United States Department of Agriculture

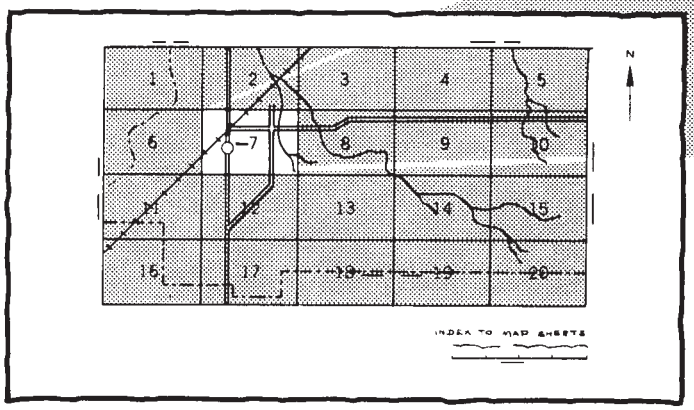
Soil Conservation Service

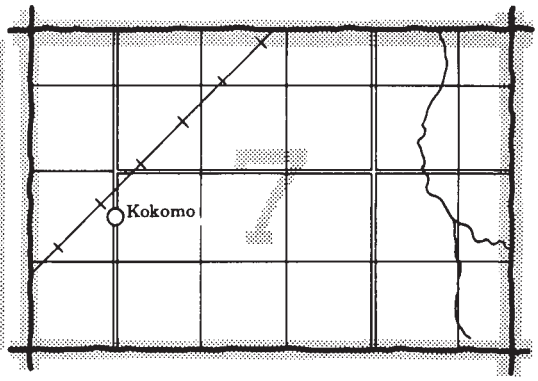
In cooperation with the Michigan Agricultural Experiment Station

Soil Survey of Mecosta County Michigan

HOW TO USE

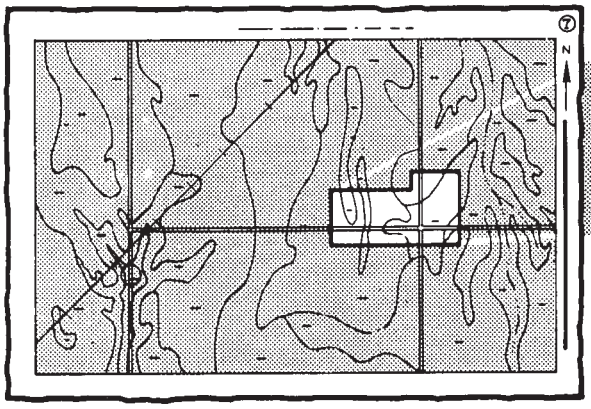
1. Locate your area of interest on the "Index to Map Sheets"

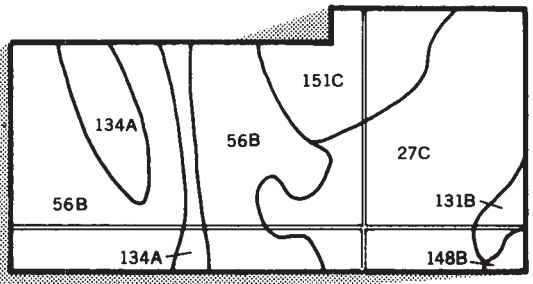




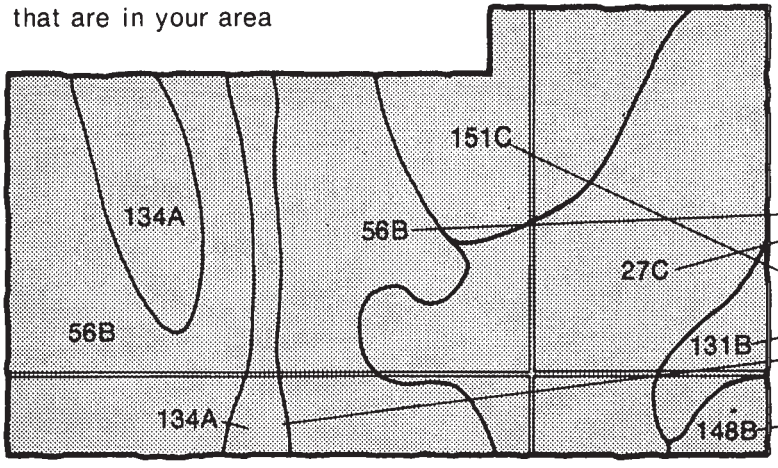
2. Note the number of the map sheet and turn to that sheet.

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





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

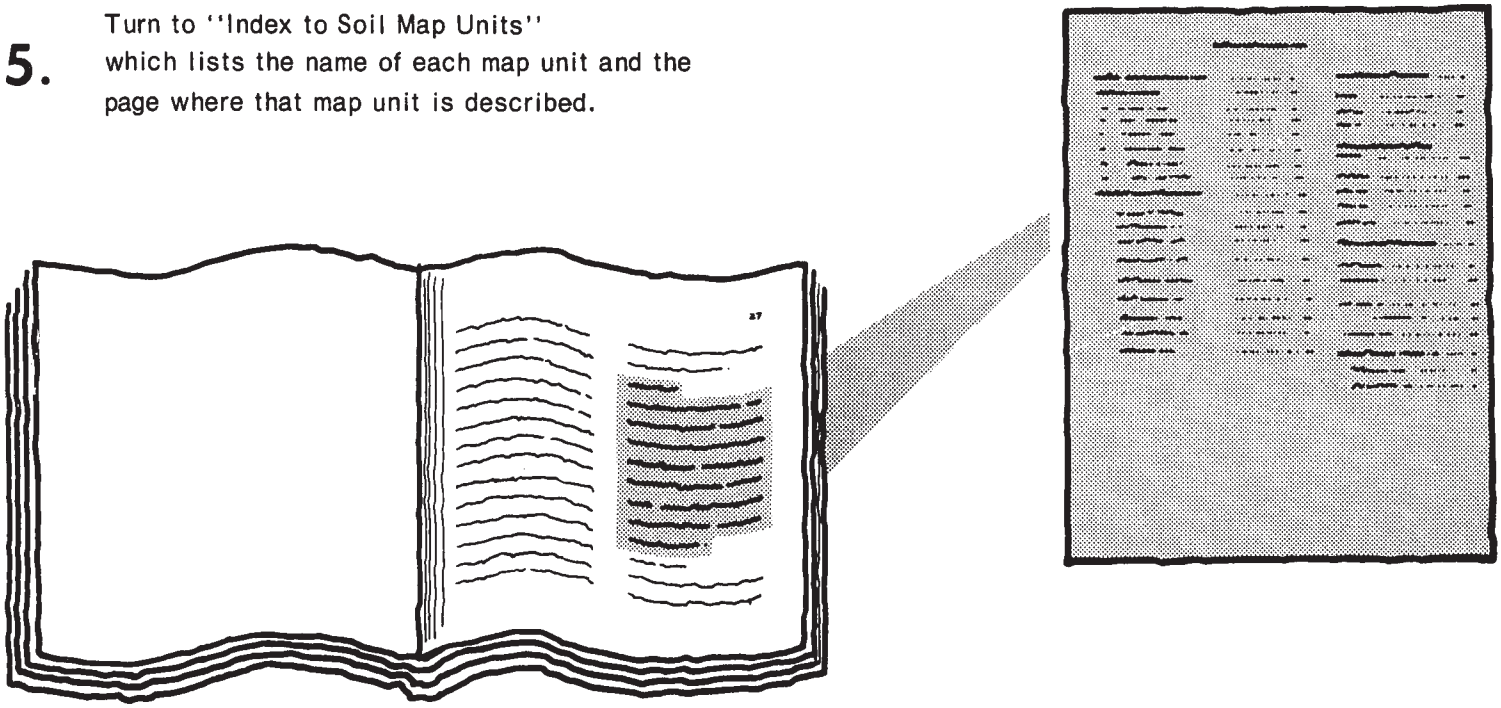


Symbols

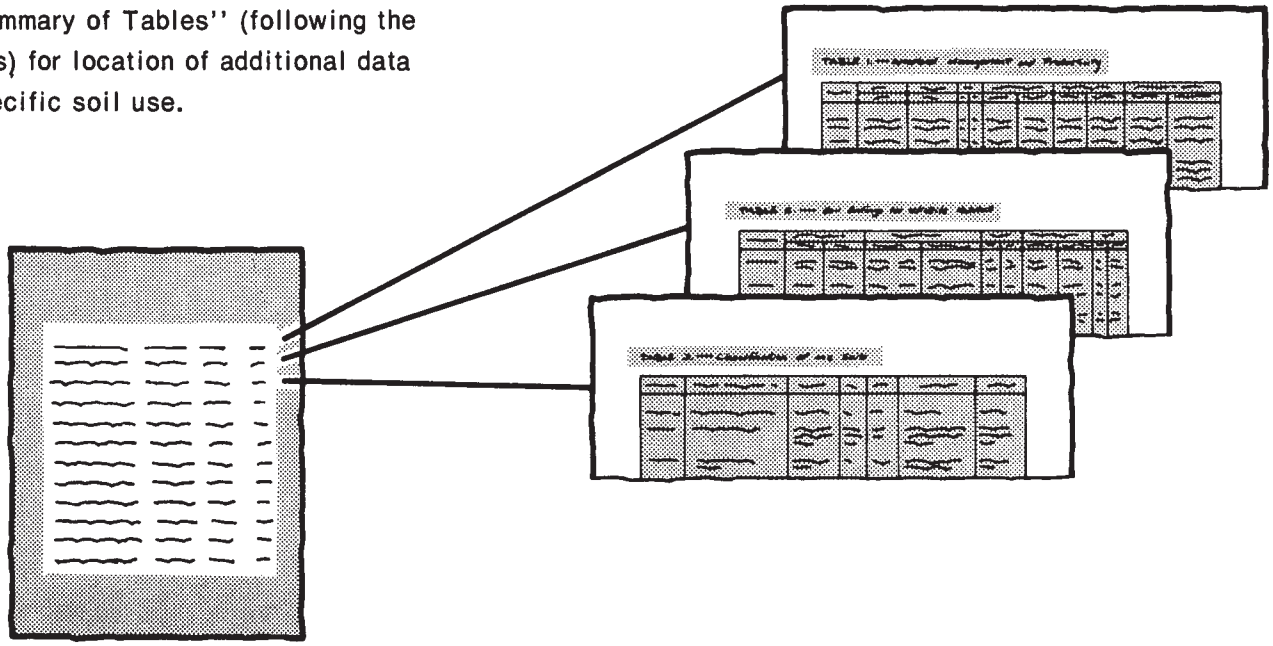
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1977-81. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station. It is part of the technical assistance furnished to the Mecosta County Soil Conservation District. Financial assistance was provided by the Mecosta 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.

Cover: Pond in Ithaca soils. Perrinton soils are on the higher slopes in the background.

Contents

Soil Series

Issued May 1984

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Mecosta County, Michigan. 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, ranchers, 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 insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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

Homer R Hilner

Homer Hilner
State Conservationist
Soil Conservation Service

Location of Mecosta County in Michigan.

Soil Survey of
Mecosta County, Michigan

By Paul G. Corder, Soil Conservation Service

Fieldwork by Paul G. Corder, Soil Conservation Service;
William Hogan, Donald Jossie, Bruce D. Knapp, and
Paul L. Wernette, Mecosta County; and
Larry Perreault, Michigan Department of Agriculture

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

Mecosta County is in the west-central part of Michigan, bordering Newaygo County on the west, Osceola County on the north, Isabella County on the east, and Montcalm County on the south. It has an area of 560 square miles, or 358,400 acres. Big Rapids, the county seat, is in the northwestern part of the county. The population of Mecosta County in 1978 was about 36,400.

Most of Mecosta County is undulating to steep moraines and has nearly level to gently rolling outwash plains along the major rivers. There are numerous lakes and streams. The Muskegon River is the largest in the county.

Farming is the main economic enterprise in the county. The growing season is about 15 days longer in the southeastern part of Mecosta County than in the northwestern part. Dairy farms are scattered throughout the county. The dominant agricultural areas are along the southern and eastern townships. The major crops are hay, corn, wheat, oats, dry beans, and potatoes.

The manufacture of shoes is the major industry. The smaller industries include machine shops and logging.

There are about 33 soil series in Mecosta County. The soils range widely in texture, natural drainage, slope, and other characteristics. Droughtiness, wetness, and undulating to rolling slopes are major limitations to the use of many of these soils. The application of several conservation practices at one time is often necessary to protect the cropland. Wind stripcropping, cover crops, conservation cropping systems, tile drainage, grassed waterways, and crop residue management commonly are used.

The first soil survey of Mecosta County was published in 1927. This survey updates the first survey and provides additional information and larger maps that show the soils in greater detail (*8*).

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of climate changes, better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey area.

General Nature of the Survey Area

This section gives general information about the county. It discusses climate, history and development, farming, industry and transportation, geology, and lakes and streams.

Climate

Prepared by the Michigan Department of Agriculture, Weather Service, East Lansing, Michigan.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Big Rapids in the period 1949 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 22.3 degrees F, and the average daily minimum temperature is 13.8 degrees. The lowest temperature on record, which occurred at Big Rapids on February 11, 1899, is -36 degrees. In summer the average temperature is 67.0

degrees, and the average daily maximum temperature is 79.8 degrees. The highest recorded temperature, which occurred at Big Rapids on July 30, 1916, is 103 degrees.

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

The average annual precipitation is 32.23 inches. Of this, 18.67 inches, or 58 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15.4 inches. The heaviest 1-day rainfall during the period of record was 4.55 inches at Big Rapids on August 31, 1975. Thunderstorms occur on about 36 days each year, and most occur in June and July.

The average seasonal snowfall is 70.4 inches. The greatest snow depth at any one time during the period of record was 45 inches in February 1936. On an average of 93 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The heaviest 1-day snowfall on record was more than 16.0 inches on January 30, 1947. The greatest seasonal snowfall was 115.3 inches during the 1951-52 season. The least seasonal snowfall was 32.0 inches during the 1944-45 season.

Based on observations taken at Grand Rapids, the average relative humidity in midafternoon is about 63 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 32 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11.6 miles per hour, in January.

History and Development

Edward Rivard, district conservationist, Soil Conservation Service, assisted in writing this section.

Mecosta County, along with the county seat at Big Rapids, was established on February 11, 1859 by the Senate and House of Representatives of the State of Michigan.

John Parish, the first settler on record in Mecosta County, lived at a site along the Muskegon River later known as the village of Paris. In the fall of 1856, before many settlers arrived in the county, a sawmill was erected and lumbering was begun. The first flour mill was built in 1866. The first school started in May 1858 in Green Township.

The Grand Rapids and Indiana Road, now Highway 131, reached Morley on October 11, 1869, but did not come through to Big Rapids until October 10, 1870, when it was formally opened from Fort Wayne to Paris. The other two roads in the county were the Chicago and West Michigan, completed to Big Rapids in July 1873, and the Detroit, Lansing, and Northern, completed in the spring of 1880. These two roads west and east are now known as Pere Marquette.

Early in March 1874, an agricultural society was formed to develop and promote the agricultural and mechanical interests of Mecosta County. The society held the first fair to exhibit what was raised or made in the county (*4*).

Farming

According to the U.S. Census of Agriculture (*13*), about 35.1 percent of the survey area, or 125,866 acres, was farmland in 1974. The rest consisted mainly of privately owned woodland, State and Federal land, abandoned farmland, recreation land, and resorts. In 1977, 7,655 acres was irrigated (*3*).

In 1974, 673 farms were in the county. Of this total, 102 ranged from 1 to 49 acres; 309, from 50 to 179 acres; 230, from 180 to 499 acres; 27, from 500 to 999 acres; and 4, from 1,000 to 1,999 acres. One farm took in more than 2,000 acres.

Industry and Transportation

A local shoe factory employs more people than any other industry or institution except Ferris State College. Businesses such as the gas, telephone, paving, and electronics companies and machine shops employ a part of the county's population.

Transportation is by air, railroads, and highways. Roben-Hood airport is located at Big Rapids. One major railroad extends north and south through the western one-third of the county. Another railroad begins at Remus, in the southeastern part of the county, and extends southeast out of the county. The two major highways in Mecosta County are U.S. Highway 131 and State Highway 20, both of which have two lanes. A new four-lane U.S. Highway 131 is being constructed. The part of the new road that extends from the south county line to a point about one-third of the way through the county has been in use since 1980. The unrenovated U.S. Highway 131 remains in use.

Geology

Mecosta County was completely covered by a series of glaciers during the Pleistocene Epoch. These glaciers left deposits 450 to 825 feet thick on the original bedrock of shale and limestone. The present topography and soil material resulted mainly from the glacial deposits of the Wisconsin Glacier, which was the last glacier to cover this area and which melted 12,000 to 10,000 years ago.

