic Haplaquods
Glawe	Coarse-silty, mixed (calcareous), frigid Typic Haplaquolls
Grace	Coarse-silty, mixed Typic Eutroboralfs
Graycalm	Mixed, frigid Alfic Udipsamments
Grayling	Mixed, frigid Typic Udipsamments
Greenwood	Dysic Typic Borohemists
Hagensville	Coarse-loamy, mixed Aquic Haploborolls
Hessel	Coarse-loamy, mixed (calcareous), frigid Typic Haplaquolls
Hettinger	Fine-loamy, mixed, nonacid, frigid Mollic Haplaquepts
Histosols	Euic, frigid Histosols
Ingalls	Sandy over loamy, mixed, frigid Entic Haplaquods
Iosco	Sandy over loamy, mixed, frigid Alfic Haplaquods
Johnswood	Loamy-skeletal, mixed Udic Argiborolls
*Kalkaska	Sandy, mixed, frigid Typic Haplorthods
Kinross	Sandy, mixed, frigid Typic Haplaquods
Kiva	Sandy, mixed, frigid Entic Haplorthods
Klacking	Coarse-loamy, mixed Psammentic Eutroboralfs
Krakow	Loamy-skeletal, mixed Typic Eutroboralfs
Lupton	Euic Typic Borosaprists
Mancelona	Sandy, mixed, frigid Alfic Haplorthods
Melita	Sandy, mixed, frigid Alfic Haplorthods
Menominee	Sandy over loamy, mixed, frigid Alfic Haplorthods
Moltke	Coarse-silty, mixed Aquic Eutroboralfs
Nunica	Fine-silty, mixed Eutric Glossoboralfs
Ocqueoc	Sandy over loamy, mixed, frigid Entic Haplorthods
Omena	Coarse-loamy, mixed Typic Eutroboralfs
Onaway	Fine-loamy, mixed Typic Eutroboralfs
Pinconning	Sandy over clayey, mixed, nonacid, frigid Mollic Haplaquents
*Roscommon	Mixed, frigid Mollic Psammaquents
Rubicon	Sandy, mixed, frigid Entic Haplorthods
Ruse	Loamy, mixed, nonacid, frigid Lithic Haplaquepts
*Summerville	Loamy, mixed, frigid Lithic Eutrochrepts
Tawas	Sandy or sandy-skeletal, mixed, euic Terric Borosaprists
Udipsamments	Mixed, frigid Udipsamments
Udorthents	Loamy, mixed, nonacid, frigid Udorthents
Wallace	Sandy, mixed, frigid, ortstein Typic Haplorthods
Wheatley	Mixed, frigid Mollic Psammaquents
Winterfield	Mixed, frigid Aquic Udipsamments
Zimmerman	Mixed, frigid Alfic Udipsamments

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