The Wisconsin Glacier had two lobes which affected Mecosta County. The Saginaw Lobe to the east and the Lake Michigan Lobe to the west came together where the Muskegon River is today. As these two lobes melted, they left undulating to sloping moraines throughout most of the county. The water flowing from those lobes formed an outwash plain about 2 or 3 miles wide. The Muskegon River is in this outwash plain. Another outwash plain was formed by water from the Saginaw Lobe. The Little Muskegon River and the Chippewa River are in this 1- to 6-mile-wide plain.

Lakes and Streams

Mecosta County has 322 natural lakes and ponds covering about 3,990 acres (*5*).

The largest lakes are found in Martiny, Morton, and Chippewa Townships. These three townships also have the largest area of water surface.

The major rivers in the county are the Muskegon River, flowing north to south through the western one-third of the county, and the Little Muskegon River, in the south-central part. Every township has a creek meandering through it.

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. 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 underlying material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

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

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

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

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

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

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

and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

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

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils 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 broad areas called soil associations that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil 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 other units 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 soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Perrinton-Coloma-Ithaca Association

Nearly level to steep, well drained, somewhat excessively drained, and somewhat poorly drained, loamy and sandy soils that formed in glacial till or outwash deposits

This association makes up about 10 percent of the survey area. It is about 30 percent Perrinton and similar soils, 15 percent Coloma and similar soils, and 10 percent Ithaca and similar soils. The remaining 45 percent is soils of minor extent (fig. 1).

Perrinton soils are undulating to steep and well drained. Typically, the surface layer is dark brown loam about 8 inches thick. The next layer is mixed brown silty clay loam and silt loam about 5 inches thick. The subsoil, about 17 inches thick, is brown clay and silty clay. The substratum to a depth of about 60 inches is brown, calcareous silty clay.

Coloma soils are nearly level to steep and somewhat excessively drained. Typically, the surface layer is brown sand about 10 inches thick. The next layer is yellowish brown and brownish yellow sand about 29 inches thick. The next layer to a depth of about 60 inches is light yellowish brown sand with bands of strong brown loamy sand.

Ithaca soils are nearly level or undulating and somewhat poorly drained. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The brown, mottled subsoil is about 19 inches thick. The upper part is mixed clay and sandy loam, and the lower part is clay. The substratum to a depth of about 60 inches is brown, mottled, calcareous clay.

The minor soils in this map unit are in the Tustin, Aubbeenaubbee, Covert, and Houghton series. The well drained Tustin soils and the somewhat poorly drained Aubbeenaubbee soils are in depressions and along drainageways, the moderately well drained Covert soils are in depressions, and the very poorly drained Houghton soils are in the very wet depressions.

Most areas of the soils in this association are in cropland or are idle. Some areas are in woodland.

The soils in this association range from well suited to generally not suited to cropland or pasture. The major management concerns are the droughtiness of the sandy soils and the susceptibility of those soils to soil blowing. In areas of the other soils, erosion, tilth, and the need for tile drainage are concerns. In some areas, drainage outlets are not available for wet soils. Steepness of slope limits the operation of machinery on the rolling to steep soils. Erosion and soil blowing are management concerns if the soils are cultivated.

The soils in this association are well suited to woodland. The major management concerns are seedling mortality on the sandy soils, erosion hazard on the steeper soils, and equipment limitations on the hilly and steep soils and wet soils.

The soils in this association range from suited to generally not suited to building site development and septic tank absorption fields. The nearly level or undulating sandy soils are suited. In areas of the loamy soils in this association, moderately slow permeability and wetness are limitations for septic tank absorption fields and wetness or shrink-swell potential are limitations for buildings. Slope is a limitation for most uses on the gently rolling to steep soils.

2. Coloma Association

Nearly level to steep, somewhat excessively drained, sandy soils that formed in glacial till or outwash deposits

This association makes up about 27 percent of the survey area. It is about 65 percent Coloma and similar soils and 35 percent soils of minor extent (fig. 2).

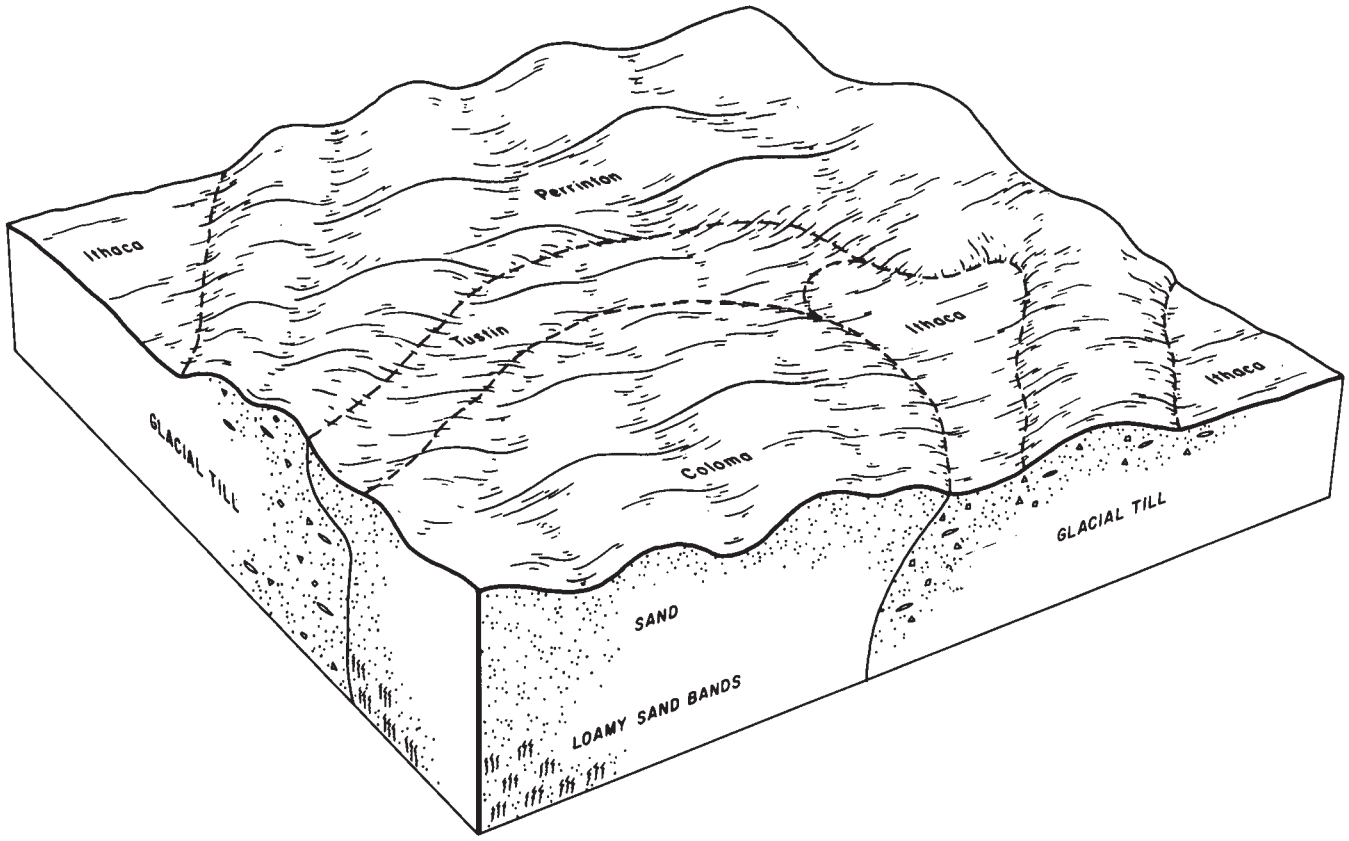


Figure 1.—Typical pattern of soils and underlying material in the Perrinton-Coloma-Ithaca association.

Coloma soils have a surface layer that is brown sand about 10 inches thick. The next layer is yellowish brown and brownish yellow sand about 29 inches thick. The next layer to a depth of about 60 inches is light yellowish brown sand with bands of strong brown loamy sand.

The minor soils in this map unit are in the Covert, Pipestone, and Loxley series. The moderately well drained Covert soils are in depressions, the somewhat poorly drained Pipestone soils are in depressions and along drainageways, and the very poorly drained Loxley soils are in the very wet depressions.

Most areas of the soils in this association are in woodland or pasture. Some areas are in cropland or are idle.

The gently rolling to steep soils in this association are generally not suited to cropland and poorly suited to pasture because of droughtiness. The nearly level or undulating soils are suited to crops, such as small grains, and fairly suited to pasture. Steep slopes limit the operation of machinery. Soil blowing and erosion are management concerns if the soils are cultivated.

The soils in this association are well suited to woodland. The major management concern is seedling mortality. In areas of the hilly and steep soils, erosion is a hazard and the use of equipment is limited.

The soils in this association range from suitable to generally unsuitable for building site development and septic tank absorption fields. The nearly level or undulating soils are suitable. Slope is a concern for the gently rolling to steep soils.

3. Remus-Spinks-Metea Association

Nearly level to rolling, well drained, loamy and sandy soils that formed in glacial till or outwash deposits

This association makes up about 28 percent of the survey area. It is about 35 percent Remus and similar soils, 25 percent Spinks and similar soils, and 20 percent Metea and similar soils. The remaining 20 percent is soils of minor extent (fig. 3).

Remus soils are nearly level to rolling. Typically, the surface layer is dark brown sandy loam about 6 inches thick. The subsurface layer is light yellowish brown sandy loam about 3 inches thick. The next layer is mixed pale brown sandy loam and brown sandy clay loam about 14 inches thick. The subsoil to a depth of about 60 inches is brown sandy clay loam.

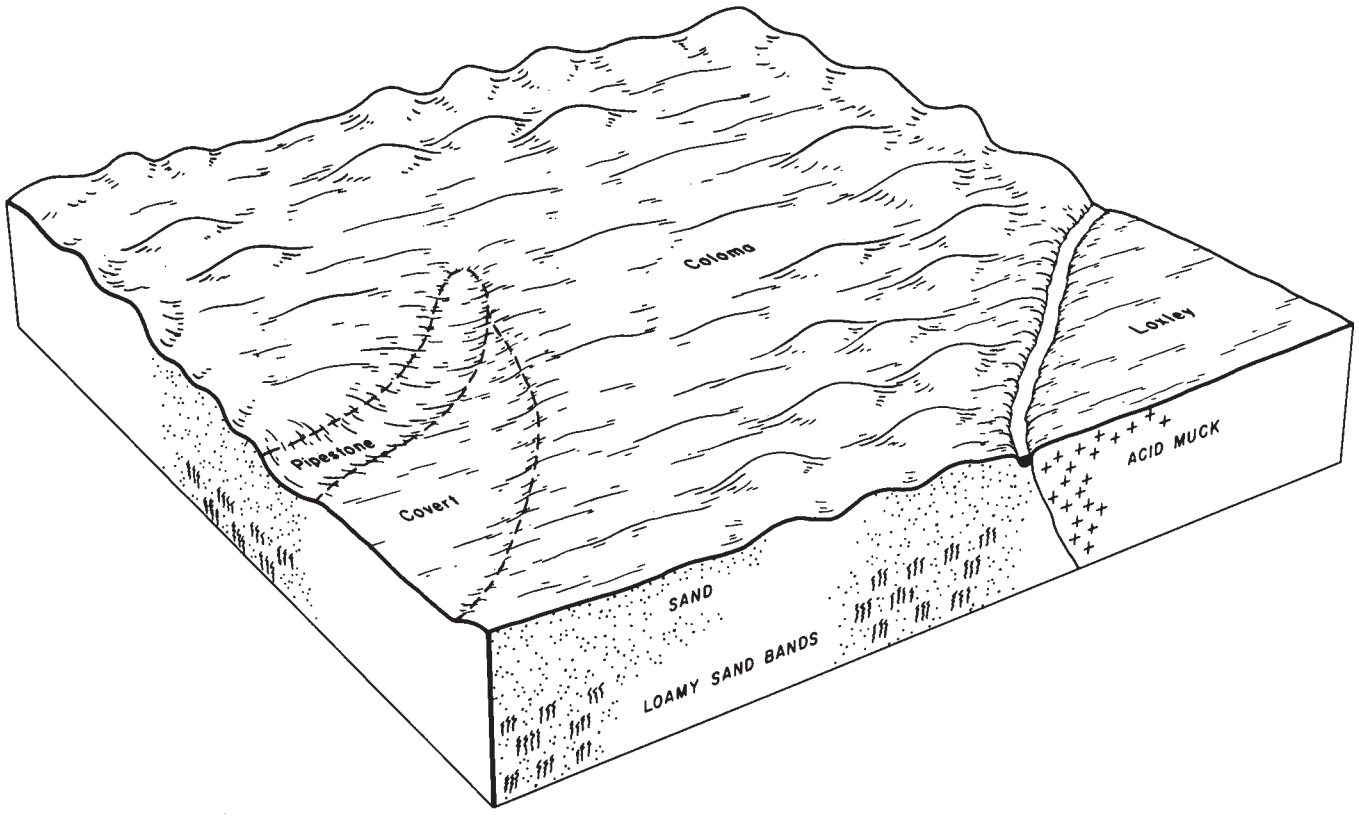


Figure 2.—Typical pattern of soils and underlying material in the Coloma association.

Spinks soils are nearly level to rolling. Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsurface layer is about 51 inches thick. The upper part is dark yellowish brown and yellowish brown loamy sand, and the lower part is yellowish brown loamy sand with bands of strong brown sandy loam and loamy sand.

Metea soils are nearly level to rolling. Typically, the surface layer is brown loamy sand about 10 inches thick. The subsoil is about 23 inches thick. The upper part is brownish yellow loamy sand, the middle part is mixed pale brown loamy sand and brown clay loam, and the lower part is brown, mottled clay loam. The substratum to a depth of about 60 inches is brown, calcareous clay loam.

The minor soils in this map unit are in the Locke, Edmore, and Houghton series. The somewhat poorly drained Locke soils and the poorly drained Edmore soils are in depressions and along drainageways, and the very poorly drained Houghton soils are in wet depressions.

Most areas of the soils in this association are in cropland or pasture. Some areas are in woodland or are idle.

The soils in this association are suited or well suited to cropland and fairly suited to well suited to pasture. The major management concerns are erosion and soil blowing. Droughtiness is a concern on the sandy soils.

The soils in this association are well suited to woodland. Seedling mortality is a management concern on the sandy soils.

The soils in this association range from well suited to generally not suited to building site development and septic tank absorption fields. The nearly level or undulating, deep sandy soils are well suited. Slope is a concern on the gently rolling and rolling soils. Permeability is a limitation for septic tank absorption fields on the Metea soils.

4. Marlette Association

Undulating to rolling, moderately well drained and well drained, loamy soils that formed in glacial till

This association makes up about 8 percent of the survey area. It is about 50 percent Marlette and similar soils and 50 percent soils of minor extent (fig. 4).

Marlette soils are undulating to rolling. Typically, the surface layer is dark brown sandy loam about 11 inches thick. The next layer is mixed brown clay loam and pale brown sandy loam about 11 inches thick. The subsoil, about 16 inches thick, is brown clay loam. The

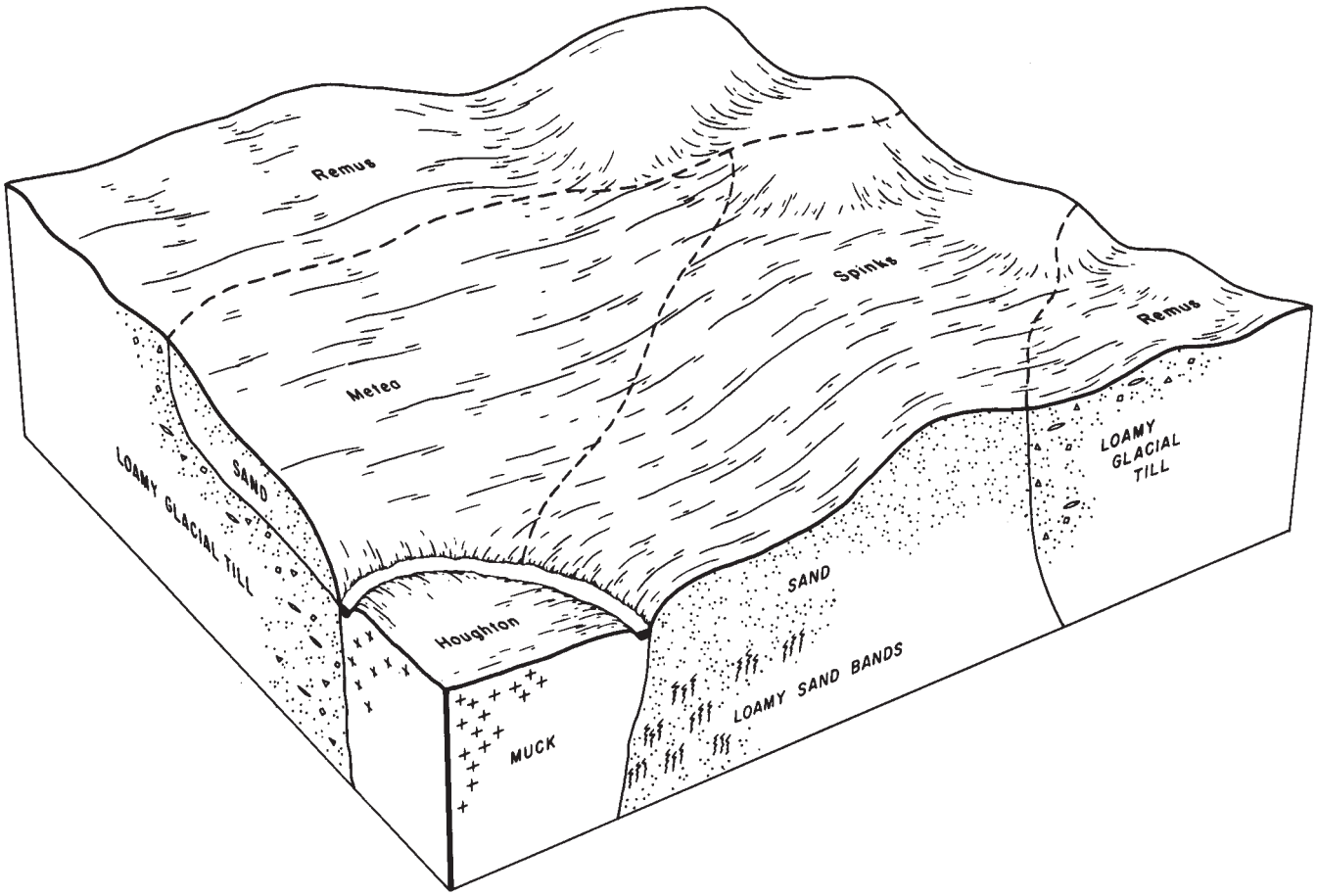


Figure 3.—Typical pattern of soils and underlying material in the Remus-Spinks-Metea association.

substratum to a depth of about 60 inches is brown, mottled, calcareous clay loam.

The minor soils in this map unit are in the Houghton, Aubbeenaubbee, Coloma, and Leoni series. The very poorly drained Houghton soils are in the very low depressions, the somewhat poorly drained Aubbeenaubbee soils are in depressions and along drainageways, and the somewhat excessively drained Coloma soils and the well drained Leoni soils are on landscape positions similar to those of the Marlette soils.

Most areas of the soils in this association are in cropland. Some areas are in pasture or are left idle.

The soils in this association are well suited to suited to pasture or cropland. The major management concerns are erosion and wet depressions in areas of undulating soils.

The soils in this association are well suited to woodland. There are no major management concerns.

The soils in this association have fair to poor suitability for building site development and septic tank absorption fields. The major limitation is the moderately slow permeability of the soils. Slope is a limitation on the rolling and gently rolling soils. Wetness is a limitation on the undulating soils.

5. Mecosta Association

Nearly level to gently rolling, somewhat excessively drained, sandy soils that formed in outwash deposits or glacial till

This association makes up about 9 percent of the survey area. It is about 50 percent Mecosta and similar soils and 50 percent soils of minor extent (fig. 5).

Mecosta soils are nearly level to gently rolling. Typically, the surface layer is dark brown sand about 10 inches thick. The subsoil is about 12 inches thick. The upper part is strong brown and yellowish brown sand and gravelly sand, and the lower part is brown gravelly coarse sand. The substratum to a depth of about 60

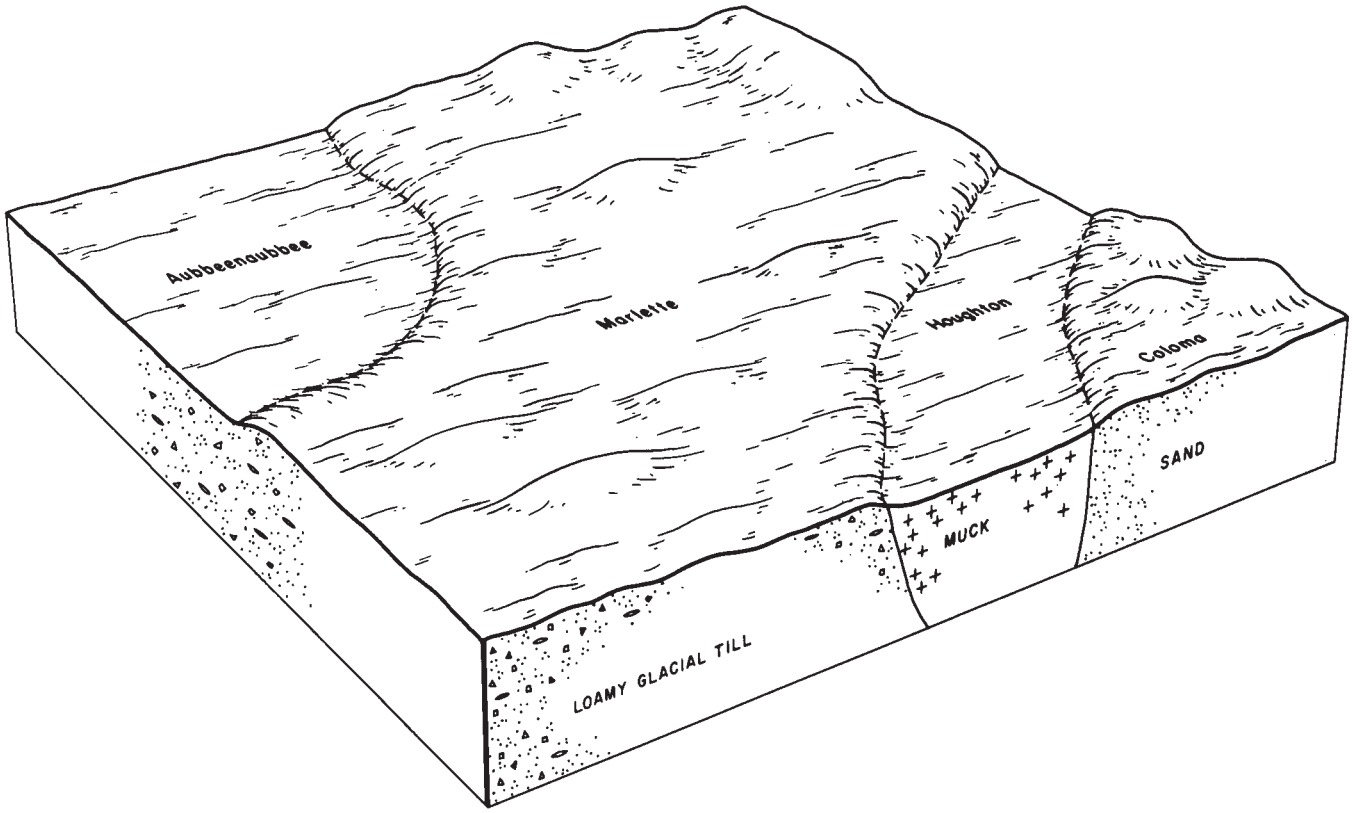


Figure 4.—Typical pattern of soils and underlying material in the Marlette association.

inches is pale brown, calcareous very gravelly and extremely gravelly coarse sand.

The minor soils in this map unit are in the Coloma, Covert, Riverdale, and Algansee series. The somewhat excessively drained Coloma soils are on landscape positions similar to those of the Mecosta soils. The moderately well drained Covert soils are in depressions, and the somewhat poorly drained Riverdale and Algansee soils are in lower depressions and along drainageways.

Most areas of the soils in this association are wooded or idle.

The soils in this association are poorly suited to generally not suited to crops such as corn and dry beans. The nearly level or undulating soils are suitable for pasture, alfalfa, and small grains. The gently rolling soils have poor suitability for pasture and are generally unsuitable for cropland. The major management concern is the droughtiness of the soils. Soil blowing is also a concern on cultivated soils.

The soils in this association are suitable for woodland. The major management concern is seedling mortality.

The nearly level or undulating soils are suited to building site development and septic tank absorption fields. Slope is a limitation for the gently rolling soils.

6. Coloma-Covert-Thetford Association

Nearly level to rolling, somewhat excessively drained, moderately well drained, and somewhat poorly drained, sandy soils that formed in outwash deposits or glacial till

This association makes up about 14 percent of the survey area. It is about 35 percent Coloma and similar soils, 25 percent Covert and similar soils, and 10 percent Thetford and similar soils. The remaining 30 percent is soils of minor extent.

Coloma soils are nearly level to rolling and somewhat excessively drained. Typically, the surface layer is brown sand about 10 inches thick. The next layer is yellowish brown and brownish yellow sand about 29 inches thick. The next layer to a depth of about 60 inches is light yellowish brown sand with bands of strong brown loamy sand.

Covert soils are nearly level and moderately well drained. Typically, the surface layer is black and brown sand about 4 inches thick. The subsoil is brown and strong brown sand about 31 inches thick. The substratum to a depth of about 60 inches is reddish yellow and light yellowish brown, mottled sand.

Thetford soils are nearly level and somewhat poorly drained. Typically, the surface layer is black loamy sand

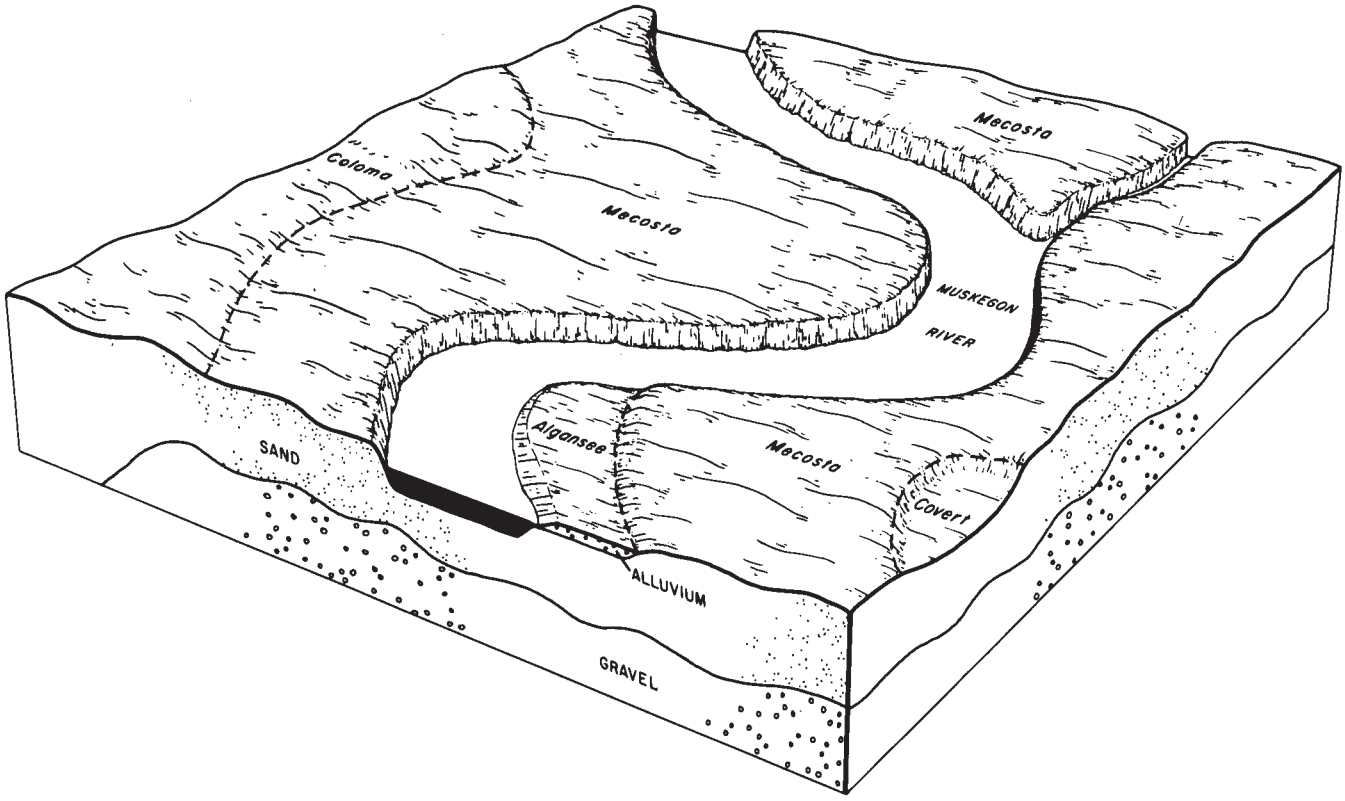


Figure 5.—Typical pattern of soils and underlying material in the Mecosta association.

about 4 inches thick. The subsoil, about 56 inches thick, is yellowish brown to pale brown, mottled loamy sand in the upper part and brown sand with bands of brown sandy loam and loamy sand in the lower part.

The minor soils in this map unit are in the Adrian, Roscommon, and Metea series. The very poorly drained Adrian and poorly drained Roscommon soils are in low depressions, and the well drained Metea soils are on uplands.

Most areas of the soils in this association are in woodland or are idle. Some areas are in cropland or pasture.

Most of the soils in this association are suitable for small grains, pasture, and alfalfa but poorly suited to corn and dry beans. The major management concerns are droughtiness and soil blowing. For some soils, wetness is a concern and tile drainage is needed. The gently rolling and rolling soils are generally not suited to cropland and are poorly suited to pasture.

The soils in this association are well suited to woodland. Seedling mortality is a concern on the better drained soils. The use of equipment is limited on the wet soils.

The soils in this association range from suited to poorly suited to building site development and septic tank absorption fields. The nearly level or undulating, somewhat excessively drained soils are suited. Wetness or slope is a limitation for the other soils in this association.

7. Wauseon-Arkona Association

Nearly level or undulating, very poorly drained and somewhat poorly drained, loamy and sandy soils that formed in outwash deposits or glacial till

This association makes up about 2 percent of the survey area. It is about 30 percent Wauseon soils, 25 percent Arkona soils, and 45 percent soils of minor extent.

Wauseon soils are nearly level and very poorly drained. Typically, the surface layer is black sandy loam about 11 inches thick. The mottled subsoil is grayish brown to olive sandy loam about 13 inches thick. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous silty clay.

Arkona soils are nearly level or undulating and somewhat poorly drained. Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The mottled subsoil is about 32 inches thick. The upper part is brown or dark yellowish brown loamy sand,

the middle part is yellowish brown sand, and the lower part is brown silty clay. The substratum to a depth of about 60 inches is brown, mottled, calcareous silty clay.

The minor soils in this map unit are in the Spinks, Aubbeenaubbee, Capac, Ziegenfuss, and Palms series. The well drained Spinks soils are on the higher rises, and the somewhat poorly drained, loamy Aubbeenaubbee and Capac soils are on landscape positions similar to those of the Arkona soils. The poorly drained Ziegenfuss soils and the very poorly drained Palms soils are on landscape positions similar to those of the Wauseon soils.

Most areas of the soils in this association are in woodland. Some areas are left idle.

The soils in this association are suited or generally not suited to cropland and are suited or poorly suited to pasture. The somewhat poorly drained soils are suited to cropland and pasture. Wetness and soil blowing are management concerns. The other soils in this association are generally unsuitable for cropland because of the hazard of ponding and lack of drainage outlets.

The soils in this association are well suited to suited to woodland. The major management concern on the somewhat poorly drained soils is the equipment limitation. Equipment limitations, windthrow, and seedling mortality are concerns for the very poorly drained soils.

The soils in this association are poorly suited to generally not suited to building site development and septic tank absorption fields. The major limitations are the difficulty in lowering the water table and removing ponded water. Drainage outlets are generally unavailable. Restricted permeability is a limitation for septic tank absorption fields, and the high shrink-swell potential is a hazard for building foundations.

8. Houghton-Adrian Association

Nearly level, very poorly drained, mucky soils that formed in organic material over outwash deposits

This association makes up about 2 percent of the survey area. It is about 45 percent Houghton and similar soils, 40 percent Adrian and similar soils, and 15 percent soils of minor extent (fig. 6).

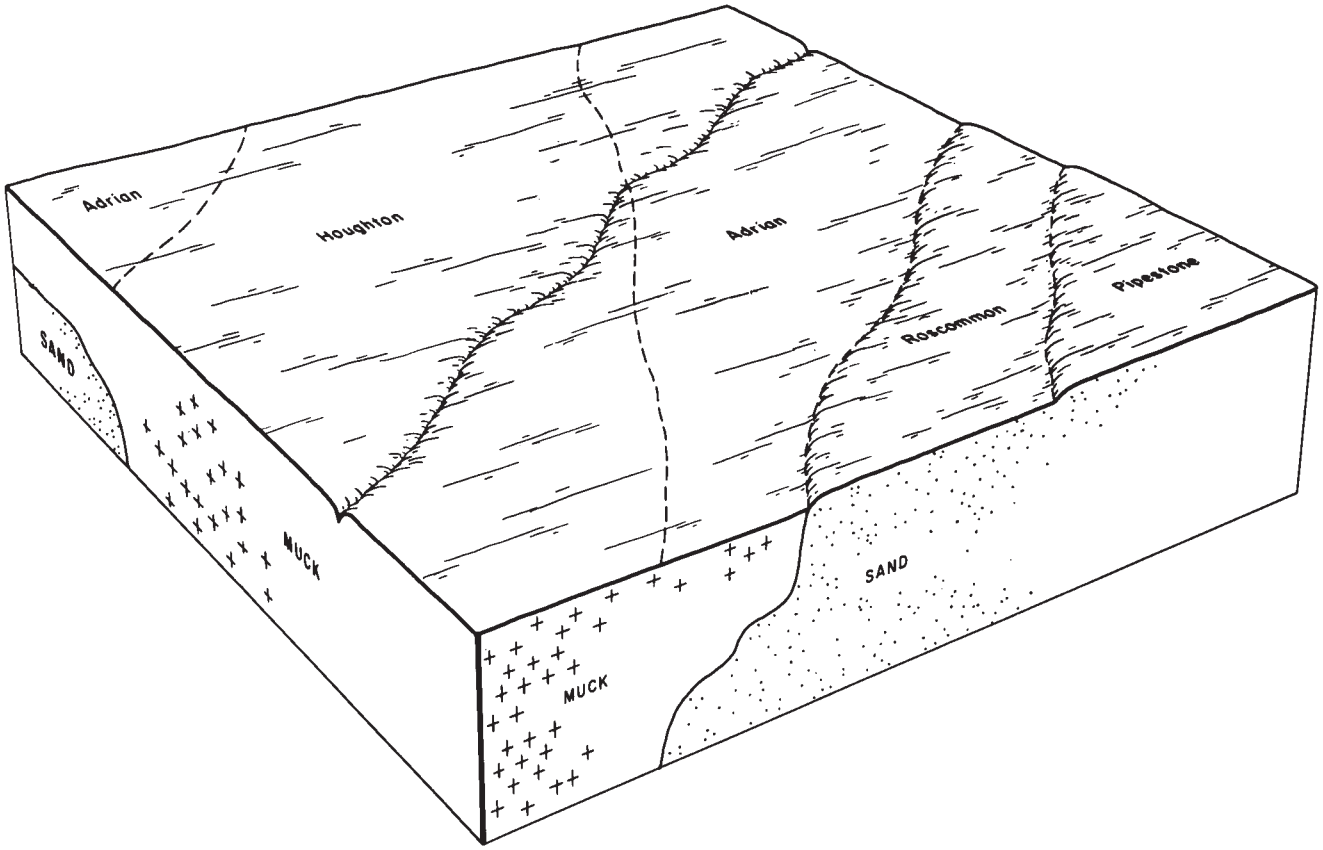


Figure 6.—Typical pattern of soils and underlying material in the Houghton-Adrian association.

Houghton soils have layers of black, well decomposed muck to a depth of about 60 inches.

Adrian soils have upper layers of black, well decomposed muck to a depth of about 31 inches. The substratum to a depth of about 60 inches is brown and grayish brown, calcareous gravelly sand.

The minor soils in this map unit are in the Pipestone, Roscommon, and Wauseon series. The somewhat poorly drained Pipestone soils are on the higher rises. The poorly drained Roscommon soils and very poorly drained Wauseon soils are on landscape positions similar to those of the Houghton or Adrian soils.

Most areas of the soils in this association are in woodland.

The soils in this association are generally unsuitable for cropland or pasture. The high water table, the hazard of ponding, and the low strength of the soil are major limitations. Drainage is impractical because outlets are generally unavailable.

The soils in this association are suited to woodland. The major management concerns are equipment limitations, windthrow, and seedling mortality.

The soils in this association are not suited to building site development and septic tank absorption fields. The major limitations are low strength and the ponding hazard. Drainage outlets are generally unavailable. The soils generally are too unstable to support structures.

Broad Land Use Considerations

Deciding proper land use is an important issue in the survey area. As more people move into the county each year, more decisions regarding building sites and other land uses are made. The general soil map in this survey can be very helpful in planning future land use patterns. This map is most helpful in planning the general location of future residential developments. It should not be used, however, to select specific sites for homes.

About 3 percent of the county is classified as residential and commercial land. The flat areas of Coloma, Mecosta, Remus, and Spinks soils in associations 1, 2, 3, 5, and 6 are suited to building site development. The other soils in associations 1 through 7 are fairly suited to generally not suited to building site development. Slope, wetness, or permeability limitations are the major concerns. The soils in association 8 are not suited to building site development. Ponding and low strength are the major limitations.

About 18 percent of the county is in cropland. The soils in associations 3 and 4 and the nearly level soils in associations 1, 2, 5, and 6 are suited to cultivated crops. Erosion and soil blowing are the major management concerns. Some of the soils need to be drained before crops can be grown. The sandy soils are droughty. The other soils in associations 1, 2, 5, 6, and 7 are fairly suited to generally not suited to cultivated crops because of slope, wetness, droughtiness, erosion, or soil blowing. The soils in association 8 are generally not suited to cultivated crops because of ponding and lack of drainage outlets.

About 33 percent of the county is used for pasture or hay or left idle. The soils in associations 3 and 4, the loamy soils in association 1, and the Arkona soils in association 7 are suited to pasture. The other soils in associations 1 through 7 are fairly suited to generally not suited to pasture because of droughtiness, wetness, or slope. The soils in association 8 are generally not suited to pasture because of ponding and the lack of drainage outlets.

About 28 percent of the county is used for woodland. The soils in associations 1 through 4 and in association 6 are well suited to woodland. The Wauseon soils in association 7 are also well suited to woodland. The soils in the other associations are fairly well suited.

About 8 percent of the county is public land and private recreation land. The flat areas of the soils in association 3 and the nearly level soils in association 1 are well suited to recreational development. The soils in association 6 and the gently rolling and rolling soils in associations 1 through 5 are fairly suited or poorly suited to recreational development because of slope or wetness. The soils in association 8, the Wauseon soils in association 7, and the steep soils in associations 1 and 2 are generally not suited to recreational development because of ponding, wetness, or slope.

About 10 percent of the county is dominantly used for wildlife habitat. The soils in associations 1 through 4 have good to fair potential as habitat for openland wildlife or woodland wildlife. The soils in association 8 have good potential as habitat for wetland wildlife.

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 underlying material, 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 underlying material. 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, Plainfield sand, 0 to 6 percent slopes, is one of several phases in the Plainfield series.

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

A *soil complex* consists of two or more soils 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. Metea-Coloma loamy sands, 6 to 18 percent slopes, is an example.

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

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

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

Soil Descriptions

10B—Plainfield sand, 0 to 6 percent slopes. This nearly level or undulating, excessively drained soil is on flat or slightly convex plains. Individual areas range from 5 to 200 acres.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil is dark yellowish brown and yellowish brown sand about 19 inches thick. The substratum to a depth of about 60 inches is brownish yellow and yellowish brown sand. In some places, the substratum has thin loamy sand bands or a gravelly sand layer.

Included with this soil in mapping are small areas of moderately well drained Covert soils. These included soils are on slightly lower positions on the landscape than the Plainfield soil and make up 5 to 10 percent of the unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. Surface runoff is slow.

Most areas of this soil are in woodland or are idle. A few areas are in cropland or pasture.

The droughtiness of the soil makes it poorly suited to corn and dry beans. This soil is generally suitable for asparagus and fall-seeded crops, such as winter wheat and rye. These crops make good use of the available water. If irrigated, this soil is suited to such crops as corn, dry beans, potatoes, and snap beans. The major management concerns are overcoming droughtiness, controlling soil blowing, and maintaining the organic matter content. Field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, help

prevent soil blowing. Use of crop residue, manure, and green manure crops adds organic matter to the soil.

This soil is poorly suited to pasture. Droughtiness is the main concern. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should not be used or should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland (fig. 7). The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be in excess of 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

Figure 7.—Red pine is one of the recommended trees to plant in areas of Plainfield sand.

This soil is poorly suited to recreational development. The major management concern is the sandy surface layer. Also, slope may be a limitation for playgrounds. To improve the sandy surface layer, loamy topsoil can be added and seeded with grasses and legumes. Paths and trails can be improved by a covering of wood chips or bark. Land shaping may be needed for playgrounds.

This soil is suited to building site development and septic tank absorption fields. Poor filtering capacity is a limitation for septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass IVs and Michigan soil management group 5a.

10C—Plainfield sand, 6 to 18 percent slopes. This gently rolling and rolling, excessively drained soil is on low to high knolls or mounds. Individual areas range from 5 to 200 acres.

Typically, the surface layer is dark brown sand about 3 inches thick. The subsoil is strong brown and brownish yellow sand about 19 inches thick. The substratum to a depth of about 60 inches is brownish yellow sand. In some places, the substratum has thin loamy sand bands or a gravelly sand layer.

Included with this soil in mapping are small areas of moderately well drained Covert soils. These included soils are in depressions and make up 5 to 10 percent of the unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. Surface runoff is medium.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland because of droughtiness and soil blowing. Many of the areas that have been cultivated are being planted to tree seedlings.

This soil is poorly suited to pasture. The major management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should not be used or should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be in excess of 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is poorly suited to camp areas, picnic areas, and paths and trails. The major management concern is the sandy surface layer. This soil is generally not suited to playgrounds because of the slope and the sandy

surface layer. To improve the sandy surface layer, loamy topsoil can be added and seeded with grasses and legumes. Paths and trails can be improved by placing them on the contour and by adding a covering of wood chips or bark. Land shaping and leveling, though costly, can be used in constructing campsites and picnic areas.

This soil is fairly suited to building site development and septic tank absorption fields. Slope is a concern for building sites. Slope and poor filtering capacity are concerns for septic tank absorption fields. Buildings constructed on this soil should be designed to 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 are generally necessary for the proper operation of septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass VIs and Michigan soil management group 5.3a.

10E—Plainfield sand, 18 to 35 percent slopes. This hilly and steep, excessively drained soil is on hills and ridges. Individual areas range from 5 to 120 acres.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil is yellowish brown loose sand about 19 inches thick. The substratum to a depth of about 60 inches is yellowish brown sand. In some places, the substratum has thin loamy sand bands or a gravelly sand layer.

Included with this soil in mapping are small areas of moderately well drained Covert soils. These included soils are in depressions and make up 2 to 5 percent of the unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. Surface runoff is medium.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland or pasture because of the steepness of slope and the severe erosion hazard. The use of equipment is restricted. Many of the areas that have been under cultivation are being planted to tree seedlings.

This soil is well suited to woodland. The major management concerns are the limitations to the use of equipment, the hazard of erosion, and seedling mortality. The use of equipment to harvest logs increases the hazard of erosion. Hauling the logs uphill with a cable can reduce this hazard. Because of the steepness of slope and the sandiness of the soil, track-type equipment may be needed. Avoiding excessive removal of ground cover and placing roads, skidtrails, and landings on gentle grades can also reduce the erosion hazard. The loss of planted or natural tree seedlings because of drought can be in excess of 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or hand planting. Reinforcement planting also may be necessary.

Recreational development of this soil is generally not practical because of the slope limitation and the sandy surface layer.

This soil is generally not suited to building site development and septic tank absorption fields. Slope is a severe limitation for buildings. Slope and poor filtering capacity are limitations for septic tank absorption fields. Slope is a limitation that is difficult to overcome.

This soil is in capability subclass VIIs and Michigan soil management group 5.3a.

11B—Coloma sand, 0 to 6 percent slopes. This nearly level or undulating, somewhat excessively drained soil is on flat or slightly convex plains. Individual areas range from 10 to 600 acres.

Typically, the surface layer is brown sand about 10 inches thick. The next layer is yellowish brown and brownish yellow sand about 29 inches thick. The next layer to a depth of about 60 inches is light yellowish brown sand with bands of strong brown loamy sand. In some places, the loamy sand bands are absent. In a few places, sandy loam bands or gravelly sand layers are present.

Included with this soil in mapping are small areas of well drained Metea soils and moderately well drained Covert soils. Metea soils are on landscape positions similar to those of the Coloma soil. Covert soils are on the slightly lower landscape positions. These included soils make up 5 to 10 percent of the unit.

Permeability of this Coloma soil is rapid. Surface runoff is slow, and the available water capacity is low.

Most areas of this soil are in cropland, pasture, or woodland. Some areas are idle.

This soil is suited to small grains and alfalfa, but poorly suited to corn and dry beans. If irrigated, the soil is suited to such crops as corn, dry beans, potatoes, and snap beans. Asparagus and sunflowers are commonly grown without additional water. Overcoming droughtiness, increasing the organic matter content, and preventing soil blowing are the major management concerns. Conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and winter cover crops, such as winter wheat and rye, help prevent soil blowing and make the best use of available moisture. Returning crop residue to the soil or regularly adding other organic material increases fertility and helps maintain or increase organic matter content.

This soil is fairly suited to pasture. Droughtiness is the major management concern. Proper stocking, pasture rotation, and timely deferment of grazing help keep the pasture in good condition.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is poorly suited to recreational development. The major management concern is the sandy surface layer. Also, slope may be a limitation for playgrounds. To improve the sandy surface layer, loamy topsoil can be added and seeded with grasses and legumes. Paths and trails can be improved by adding a covering of wood chips or bark. Land shaping may be needed for playgrounds.

This soil is suited to building site development and septic tank absorption fields. Poor filtering capacity is a limitation for septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass IVs and Michigan soil management group 5a.

11C—Coloma sand, 6 to 18 percent slopes. This gently rolling and rolling, somewhat excessively drained soil is on low to high knolls or mounds. Individual areas range from 10 to 300 acres.

Typically, the surface layer is very dark grayish brown sand about 2 inches thick. The next layer is strong brown to yellowish brown sand about 37 inches thick. The next layer to a depth of about 60 inches is light yellowish brown sand with bands of strong brown loamy sand. In some places, the loamy sand bands are absent. In a few places, sandy loam bands or gravelly sand layers are present.

Included with this soil in mapping are small areas of well drained Metea soils and moderately well drained Covert soils. Metea soils are on landscape positions similar to those of the Coloma soil. Covert soils are in depressions. These included soils make up 10 to 15 percent of the unit.

Permeability of this Coloma soil is rapid. Surface runoff is medium. The available water capacity is low.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to crops because of droughtiness and soil blowing. Many of the areas that have been cultivated are being planted to tree seedlings or seeded to permanent pasture.

This soil is poorly suited to pasture. Droughtiness is the major management concern. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should not be used or should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing (fig. 8). Reinforcement planting also may be necessary.

This soil is poorly suited to camp areas, picnic areas, and paths and trails and is generally not suited to playgrounds. The major management concerns are the sandy surface layer and the slope limitation. To improve the sandy surface layer, loamy topsoil can be added and seeded with grasses and legumes. Paths and trails can be improved by placing them on the contour and by adding a covering of wood chips or bark. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development. Slope is a limitation for building sites. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is poorly suited to septic tank absorption fields. Slope and poor filtering capacity are limitations. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass VIs and Michigan soil management group 5a.

11E—Coloma sand, 18 to 35 percent slopes. This somewhat excessively drained, hilly and steep soil is on hills and ridges. Individual areas range from 5 to 100 acres.

Typically, the surface layer is dark brown sand about 2 inches thick. The next layer is brownish yellow sand about 37 inches thick. The next layer to a depth of about 60 inches is yellowish brown sand with bands of strong brown loamy sand. In some places, the loamy sand bands are absent. In a few places, sandy loam bands or gravelly sand layers are present.

Included with this soil in mapping are small areas of moderately well drained Covert soils. These included soils are in depressions and make up 2 to 5 percent of the unit.

Permeability of this Coloma soil is rapid, and the available water capacity is low. Surface runoff is medium.

Most areas of this soil are in woodland. Some areas are in pasture or are idle.

This soil is generally not suited to cropland or pasture because of the steepness of slope and the severe

Figure 8.—Furrowing is often used on Coloma sand, 6 to 18 percent slopes, to reduce seedling mortality.

erosion hazard. The use of equipment is restricted. Many of the areas that have been under cultivation are being planted to tree seedlings or seeded to permanent pasture.

This soil is well suited to woodland. The major management concerns are the limitations to the use of equipment, the hazard of erosion, and seedling mortality. The use of equipment to harvest logs increases the hazard of erosion. Hauling the logs uphill with a cable can reduce this hazard. Because of the steepness of slope and the sandiness of the soil, track-type equipment may be needed. Avoiding excessive removal of ground cover and placing roads, skidtrails, and landings on gentle grades can also reduce the erosion hazard. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or hand planting. Reinforcement planting also may be necessary.

Recreational development of this soil is generally not practical because of the slope concern and the sandy surface layer.

This soil is generally not suited to building site development and septic tank absorption fields. Slope is a severe limitation for buildings. Slope and poor filtering capacity are limitations for septic tank absorption fields. Slope is a limitation that is difficult to overcome.

This soil is in capability subclass VIIs and Michigan soil management group 5a.

12B—Spinks loamy sand, 0 to 6 percent slopes. This well drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 20 to 300 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsurface layer is about 51 inches thick. The upper part is dark yellowish brown and yellowish brown loamy sand, and the lower part is yellowish brown loamy sand with bands of strong brown sandy loam and loamy sand.

Included with this soil in mapping are small areas of well drained Metea and Remus soils and somewhat poorly drained Thetford soils. The Metea and Remus soils are on landscape positions similar to those of the Spinks soil. They are not as droughty. The Thetford soils are on the lower positions on the landscape. These included soils make up 5 to 10 percent of the unit.

Permeability of this Spinks soil is moderately rapid, and surface runoff is very slow. The available water capacity is low.

Most areas of this soil are in cropland or are idle. Some areas are in pasture or woodland.

This soil is fairly suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, snap beans, and alfalfa. Overcoming droughtiness and preventing soil blowing are the major management concerns. Soil blowing can be reduced by using wind stripcropping, conservation tillage (fig. 9), vegetative barriers, field windbreaks, crop residue management, and crops that provide ground cover. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Irrigation can significantly increase yields for such crops as corn, dry beans, snap beans, and potatoes.

This soil is fairly suited to pasture. The major management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site

Figure 9.—Conservation tillage is used in this area of Spinks loamy sand, 0 to 6 percent slopes, to maintain crop residue in the soil.

preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is well suited to recreational development. Land shaping and leveling of some places may be needed to provide areas for playgrounds.

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

This soil is in capability subclass IIIs and Michigan soil management group 4a.

12C—Spinks loamy sand, 6 to 12 percent slopes. This well drained, gently rolling soil is on low to high knolls. Individual areas range from 4 to 80 acres.

Typically, the surface layer is dark brown loamy sand about 6 inches thick. The subsurface layer is about 54 inches thick. The upper part is dark yellowish brown and yellowish brown sand, and the lower part is light yellowish brown sand with bands of strong brown sandy loam and loamy sand.

Included with this soil in mapping are small areas of well drained Metea and Remus soils. These soils are on landscape positions similar to those of the Spinks soil. They are not as droughty as the Spinks soil. These included soils make up 10 to 15 percent of the unit.

Permeability of this Spinks soil is moderately rapid, and the available water capacity is low. Surface runoff is medium.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, snap beans, and alfalfa. The major management concerns are the hazard of erosion, soil blowing, and droughtiness. Diversions, grassed waterways, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, help control erosion. Field windbreaks, cover crops, wind stripcropping, and conservation tillage reduce soil blowing. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Irrigation can significantly increase yields for such crops as corn, dry beans, snap beans, and potatoes.

This soil is fairly suited to pasture. The major management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is fairly suited to camp areas and picnic areas. It is suited to paths and trails. This soil is generally not suited to playgrounds. The major management concern for all uses except paths and trails is slope. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development and septic tank absorption fields. Slope is the major concern. Buildings constructed on this soil should be designed to 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 are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe and Michigan soil management group 4a.

12D—Spinks loamy sand, 12 to 18 percent slopes. This well drained, rolling soil is on knolls. Individual areas range from 10 to 100 acres.

Typically, the surface layer is dark brown loamy sand about 5 inches thick. The subsurface layer is dark yellowish brown sand about 22 inches thick. The subsoil to a depth of about 60 inches is dark yellowish brown sand with bands of brown sandy loam and loamy sand.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils and the well drained Metea and Remus soils. Metea and Remus soils are not as droughty as the Spinks soil and are on similar positions on the landscape. These included soils make up 10 to 15 percent of the unit.

Permeability of this Spinks soil is moderately rapid, and the available water capacity is low. Surface runoff is medium.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is suited to small grains and alfalfa, but poorly suited to corn and dry beans. The main management concerns are erosion, soil blowing, and droughtiness. Slopes are too steep for intensive cropping. Erosion and soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and cover crops. Planting to grasses and legumes or planting tree seedlings can also reduce erosion and soil blowing. Crops that mature early in the season, such as small grains, make good use of the soil moisture.

This soil is fairly suited to pasture. The main management concerns are droughtiness and slope. The application of fertilizer might be difficult because of slope. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pasture should be rotated more frequently during the dry summer months than during the rest of the grazing season.

The soil is well suited to woodland. The main management concern is seedling mortality. The loss of

planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is poorly suited to camp areas and picnic areas and fairly suited to paths and trails. It is generally not suited to playgrounds. The major management concern is slope. Land shaping, though costly, can be used in constructing camp areas, picnic areas, and paths and trails.

This soil is poorly suited to building site development and septic tank absorption fields. Slope is the major concern. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. In some places, septic tank absorption fields can be installed on the contour.

This soil is in capability subclass IVe and Michigan soil management group 4a.

13B—Metea loamy sand, 0 to 6 percent slopes. This well drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 5 to 80 acres.

Typically, the surface layer is brown loamy sand about 10 inches thick. The subsoil is about 23 inches thick. The upper part is brownish yellow loamy sand; the middle part is mixed pale brown loamy sand and brown clay loam; and the lower part is brown, mottled clay loam. The substratum to a depth of about 60 inches is brown, calcareous clay loam. In some places, the depth to the loamy material is 40 to 50 inches.

Included with this soil in mapping are small areas of well drained Spinks soils. Spinks soils have moderately rapid permeability and are on landscape positions similar to those of the Metea soil. These included soils make up 10 to 15 percent of the unit.

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

Most areas of this soil are in cropland, pasture, or woodland. Some areas are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, snap beans, and alfalfa. Droughtiness, soil blowing, and erosion are the main management concerns. Irrigation can significantly increase yields for such crops as corn, dry beans, snap beans, and potatoes. Erosion and soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Erosion is also reduced by using grassed waterways, cover crops, and diversions. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, and cover crops.

This soil is fairly suited to pasture. The major management concern is droughtiness during the dry summer months. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the year.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted seedlings can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is well suited to recreational development. Land shaping and leveling are generally needed to provide sites for playgrounds.

This soil is fairly suited to septic tank absorption fields. The moderate permeability of the lower part of the soil profile is a major concern. This soil is well suited to use as building sites and has no limitations for this use. For septic tank absorption fields, a special structure, such as an absorption field that is larger than normal or a system of alternating absorption fields, may be needed to overcome the limited permeability. The included Spinks soils are better suited to use as septic tank absorption fields because they do not have the permeability concern.

This soil is in capability subclass IIIe and Michigan soil management group 4/2a.

13C—Metea loamy sand, 6 to 12 percent slopes. This well drained, gently rolling soil is on knolls or mounds. Individual areas range from 5 to 30 acres.

Typically, the surface layer is very dark gray loamy sand about 8 inches thick. The subsoil is about 25 inches thick. The upper part is yellowish brown and brownish yellow sand, the middle part is brown loamy sand, and the lower part is brown sandy clay loam. The substratum to a depth of about 60 inches is brown, calcareous sandy clay loam. In some places, the depth to the loamy material is 40 to 50 inches.

Included with this soil in mapping are small areas of somewhat excessively drained Coloma soils. They are on landscape positions similar to those of the Metea soil. These included soils make up 5 to 15 percent of the unit.

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

Most areas of this soil are in cropland or woodland. Some areas are in pasture or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, snap beans,

and alfalfa. Erosion, droughtiness, and soil blowing are the main management concerns. Erosion and soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Erosion is also reduced by using grassed waterways, cover crops, and diversions. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, and cover crops. Irrigation can significantly increase yields for such crops as corn, dry beans, snap beans, and potatoes.

This soil is fairly suited to pasture. Droughtiness during the dry summer months is the major management concern. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted seedlings can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is fairly suited to camp areas and picnic areas and is suited to paths and trails. It is generally not suited to playgrounds. The major management concern is slope for all uses except paths and trails. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development. Slope is a major concern. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is fairly suited to septic tank absorption fields. Slope and moderate permeability are the major concerns. Land shaping and installing the distribution lines across the slope may be necessary for proper operation of the septic tank absorption fields. Also, a special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, may be needed to overcome the limited permeability. The included Coloma soils are better suited to use as septic tank absorption fields because they do not have the permeability concern.

This soil is in capability subclass IIIe and Michigan soil management group 4/2a.

13D—Metea loamy sand, 12 to 18 percent slopes. This well drained, rolling soil is on knolls. Individual areas range from 3 to 40 acres.

Typically, the surface layer is very dark gray loamy sand about 7 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown and brownish yellow sand, the middle part is brown loamy sand, and the lower part is brown clay loam. The substratum to a depth of about 60 inches is brown, calcareous clay loam. In some places, the substratum is clay.

Included with this soil in mapping are small areas of somewhat excessively drained Coloma soils and well drained Marlette soils. These soils are on landscape positions similar to those of the Metea soil. The Marlette soils have moderately slow permeability. The included soils make up 5 to 15 percent of the unit.

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

Most areas of this soil are in pasture or woodland. Some areas are in cropland or are idle.

This soil is suited to small grains and alfalfa, but it is poorly suited to corn and dry beans. The main management concerns are erosion, droughtiness, and soil blowing. Slopes are too steep for intensive cropping. Erosion and soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and cover crops. Using hay and small grains in the crop rotation also reduces erosion and soil blowing.

This soil is fairly suited to pasture. Droughtiness during the dry summer months is the main management concern. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted seedlings can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing. Reinforcement planting also may be necessary.

This soil is poorly suited to camp areas and picnic areas and fairly suited to paths and trails. It is generally not suited to playgrounds. The major management concern is slope. Land shaping, though costly, can be used in constructing camp areas, picnic areas, and paths and trails.

This soil is poorly suited to building site development because of slope. It is generally not suited to septic tank absorption fields because of the slope and moderate permeability. These concerns are difficult to overcome.

This soil is in capability subclass IVe and Michigan soil management group 4/2a.

14A—Covert sand, 0 to 3 percent slopes. This nearly level, moderately well drained soil is on flat plains and in small depressions. Individual areas range from 10 to 120 acres.

Typically, the surface layer is black and brown sand about 4 inches thick. The subsoil is brown and strong

brown sand about 31 inches thick. The substratum to a depth of about 60 inches is reddish yellow and light yellowish brown, mottled sand. In some places, loamy sand and sandy loam bands are present in the substratum.

Included with this soil in mapping are small areas of excessively drained Coloma soils and somewhat poorly drained Pipestone soils. The Coloma soils are on higher rises than the Covert soil, and the Pipestone soils are in the lower depressions. These included soils make up 5 to 15 percent of the unit.

Permeability of this Covert soil is rapid, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2 to 3 1/2 feet from late fall to early spring.

Most areas of this soil are in woodland or are idle. Some areas are in cropland or pasture.

This soil is suited to small grains, asparagus, sunflowers, and alfalfa but poorly suited to corn and dry beans. The major management concerns are soil blowing, droughtiness, and wet depressions. Soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and by using wind stripcropping, vegetative barriers, field windbreaks, and cover crops. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Irrigation can significantly increase yields for such crops as corn, dry beans, snap beans, and potatoes. Excess water in wet depressions can make it difficult to operate machinery. Wet depressions can generally be drained by installing a random subsurface tile drainage system.

This soil is fairly suited to pasture. The major management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of selected chemicals. Reinforcement planting also may be necessary.

This soil is poorly suited to recreational development. The major management concerns are the sandy surface layer and the seasonal high water table. To improve the sandy surface layer, loamy topsoil can be added and seeded with grasses and legumes. Paths and trails can be improved by a covering of wood chips or bark. In some places, a subsurface drainage system can be used to lower the water table, and suitable material can be used to fill wet depressions.

This soil is poorly suited to building site development. Wetness is the major concern. This soil can be used as a site for buildings with basements, if well compacted fill material is used to raise the level of the site and if artificial drainage is used to lower the water table. This soil is poorly suited to septic tank absorption fields. Wetness and poor filtering capacity are the major concerns. The poor filtering capacity may result in the pollution of ground water. Special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site above the water table. The included Coloma soils are better suited to use as sites for buildings with basements and as septic tank absorption fields because they are not limited by a high water table.

This soil is in capability subclass IVs and Michigan soil management group 5a.

16B—Remus sandy loam, 0 to 6 percent slopes. This nearly level or undulating, well drained soil is on flat or slightly convex plains. Most areas of this soil are dissected by drainageways. Individual areas range from 10 to 200 acres.

Typically, the surface layer is dark brown sandy loam about 6 inches thick. The subsurface layer is light yellowish brown sandy loam about 3 inches thick. The next layer is mixed pale brown sandy loam and brown sandy clay loam about 14 inches thick. The subsoil to a depth of about 60 inches is brown sandy clay loam.

Included with this soil in mapping are small areas of well drained, sandy Spinks soils and somewhat poorly drained Locke soils. Spinks soils are on landscape positions similar to those of the Remus soil. They are more droughty. Locke soils are in depressions and along drainageways. These included soils make up 10 to 15 percent of the unit.

Permeability of this Remus soil and the available water capacity are moderate. Surface runoff is medium.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, snap beans, and alfalfa. The major management concern is erosion. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and grassed waterways, cover crops, and diversions. Irrigation can increase yields of such crops as corn, dry beans, snap beans, and potatoes.

This soil is well suited to pasture. The available water capacity is adequate for good forage yields during most years.

This soil is well suited to woodland. There are no major management concerns.

This soil is well suited to recreational development. Land shaping may be necessary to prepare areas for playgrounds.

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

This soil is in capability subclass IIe and Michigan soil management group 3a.

16C—Remus sandy loam, 6 to 12 percent slopes. This well drained, gently rolling soil is on low to high knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 10 to 100 acres.

Typically, the surface layer is very dark brown sandy loam about 7 inches thick. The next layer is mixed pale brown loamy sand and brown sandy loam about 16 inches thick. The subsoil to a depth of about 60 inches is strong brown sandy loam.

Included with this soil in mapping are small areas of sandy Spinks soils and somewhat poorly drained Locke soils. Spinks soils are on landscape positions similar to those of the Remus soil. They are more droughty. Locke soils are in depressions and along drainageways. These included soils make up 5 to 15 percent of the unit.

The permeability of this Remus soil and the available water capacity are moderate. Surface runoff is medium.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, snap beans, and alfalfa. The major management concern is erosion. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and grassed waterways, cover crops, and diversions. Irrigation can increase yields of such crops as corn, dry beans, snap beans, and potatoes.

This soil is suited to pasture. The available water capacity is adequate for good forage yields during most years.

This soil is well suited to woodland. There are no major management concerns.

This soil is well suited to paths and trails. It is fairly suited to camp areas and picnic areas and is generally not suited to playgrounds. The major management concern is slope. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development and to septic tank absorption fields. Slope is the major concern. Buildings constructed on this soil should be designed to 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 are generally necessary for the proper operation of septic tank absorption fields.

This soil is in capability subclass IIIe and Michigan soil management group 3a.

16D—Remus sandy loam, 12 to 18 percent slopes. This well drained, rolling soil is on knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 10 to 40 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 5 inches thick. The subsurface layer is yellowish brown sandy loam about 5 inches thick. The next layer is mixed brown sandy clay loam and pale brown sandy loam about 16 inches thick. The subsoil to a depth of about 60 inches is brown sandy clay loam.

Included with this soil in mapping are small areas of sandy Spinks and Metea soils. These soils are on landscape positions similar to those of the Remus soil. Metea soils have rapid permeability in the upper part of the profile. Spinks soils are more droughty than the Remus soil. These included soils make up 10 to 15 percent of the unit.

Permeability of this Remus soil is moderate. Surface runoff is rapid, and the available water capacity is moderate.

Most areas of this soil are in pasture or cropland. Some areas are in woodland or are idle.

This soil is suited to corn, dry beans, winter wheat, oats, and alfalfa. The major management concern is erosion. Slopes are too steep for intensive cropping. Planting to grasses and legumes or planting tree seedlings can reduce erosion. Erosion can also be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and cropping systems that emphasize small grains, hay, and cover crops.

This soil is suited to pasture. The available water capacity is adequate for good forage yields during most years.

This soil is well suited to woodland. There are no major management concerns.

This soil is poorly suited to camp areas and picnic areas and fairly suited to paths and trails. It is generally not suited to playgrounds. Slope is the main limitation. Land shaping and leveling are generally not practical for use in modifying the slope for camp and picnic areas. If paths and trails are placed across the slope, the limitation of slope can be reduced.

This soil is poorly suited to building site development and to septic tank absorption fields. Slope is the major concern. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. In some places, distribution lines can be placed on the contour for the proper operation of septic tank absorption fields.

This soil is in capability subclass IVe and Michigan soil management group 3a.

16E—Remus sandy loam, 18 to 35 percent slopes. This well drained, hilly and steep soil is on low to high hills. Individual areas range from 5 to 40 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 4 inches thick. The next layer is mixed light yellowish brown sandy loam and brown fine sandy loam about 8 inches thick. The subsoil is about 48 inches thick. The upper part is strong brown sandy loam, the middle part is brown sandy clay loam, and the lower part is brown sandy loam.

Included with this soil in mapping are small areas of sandy Spinks and Metea soils. These soils are on landscape positions similar to those of the Remus soil. Metea soils have rapid permeability in the upper part of the profile. Spinks soils have moderately rapid permeability. These included soils make up 10 to 15 percent of the unit.

Permeability of this Remus soil is moderate. Surface runoff is rapid, and the available water capacity is moderate.

Most areas of this soil are in woodland. Some areas are in pasture or are idle.

This soil is generally not suited to cropland because of the steep slope and the severe hazard of erosion. The use of equipment is restricted.

This soil is poorly suited to pasture. Excessive slope makes it difficult to operate equipment needed to maintain pasture. Overgrazing can leave soil unprotected and subject to erosion. Rotational grazing can help prevent erosion.

This soil is well suited to woodland. The major management concerns are the limitations to the use of equipment and the hazard of erosion. The use of equipment to harvest logs increases the erosion hazard. Hauling the logs uphill with a cable can reduce the erosion hazard. Avoiding excessive removal of ground cover and placing roads, skidtrails, and landings on gentle grades can also reduce the erosion hazard. If seedlings are planted, hand planting is generally necessary because of the slope.

The use of this soil for most recreational development is generally not practical because of the slope limitation. The slope limitations for paths and trails can be reduced by following slope contours.

This soil is generally not suitable for building site development and for septic tank absorption fields because of the slope.

This soil is in capability subclass VIe and Michigan soil management group 3a.

17B—Marlette sandy loam, 2 to 6 percent slopes. This moderately well drained, undulating soil is on low knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 5 to 40 acres.

Typically, the surface layer is dark brown sandy loam about 11 inches thick. The next layer is mixed brown clay loam and pale brown sandy loam about 11 inches thick. The subsoil, about 16 inches thick, is brown clay loam. The substratum to a depth of about 60 inches is brown, mottled, calcareous clay loam. In some places, the upper part of the subsoil is sandy loam or the substratum is sandy loam or silty clay.

Included with this soil in mapping are small areas of somewhat poorly drained Aubbeenaubbee and Capac soils. These soils are in depressions and along drainageways. These included soils make up 10 to 15 percent of the unit.

Permeability of this Marlette soil is moderately slow. The available water capacity is high, and surface runoff is medium. The seasonal high water table is at a depth of 2 1/2 to 6 feet from late fall to early spring.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, alfalfa (fig. 10), potatoes, snap beans, and sunflowers. The major management concerns are erosion and excess water in depressions. These concerns make it difficult to operate machinery. Excess water is commonly drained by installing a random subsurface tile drainage system. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and grassed waterways, cover crops, and diversions. Irrigation can increase yields of corn, dry beans, potatoes, and snap beans.

This soil is well suited to pasture. There are no major management concerns.

This soil is well suited to woodland. There are no major management concerns.

This soil is well suited to recreational development. Land shaping may be necessary to prepare areas for playgrounds.

This soil is fairly suited to building site development. Wetness is a limitation for buildings with basements. This soil can be used as a site for buildings with basements, if well compacted fill material is used to raise the level of the site and if artificial drainage is used to lower the water table. This soil is poorly suited to septic tank absorption fields. The major limitations are the moderately slow permeability and wetness. A special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, can overcome these limitations.

This soil is in capability subclass IIe and Michigan soil management group 2.5a.

17C—Marlette sandy loam, 6 to 12 percent slopes. This well drained, gently rolling soil is on low to high knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 2 to 30 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The next layer is mixed yellowish brown loam and sandy loam about 14 inches thick. The subsoil, about 16 inches thick, is brown and dark yellowish brown clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous

Figure 10.—Hay yields are high on Marlette sandy loam, 2 to 6 percent slopes. Hay crops reduce erosion to a minimum.

loam. In some places, the upper part of the subsoil is sandy loam or the substratum is sandy loam or silty clay.

Included with this soil in mapping are small areas of somewhat poorly drained Aubbeenaubbee and Capac soils. These soils are in depressions and along drainageways. These included soils make up 5 to 10 percent of the unit.

Permeability of this Marlette soil is moderately slow, and the available water capacity is high. Surface runoff is rapid.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, potatoes, snap beans, sunflowers, and alfalfa. The major management concern is erosion. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and grassed waterways (fig. 11), diversions, and cropping systems that include small grains, hay, and cover crops. Irrigation can increase yields of corn, dry beans, potatoes, and snap beans.

This soil is suited to pasture. There are no major management concerns.

This soil is well suited to woodland. There are no major management concerns.

This soil is well suited to paths and trails. It is fairly suited to camp areas and picnic areas. It is generally unsuitable for playgrounds. Slope is the main limitation. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development. The major concern is slope. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is poorly suited to septic tank absorption fields. The major concerns are slope and moderately slow permeability. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. A special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, may be needed to overcome the limited permeability.

This soil is in capability subclass IIIe and Michigan soil management group 2.5a.

17D—Marlette sandy loam, 12 to 18 percent slopes. This well drained, rolling soil is on high knolls.

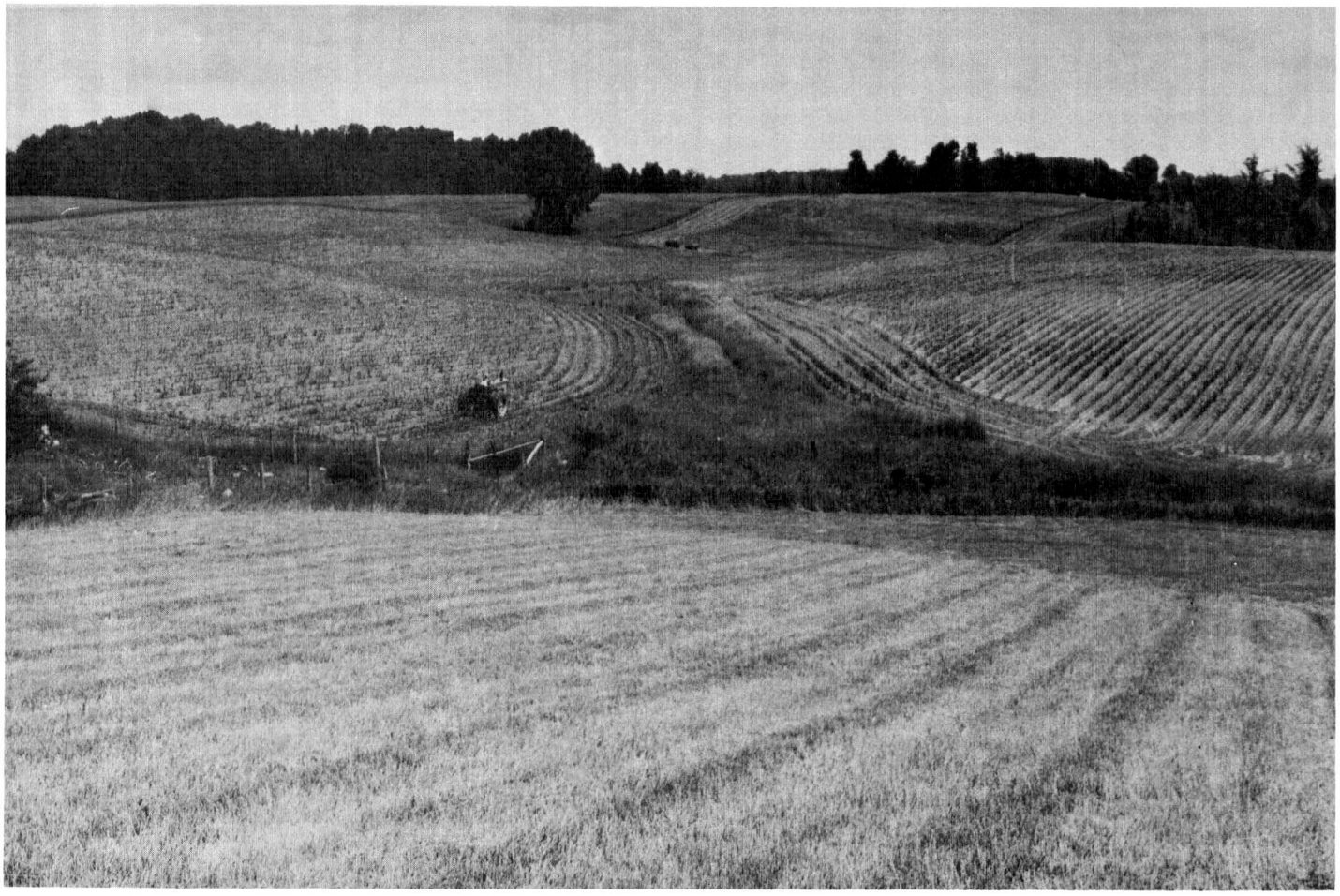


Figure 11.—Erosion can be a severe problem on Marlette sandy loam, 6 to 12 percent slopes. A grassed waterway is often used to reduce erosion.

Most areas of this soil are dissected by shallow drainageways. Individual areas range from 2 to 40 acres.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. The next layer is mixed strong brown clay loam and sandy loam about 14 inches thick. The subsoil, about 16 inches thick, is brown clay loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous clay loam. In some places, the upper part of the subsoil is sandy loam or the substratum is sandy loam or silty clay.

Included with this soil in mapping are small areas of well drained Spinks and Metea soils. These soils are on landscape positions similar to those of the Marlette soil. Spinks soils are more droughty. Metea soils have rapid permeability in the upper part of the profile. These included soils make up 10 to 15 percent of the unit.

Permeability of this Marlette soil is moderately slow, and the available water capacity is high. Surface runoff is rapid.

Most areas of this soil are in pasture or cropland. Some areas are in woodland or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, and alfalfa. The major management concern is erosion. Slopes are too steep for intensive cropping. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Cropping systems that emphasize small grains, hay, and cover crops can also reduce erosion.

This soil is suited to pasture. There are no major management concerns.

This soil is well suited to woodland. After harvesting, seedlings commonly regenerate. There are no major management concerns.

This soil is poorly suited to camp areas and picnic areas and fairly suited to paths and trails. It is generally not suited to playgrounds. Slope is the main limitation. Land shaping and leveling are generally not practical to use in modifying the slope for camp areas and picnic areas. If paths and trails are placed across the slope, the limitation of slope can be reduced.

This soil is poorly suited to building site development and to septic tank absorption fields. Slope is a major concern. Moderately slow permeability is an additional major concern for septic tank absorption fields. These limitations are difficult to overcome.

This soil is in capability subclass IVe and Michigan soil management group 2.5a.

19B—Perrinton loam, 2 to 6 percent slopes. This well drained, undulating soil is on low knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 10 to 35 acres.

Typically, the surface layer is dark brown loam about 8 inches thick. The next layer is mixed brown silty clay loam and silt loam about 5 inches thick. The subsoil, about 17 inches thick, is brown clay and silty clay. The substratum to a depth of about 60 inches is brown, calcareous silty clay.

Included with this soil in mapping are small areas of somewhat poorly drained Ithaca soils and sandy surfaced Tustin soils. The Ithaca soils are in depressions, and the Tustin soils are on landscape positions similar to those of the Perrinton soil. Tustin soils are rapidly permeable in the upper part of the profile. These included soils make up 10 to 15 percent of the unit.

Permeability of this Perrinton soil is moderately slow, and the available water capacity is moderate. Surface runoff is medium, and the shrink-swell potential is moderate.

Most areas of this soil are in cropland or are idle. Some areas are in woodland or pasture.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, and alfalfa. The major management concerns are erosion, puddling and crusting, and slowness of the soil to warm in the spring. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and grassed waterways, cover crops, and diversions. Tilling when the soil is not excessively wet and using conservation tillage and green manure crops can help maintain good tilth and reduce puddling and crusting.

This soil is well suited to pasture. Grazing when this soil is excessively wet, however, can cause surface compaction, excessive runoff, and poor soil structure.

This soil is well suited to woodland. There are no major management concerns.

This soil is well suited to recreational development. Land shaping and leveling may be necessary to prepare areas for playgrounds.

This soil is fairly suited to building site development. The shrink-swell potential of the soil is a major concern if buildings are constructed. Foundation trenches, therefore, should be wider than normal and should be backfilled with suitable coarse material. This soil is poorly suited to septic tank absorption fields because of its moderately slow permeability. A special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, can overcome this limitation in some places.

This soil is in capability subclass IIe and Michigan soil management group 1.5a.

19C—Perrinton loam, 6 to 12 percent slopes. This well drained, gently rolling soil is on low to high knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 5 to 160 acres.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The next layer is mixed brown silty clay and silt loam about 5 inches thick. The subsoil, about 18 inches thick, is brown clay. The substratum to a depth of about 60 inches is brown, calcareous clay.

Included with this soil in mapping are small areas of somewhat poorly drained Ithaca soils and well drained Tustin soils. The Ithaca soils are in depressions, and the Tustin soils are on landscape positions similar to those of the Perrinton soil. Tustin soils have rapid permeability in the upper part of the profile. These included soils make up 10 to 15 percent of the unit.

Permeability of this Perrinton soil is moderately slow, and the available water capacity is moderate. Surface runoff is rapid, and the shrink-swell potential is moderate.

Most areas of this soil are in cropland or are idle. Some areas are in woodland or pasture.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, and alfalfa. The major management concerns are erosion, puddling and crusting, and the slowness of the soil to warm in spring. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and grassed waterways, diversions, and cropping sytems that include small grains, hay, and cover crops. Tilling when the soil is not excessively wet and using conservation tillage and green manure crops can help maintain good tilth and reduce puddling and crusting.

This soil is suited to pasture. Grazing when this soil is excessively wet can cause surface compaction, excessive runoff, and poor soil structure.

This soil is well suited to woodland. There are no major management concerns.

This soil is suited to paths and trails. It is fairly suited to camp areas and picnic areas. It is generally not suited to playgrounds. Slope is the major management concern. Land shaping and leveling though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development. The slope and shrink-swell potential are major concerns. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. The foundation trench

should be wider than normal and backfilled with suitable coarse material in order to prevent damage caused by shrinking and swelling of the soil. This soil is poorly suited to septic tank absorption fields. Slope and moderately slow permeability are the major concerns. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of the septic tank absorption field. A special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, may be necessary to overcome the limited permeability.

This soil is in capability subclass IIIe and Michigan soil management group 1.5a.

19D—Perrinton loam, 12 to 18 percent slopes. This well drained, rolling soil is on high knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 2 to 80 acres.

Typically, the surface layer is brown loam about 5 inches thick. The next layer is mixed brown clay and silt loam about 5 inches thick. The subsoil, about 20 inches thick, is brown clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous clay.

Included with this soil in mapping are small areas of somewhat excessively drained Mecosta soils and well drained Tustin soils. These soils are on hilltops and near the edges of the unit. Mecosta soils have very rapid or rapid permeability. Tustin soils have rapid permeability in the upper part of the profile. These included soils make up 5 to 15 percent of the unit.

Permeability of this Perrinton soil is moderately slow, and the available water capacity is moderate. Surface runoff is rapid, and the shrink-swell potential is moderate.

Most areas of this soil are in pasture or are idle. Some areas are in cropland or woodland.

This soil is suited to corn, small grains, and alfalfa but poorly suited to dry beans. The major management concerns are erosion, puddling and crusting, and slowness of the soil to warm in spring. Slopes are too steep for intensive cropping. Planting to grasses and legumes can reduce erosion. Good tilth can be maintained and puddling and crusting can be reduced by limiting tillage operations to periods when the soil is not excessively wet. Using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and using green manure crops can also maintain good tilth and reduce puddling and crusting.

This soil is suited to pasture. Grazing when this soil is excessively wet can cause surface compaction, excessive runoff, and poor soil structure.

This soil is well suited to woodland. There are no major management concerns.

This soil is poorly suited to camp areas and picnic areas and fairly suited to paths and trails. It is generally not suited to playgrounds. The major management concern is slope. Land shaping and leveling for camp areas and picnic areas are generally not practical. Paths and trails that follow slope contours reduce the slope limitation.

This soil is generally not suitable for building site development and septic tank absorption fields because of the slope limitation.

This soil is in capability subclass IVe and Michigan soil management group 1.5a.

19E—Perrinton loam, 18 to 35 percent slopes. This well drained, hilly and steep soil is on low to high hills. Individual areas range from 2 to 60 acres.

Typically, the surface layer is very dark grayish brown loam about 5 inches thick. The next layer is mixed brown silty clay loam and silt loam about 5 inches thick. The subsoil, about 20 inches thick, is brown clay. The substratum to a depth of about 60 inches is brown, calcareous clay.

Included with this soil in mapping are small areas of well drained Tustin soils and somewhat poorly drained Ithaca soils. The Tustin soils are on hilltops, and the Ithaca soils are in depressions. The Tustin soils have rapid permeability in the upper part of the profile. These included soils make up 5 to 10 percent of the unit.

Permeability of this Perrinton soil is moderately slow, and the available water capacity is moderate. Surface runoff is rapid, and the shrink-swell potential is moderate.

Most areas of this soil are in pasture or woodland. Some areas are idle.

This soil is generally not suited to cropland or pasture because of the steep slope limitation and severe erosion hazard. The use of equipment is restricted.

This soil is well suited to woodland. The major management concerns are the limitations to the use of equipment and the hazard of erosion. The use of equipment to harvest logs increases the erosion hazard. Hauling the logs uphill with a cable can reduce the erosion hazard. If equipment is used, the logs should be hauled across the slope. Avoiding excessive removal of ground cover and placing roads, skidtrails, and landings on gentle grades can also reduce the erosion hazard. If seedlings are planted, hand planting is generally necessary because of the slope limitation.

Recreational development of this soil is generally not practical because of the slope limitation. Paths and trails can be placed on the contour.

This soil is generally not suitable for building site development and for septic tank absorption fields because of the slope.

This soil is in capability subclass VIIe and Michigan soil management group 1.5a.

20—Pits, sand and gravel. This map unit consists of open excavations from which sand or gravel have been

removed (fig. 12). The depth of excavation ranges from 4 to more than 30 feet. Individual areas range from 3 to 60 acres.

The original soil material has been excavated. The remaining material ranges from gravelly sand to clay.

Most areas are idle and have sparse or no vegetation. Some areas are active sand or gravel pits. A few pits contain small deposits of rubbish and trash. Suitability for different uses varies. Onsite investigation is needed to determine the suitability of a site for different uses.

This map unit is not assigned to a capability subclass or a Michigan soil management group.

21B—Ithaca loam, 0 to 4 percent slopes. This somewhat poorly drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The brown, mottled subsoil is about 19 inches thick. The upper part is mixed clay and sandy loam, and the lower part is clay. The substratum to a depth of about 60 inches is brown, mottled, calcareous clay. In some places, the subsoil and substratum are loam or clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Arkona soils and the poorly drained Ziegenfuss soils. Arkona soils are on landscape positions similar to those of the Ithaca soil and are sandy in the upper part of the subsoil. Ziegenfuss soils are on the slightly lower positions on the landscape. These included soils make up 10 to 15 percent of the unit.

Permeability of this Ithaca soil is moderately slow. The available water capacity is moderate, and surface runoff is slow. The shrink-swell potential is moderate. The seasonal high water table is at a depth of 1 foot to 2 feet from fall to spring.

Most areas of this soil are in cropland or are idle. Some areas are in woodland or pasture.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, and alfalfa. The major management concern is the seasonal high water table. Working the soil when it is too wet can cause puddling

Figure 12.—Most gravel pits are shallow. Vegetation is sparse.

and crusting and reduce trafficability. The soil warms slowly in the spring. Crop yields are improved by installing artificial drainage. Drainage outlets are not available in some areas. Where outlets are available, subsurface drains can be used to lower the water table. Good tilth can be maintained by tilling the soil when it is not excessively wet, using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and using green manure crops. Including legumes and grasses in the cropping sequence can improve soil structure and permeability.

This soil is well suited to pasture. This soil should not be used for pasture when it is excessively wet in order to reduce surface compaction, runoff, and poor soil structure.

This soil is well suited to woodland. The main management concern is the limitation to the use of equipment. The wet, sticky nature of the soil limits the use of equipment during wet periods. Equipment can form ruts when the soil is wet; therefore, woodland operations should be timed to seasons of the year when the soil is relatively dry or frozen.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. Moderately slow permeability is a concern for picnic areas. Wetness and limited permeability can be overcome by lowering the water table with a subsurface drainage system and filling areas with suitable material. Drainage outlets may not be available.

This soil is generally not suited to building site development because of the seasonal high water table. It is not suited to septic tank absorption fields because of the seasonal high water table and moderately slow permeability.

This soil is in capability subclass IIw and Michigan soil management group 1.5b.

22—Ziegenfuss silty clay loam. This poorly drained, nearly level soil is in small depressions. It is subject to frequent ponding. Individual areas range from 2 to 30 acres.

Typically, the surface layer is black silty clay loam about 6 inches thick. The subsoil is gray and dark gray, mottled clay about 15 inches thick. The substratum to a depth of about 60 inches is gray, mottled, calcareous clay.

Included with this soil in mapping are small areas of somewhat poorly drained Ithaca soils. These included soils are on slightly higher rises than the Ziegenfuss soil and make up 3 to 5 percent of the unit.

Permeability of this Ziegenfuss soil is moderately slow, and the available water capacity is moderate. Surface runoff is very slow to ponded, and the shrink-swell potential is moderate. This soil has a high water table at or above the surface from fall to late spring.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland. The major management concerns are ponding and a high water table. Drainage outlets are not available in most areas.

This soil is poorly suited to pasture. It is subject to ponding, and only a few areas have drainage outlets.

This soil is suitable for woodland. The major management concerns are equipment limitations, the windthrow hazard, and seedling mortality. The wet, sticky nature of the soil limits the use of equipment during wet periods. Equipment can form ruts when the soil is wet; therefore, woodland operations should be timed to seasons of the year when the soil is relatively dry or frozen. Windthrow may be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is generally difficult because the soil is too wet.

Recreational development on this soil is generally impractical because of the high water table and the hazard of ponding. Drainage outlets are generally not available.

This soil is generally not suitable for building site development because of the high water table and the shrink-swell potential. This soil is not suited to septic tank absorption fields because of the high water table, the hazard of ponding, and the moderately slow permeability.

This soil is in capability subclass Vw and Michigan soil management group 1.5c.

23—Roscommon loamy sand. This poorly drained, nearly level soil is in small depressions. It is subject to frequent ponding. Individual areas range from 3 to 40 acres.

Typically, the surface layer is black loamy sand about 7 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and grayish brown sand. In some places, the substratum has bands of gravelly sand, loamy sand, or sandy loam.

Included with this soil in mapping are small areas of very poorly drained Adrian soils and somewhat poorly drained Pipestone soils. The Adrian soils are in lower depressions than the Roscommon soil, and the Pipestone soils are on the slightly higher rises. These included soils make up 10 to 15 percent of the unit.

Permeability of this Roscommon soil is rapid, and the available water capacity is low. Surface runoff is very slow to ponded. This soil has a high water table at or above the surface during most of the year.

Most areas of this soil are in woodland. Some areas are in pasture or are idle.

This soil is generally not suited to cropland. The major management concerns are ponding and the high water table. Drainage outlets are not available in most areas.

This soil is poorly suited to pasture. The major management concern is ponding. Drainage outlets are not available in most areas.

This soil is suited to woodland. The major management concerns are equipment limitations, windthrow hazard, and seedling mortality. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is generally difficult because the soil is too wet.

This soil is generally not suitable for recreational development because of the high water table and the hazard of ponding. Drainage outlets are generally not available.

This soil is generally not suitable for building site development and for septic tank absorption fields because of the high water table and ponding.

This soil is in capability subclass VIw and Michigan soil management group 5c.

24—Vestaburg sandy loam. This nearly level, poorly drained soil is in depressions or in broad flat areas. It is subject to ponding. Individual areas range from 10 to 320 acres.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsoil is dark grayish brown sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown gravelly sand and very gravelly sand. In some places, the substratum has bands of sandy loam.

Included with this soil in mapping are small areas of very poorly drained Adrian soils and somewhat poorly drained Riverdale soils. Adrian soils are in lower depressions than the Vestaburg soil. Riverdale soils are on low knolls and ridges. These included soils make up 5 to 15 percent of the unit.

Permeability of this Vestaburg soil is very rapid, and the available water capacity is low. Surface runoff is very slow to ponded. This soil has a high water table at or above the surface from fall to spring.

Most areas of this soil are in woodland. Some areas are in pasture or are idle.

This soil is generally not suited to cropland because of the high water table and the lack of drainage outlets. Ponding is common in undrained areas.

This soil is poorly suited to pasture. Grazing should be restricted during wet periods because of ponding. Only a few areas have drainage outlets.

This soil is poorly suited to woodland. The major management concerns are equipment limitations, windthrow hazard, and seedling mortality. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is generally difficult because the soil is too wet.

This soil is generally not suitable for recreational development because of the high water table and the hazard of ponding. Drainage outlets are generally not available.

This soil is generally not suitable for building site development and septic tank absorption fields because of the high water table and ponding.

This soil is in capability subclass Vw and Michigan soil management group 5c.

25—Edmore sandy loam. This poorly drained, nearly level soil is in small depressions or broad flat areas. It is subject to frequent ponding. Individual areas range from 2 to 120 acres.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsoil is about 32 inches thick. It is grayish brown sand with bands of dark grayish brown, mottled sandy loam. The substratum to a depth of about 60 inches is grayish brown, calcareous sand. In some places, the substratum has bands of sandy clay loam or gravelly sand.

Included with this soil in mapping are small areas of the very poorly drained Adrian soils and the somewhat poorly drained Thetford soils. Adrian soils are in lower depressions than the Edmore soil, and Thetford soils are on the slightly higher rises. These included soils make up 10 to 15 percent of the unit.

Permeability of this Edmore soil is moderately rapid, and the available water capacity is low. Surface runoff is slow to ponded. This soil has a high water table at or above the surface from late fall to early summer.

Most areas of this soil are in woodland. Some areas are in pasture or are idle.

This soil is generally not suited to cropland. The major management concerns are ponding and the high water table. Drainage outlets are not available in most areas.

This soil is poorly suited to pasture. The major management concern is ponding. Drainage outlets are not available in most areas.

This soil is suited to woodland. The major management concerns are equipment limitations, windthrow, and seedling mortality. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons of the year when the soil is relatively dry or frozen. Windthrow can be reduced by

using harvest methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is generally difficult because the soil is too wet.

This soil is generally not suitable for recreational development because of the high water table and the hazard of ponding. Drainage outlets are generally not available.

This soil is generally not suitable for building site development and septic tank absorption fields because of the high water table and ponding.

This soil is in capability subclass Vw and Michigan soil management group 4c.

26—Edwards muck. This nearly level, very poorly drained soil is in swamps and in depressions on uplands. It is subject to frequent ponding. Individual areas range from 4 to 120 acres.

Typically, black muck is in the upper 28 inches. The substratum to a depth of about 60 inches is grayish brown marl. In some places, the thickness of the muck is more than 51 inches.

Included with this soil in mapping are small areas of poorly drained Glendora and Vestaburg soils. The Vestaburg soils are on landscape positions similar to those of the Edwards soil. The Glendora soils are near streams. These included soils make up 5 to 10 percent of the unit.

Permeability in the muck part of this Edwards soil is moderately slow to moderately rapid. Surface runoff is very slow to ponded, and the available water capacity is high. This soil has a high water table at or above the surface from fall to early spring.

Most areas of this soil are in woodland. A few areas are in shrubs and grasses.

This soil is generally not suitable for cropland or pasture because of the high water table, the ponding, and the lack of drainage outlets. In most areas the soil is not drained and does not have the strength to support equipment or livestock.

This soil is suitable for woodland. The major management concerns are the windthrow hazard, equipment limitations, and seedling mortality. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Wetness, ponding, and low strength limit the use of equipment. Equipment limitations can be partly overcome by timing woodland operations to seasons when the soil is relatively dry or frozen. Special harvesting equipment is generally needed because ordinary crawler tractors and rubber-tired skidders are generally not suited to use on muck soils. Seedling mortality generally exceeds 50 percent. Planting seedlings is generally difficult because the soil is too wet.

This soil is generally not suitable for recreational development because of the high water table, ponding, and low strength of the soil. Drainage outlets generally are not available.

Because of its low strength and the susceptibility to ponding, this soil is not suited to use as building sites and septic tank absorption fields.

This soil is in capability subclass Vw and Michigan soil management group M/mc.

27—Houghton muck. This very poorly drained, nearly level soil is in swamps and in depressions. It is frequently ponded. Individual areas range from 2 to 440 acres.

Typically, the soil layers are black, well decomposed muck to a depth of about 60 inches. In some places, the muck is extremely acid.

Included with this soil in mapping are small areas of the very poorly drained Adrian and Edwards soils. These soils are on landscape positions similar to those of the Houghton soil. Adrian soils have a sandy substratum, and Edwards soils are underlain by marl. These included soils make up 5 to 15 percent of the unit.

Permeability of this Houghton soil is moderately slow to moderately rapid, and the available water capacity is high. Surface runoff is very slow to ponded. This soil has a high water table at or above the surface from fall to early summer.

Most areas of this soil are in woodland. Some areas are in marsh grass and brush.

This soil is generally not suited to cropland or pasture because of the the low strength of the soil, the lack of drainage outlets, the high water table, and ponding. Most areas remain undrained and are too unstable to support equipment or livestock.

This soil is suitable for woodland. The major management concerns are equipment limitations, windthrow hazard, and seedling mortality. Equipment limitations can be partly overcome by timing woodland operations to seasons of the year when the soil is relatively dry or frozen. Special harvesting equipment is usually needed because crawler tractors and rubber-tired skidders are generally unsuitable for muck soils. Windthrow can be reduced by using harvesting methods that do not leave trees standing alone or widely spaced. Seedling mortality generally exceeds 50 percent. Planting seedlings is generally difficult because the soil is too wet.

This soil is generally unsuitable for recreational development because of the low strength of the soil, the high water table, and the susceptibility to ponding. Drainage outlets generally are not available.

Because of its low strength and susceptibility to ponding, this soil is not suited to use as building sites and septic tank absorption fields.

This soil is in capability subclass Vw and Michigan soil management group Mc.

28—Houghton muck, ponded. This very poorly drained, nearly level soil is in swamps. It is usually ponded (fig. 13). Individual areas range from 3 to 300 acres.

Typically, about 1 foot to 2 feet of water is on the soil surface. Below this are well decomposed and partially decomposed layers of black or dark reddish brown muck. In some places, the muck layers may be underlain by material that ranges in texture from sand to clay loam.

Permeability of this Houghton soil is moderately slow to moderately rapid, and the available water capacity is high. Surface runoff is ponded. The high water table ranges from 2 feet above to 1/2 foot below the surface from September to June.

Most areas of this soil are in marsh grass and brush. Some areas are in woodland. The soil is best suited to wetland wildlife habitat.

This soil is not suited to cropland or pasture. The soil has low strength, which limits its ability to support machinery or livestock. This soil is ponded during most of the year.

This soil is generally not suitable for woodland, recreational development, or building site development because of the hazard of ponding. Drainage outlets generally are not available.

This soil is in capability subclass VIIIw and Michigan soil management group Mc.

29—Loxley muck. This very poorly drained, nearly level soil is in small depressions or swamps. It is subject to frequent ponding. Individual areas range from 3 to 360 acres.

Typically, the surface layer is brown, slightly decomposed, acidic muck about 2 inches thick. The underlying layer to a depth of about 60 inches is black or

Figure 13.—Houghton muck, ponded, has standing water year round. Cattails and dead trees are common.

dark reddish brown, well decomposed, acidic muck. In some places, the soil is not acidic.

Included with this soil in mapping are small areas of very poorly drained Adrian soils. Adrian soils have a sandy substratum and are on landscape positions similar to those of the Loxley soil. These included soils make up 5 to 10 percent of the unit.

Permeability of this Loxley soil is moderately slow to moderately rapid, and the available water capacity is high. Surface runoff is very slow to ponded. This soil has a high water table at or above the surface from fall to spring.

Most areas of this soil are in leatherleaf bogs. In some areas this soil supports a few trees.

This soil is generally not suited to cropland or pasture because of the low strength of the soil, the acid reaction, the lack of drainage outlets, the high water table, and ponding. Most areas remain undrained and are unable to support machinery or livestock.

This soil is generally not suitable for woodland. The major factors that prevent the survival of most trees are the high water table, the hazard of ponding, and soil acidity. Harvesting the trees is difficult because of the low strength of the soil. Seedlings are generally not planted because the soil is too wet.

Recreational development of this soil is generally impractical because of the low strength of the soil, the high water table, and the hazard of ponding. These limitations are difficult to overcome.

Because of its low strength and susceptibility to ponding, this soil is not suited to use as building sites and septic tank absorption fields.

This soil is in capability subclass VIIw and Michigan soil management group Mc-a.

30—Adrian muck. This very poorly drained, nearly level soil is in depressions and swamps. It is frequently ponded. Individual areas range from 5 to 300 acres.

Typically, the upper layers are black, well decomposed muck to a depth of about 31 inches. The substratum to a depth of about 60 inches is brown and grayish brown, calcareous gravelly sand. In some places, the muck layers are more than 51 inches thick.

Included with this soil in mapping are small areas of the poorly drained Glendora and Roscommon soils. Glendora soils are located near streams. Roscommon soils are near the edge of the unit. These included soils make up 5 to 15 percent of the unit.

Permeability of this Adrian soil is moderately slow to moderately rapid in the muck layers and rapid in the mineral substratum. The available water capacity is high, and surface runoff is very slow to ponded. This soil has a high water table at or above the surface from fall to spring.

Most areas of this soil are in woodland. Some areas are in marsh grass and brush.

This soil is generally not suited to cropland or pasture because of ponding, the high water table, and the low strength of the soil. Drainage outlets are not available in most areas.

This soil is suitable for woodland. The major management concerns are equipment limitations, the windthrow hazard, and seedling mortality. Equipment limitations can be partly overcome by timing woodland operations to seasons when the soil is relatively dry or frozen. Special equipment may be needed because crawler tractors and rubber-tired skidders are generally not suited to use on muck soils. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Seedling mortality generally exceeds 50 percent. Planting seedlings is difficult because of soil wetness.

Recreational development of this soil is generally impractical because of the high water table, the hazard of ponding, and the low strength of the soil. These concerns are difficult to overcome. Drainage outlets are not available in most areas.

Because of its low strength and susceptibility to ponding, this soil is not suited to use as building sites and septic tank absorption fields.

This soil is in capability subclass Vw and Michigan soil management group M/4c.

31A—Algansee loamy sand, 0 to 3 percent slopes. This somewhat poorly drained, nearly level soil is on flood plains. It is subject to occasional flooding. Individual areas range from 3 to 50 acres.

Typically, the surface layer is very dark gray loamy sand about 10 inches thick. The substratum to a depth of about 60 inches is mottled sand. In the upper part it is yellowish brown, in the middle part it is brown, and in the lower part it is grayish brown. In some places, the substratum has bands of sandy loam or gravelly sand.

Included with this soil in mapping are small areas of poorly drained Glendora soils. They are in the slightly lower depressions and make up 3 to 5 percent of the unit.

Permeability of this Algansee soil is rapid, and the available water capacity is low. Surface runoff is slow or very slow. The seasonal high water table is at a depth of 1 foot to 2 feet from late fall to spring.

Most areas of this soil are idle or are in woodland. Some areas are in pasture.

This soil is suited to crops, such as corn, winter wheat, oats, dry beans, and alfalfa. The major management concerns are occasional flooding, the seasonal high water table, midsummer droughtiness, and soil blowing. If this soil is used for cultivated crops, underground drains are generally needed. If tile lines are installed, a suitable filter material, such as grass clippings, fiberglass mats, or straw, is needed around the lines to prevent flowing sand from plugging the drain. Crops that mature early in the season, such as small grains, make good

use of soil moisture. Soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and wind stripcropping and cover crops.

This soil is fairly suited to pasture. The major concerns are occasional flooding and midsummer droughtiness. Grazing is restricted during flooding, and plant growth is reduced during the dry summers. Frequent rotation of pastures can help maintain productivity during periods of drought.

This soil is suitable for woodland. There are no major management concerns.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concerns are excess water and flooding. Filling areas with suitable material helps to overcome the wetness concern.

Because of the hazard of flooding and the seasonal high water table, this soil is not suited to use as building sites and septic tank absorption fields.

This soil is in capability subclass IIIw and Michigan soil management group L-4c.

32—Glendora loamy sand. This poorly drained, nearly level soil is on flood plains. It is subject to frequent flooding (fig. 14). Individual areas range from 3 to 240 acres.

Typically, the surface layer is black loamy sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown sand in the upper part; very dark grayish brown loamy sand in the next part; brown, mottled sand in the next part; and grayish brown sand in the lower part. In some places, the substratum has bands of sandy loam and gravelly sand.

Included with this soil in mapping are small areas of the very poorly drained Adrian soils and the somewhat poorly drained Algansee soils. Adrian soils are in the slightly lower depressions. Algansee soils are on the

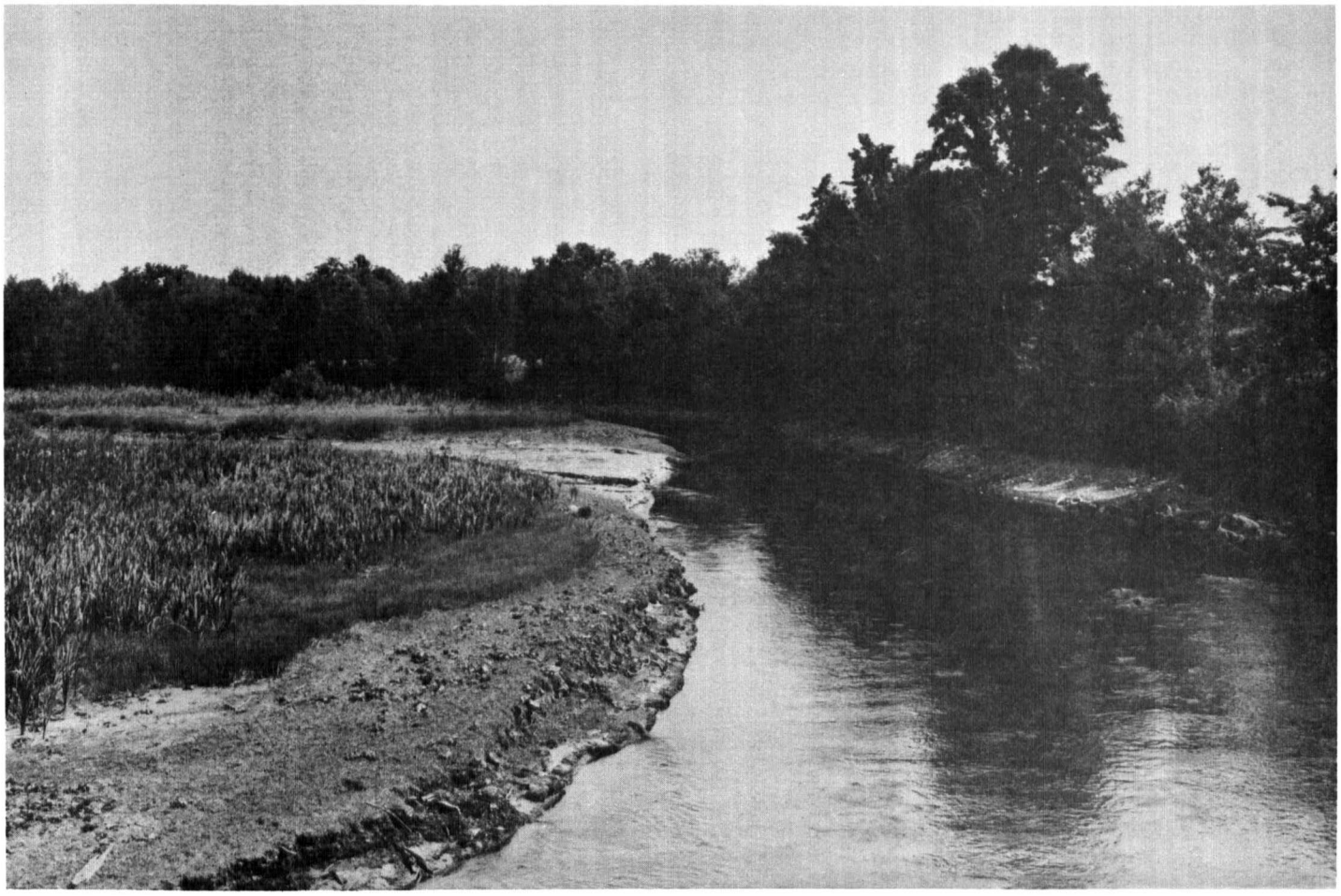


Figure 14.—Glendora soils are often located next to the Little Muskegon River.

slightly higher rises. These included soils make up 10 to 15 percent of the unit.

Permeability of this Glendora soil is rapid, and the available water capacity is low. Surface runoff is very slow or ponded. This soil has a high water table at the surface or within a depth of 1 foot from late fall to early summer.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland because of frequent flooding. Another major concern is the high water table. Drainage outlets are not available in most areas.

This soil is poorly suited to pasture because of frequent flooding. Grazing should be restricted during flooding.

This soil is suited to woodland. The major management concerns are equipment limitations, the windthrow hazard, and seedling mortality. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is usually difficult because the soil is too wet.

This soil is poorly suited to recreational development because of the hazard of flooding and the high water table. These concerns severely limit the time of use.

Because of the hazard of flooding and the high water table, this soil is not suited to use as building sites and septic tank absorption fields.

This soil is in capability subclass VIw and Michigan soil management group L-4c.

33A—Wixom loamy sand, 0 to 3 percent slopes. This somewhat poorly drained, nearly level soil is in depressions and along drainageways. Individual areas range from 5 to 40 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil is mottled and about 25 inches thick. The upper part is strong brown sand, the middle part is pale brown clay loam, and the lower part is brown clay loam. The substratum to a depth of about 60 inches is brown, mottled, calcareous clay loam. In some places, the lower part of the subsoil and the substratum are clay.

Included with this soil in mapping are small areas of poorly drained Corunna soils and well drained Metea soils. Corunna soils are in lower depressions than the Wixom soil. Metea soils are on the higher rises. These included soils make up 5 to 15 percent of the unit.

Permeability of this Wixom soil is rapid in the upper part of the profile and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is slow. This soil has a seasonal high water table at a depth of 1 foot to 2 feet from late fall to early summer. The shrink-swell potential is moderate in the lower part of the profile.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is suited to crops, such as corn, dry beans, snap beans, winter wheat, oats, asparagus, sunflowers, potatoes, and alfalfa. The major management concerns are the seasonal high water table and soil blowing. Combined surface and subsurface drainage systems help control wetness. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Crop yields of corn, dry beans, snap beans, and potatoes can be increased with irrigation.

This soil is suited to pasture. Legumes and grasses that are tolerant of wet conditions are the most suitable for undrained areas.

This soil is suitable for woodland. The major management concern is the equipment limitation. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. In some places, the water table can be lowered with subsurface drains. Filling areas with suitable material can help overcome the wetness concern.

This soil is poorly suited to building site development. The major concern is wetness. This soil can be used as a site for buildings if well compacted fill is used to raise the level of the site and if surface or subsurface drainage is used to lower the water table. This soil is poorly suited to septic tank absorption fields. Wetness and moderately slow permeability are the major concerns. A special structure, such as an absorption field that is larger than normal or that has been filled or mounded with suitable soil material or a system containing alternating absorption fields, may be needed to overcome the wetness and permeability concerns.

This soil is in capability subclass IIIw and Michigan soil management group 4/2b.

34A—Pipestone loamy sand, 0 to 3 percent slopes. This somewhat poorly drained, nearly level soil is in depressions or on broad flat plains. Individual areas range from 5 to 100 acres.

Typically, the surface layer is very dark brown and very dark grayish brown loamy sand about 9 inches thick. The subsoil is mottled and about 15 inches thick. The upper part is brown loamy sand, and the lower part is dark yellowish brown sand. The substratum to a depth of

about 60 inches is yellowish brown, mottled sand. In some places, the substratum has sandy loam bands.

Included with this soil in mapping are small areas of moderately well drained Covert soils and poorly drained Edmore and Roscommon soils. Covert soils are on slightly higher rises than the Pipestone soil. Edmore and Roscommon soils are in the lower depressions. These included soils make up 5 to 15 percent of the unit.

Permeability of this Pipestone soil is rapid, and the available water capacity is low. Surface runoff is slow or very slow. The seasonal high water table is at a depth of 1 foot to 2 feet from fall to early summer.

Most areas of this soil are in woodland or pasture. Some areas are in cropland or are idle.

This soil is suited to crops, such as corn, winter wheat, oats, dry beans, snap beans, asparagus, sunflowers, potatoes, and alfalfa. The major management concerns are the seasonal high water table, midsummer droughtiness, and soil blowing. Crop yields are commonly improved by installing subsurface drainage. If tile lines are installed, a suitable filter material, such as grass clippings, fiberglass mats, or straw, is needed around the lines to prevent the flowing sand from plugging the drain. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Irrigation can significantly increase yields of such crops as corn, potatoes, dry beans, and snap beans.

This soil is fairly suited to pasture. Droughtiness is a concern during midsummer. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. There are no major management concerns.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. In some places, the water table can be lowered with subsurface drains. Filling areas with suitable material can help overcome the wetness concern.

This soil is poorly suited to building site development. The major concern is wetness. This soil can be used as a site for buildings if surface or subsurface drainage is used to lower the water table and if well compacted fill is used to raise the level of the site. This soil is poorly suited to septic tank absorption fields. Wetness and poor filtering capacity are the major concerns. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent, which can pollute ground water. Special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site above the water table and increase the filtering capacity.

This soil is in capability subclass IVw and Michigan soil management group 5b.

35B—Capac loam, 0 to 4 percent slopes. This somewhat poorly drained, nearly level or undulating soil is in depressions or on flat plains. Individual areas range from 5 to 100 acres.

Typically, the surface layer is very dark grayish brown loam about 11 inches thick. The mottled subsoil is pale brown to light brownish gray clay loam about 29 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous clay loam. In some places, the subsoil is clay.

Included with this soil in mapping are small areas of somewhat poorly drained Arkona and Riverdale soils. These soils are sandy in the upper part of the profile. Arkona soils are on the base of slopes. Riverdale soils are along drainageways and have a gravelly sand substratum. These included soils make up 8 to 10 percent of the unit.

Permeability of this Capac soil is moderately slow, and the available water capacity is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 foot to 2 feet from late fall to spring.

Most areas of this soil are in cropland or are idle. Some areas are in pasture or woodland.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the seasonal high water table, puddling and crusting, and slowness of the soil to warm in the spring. Installing artificial drainage commonly improves crop yields and reduces soil puddling and crusting. Puddling and crusting can also be reduced by tilling when the soil is not excessively wet and by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Irrigation can increase yields of corn, dry beans, potatoes, and snap beans.

This soil is well suited to pasture. Grazing when this soil is wet should be avoided in order to prevent surface compaction, excessive runoff, and damage to soil structure. Legumes and grasses that are tolerant of wet conditions are most suitable in undrained areas.

This soil is well suited to woodland. The major management concern is the equipment limitation. The wet, sticky nature of the soil limits the use of equipment during wet periods. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen.

This soil is fairly suited to picnic areas and paths and trails and poorly suited to camp areas and playgrounds. The major management concern is excess water. The limited permeability is also a concern for picnic areas and playgrounds. The wetness limitation can be reduced

by lowering the water table with tile drains and by using coarse-textured fill in the low areas. Drainage outlets may not be available.

This soil is poorly suited to building site development because of wetness, and it is generally not suited to septic tank absorption fields because of wetness and the moderately slow permeability.

This soil is in capability subclass IIw and Michigan soil management group 2.5b.

37A—Locke sandy loam, 0 to 3 percent slopes. This somewhat poorly drained, nearly level soil is in depressions or on flat plains. Individual areas range from 3 to 100 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The brown, mottled subsoil is about 17 inches thick. The upper part is sandy loam, and the lower part is sandy clay loam. The substratum is yellowish brown, mottled, and calcareous. The upper part is loam, and the lower part to a depth of about 60 inches is sandy loam.

Included with this soil in mapping are small areas of well drained Remus soils and somewhat poorly drained Thetford and Ithaca soils. Remus soils are on higher rises than the Locke soil. Thetford soils have moderately rapid permeability, and Ithaca soils have moderately slow permeability. These included soils make up 10 to 15 percent of the unit.

Permeability of this Locke soil and the available water capacity are moderate. Surface runoff is slow. The seasonal high water table is at a depth of 1 foot to 2 feet from late fall to spring.

Most areas of this soil are in cropland or pasture. Some areas are in woodland or are idle.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the seasonal high water table and soil blowing. Crop yields are commonly improved by installing artificial drainage. Soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Crop yields of corn, dry beans, potatoes, and snap beans can be increased with irrigation.

This soil is well suited to pasture. Legumes and grasses that are tolerant of wet conditions are most suitable in undrained areas.

This soil is well suited to woodland. The major management concern is the equipment limitation. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen.

This soil is fairly suited to picnic areas and paths and trails and poorly suited to camp areas and playgrounds. The major management concern is excess water. The water table can be lowered with subsurface drains, and low wet areas can be filled with suitable material.

This soil is poorly suited to building site development and septic tank absorption fields. The major concern is the seasonal high water table. This soil can be used as a site for buildings if well compacted fill is used to raise the level of the site, and if surface or subsurface drainage is used to lower the water table. For septic tank absorption fields, special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site above the water table.

This soil is in capability subclass IIw and Michigan soil management group 3b.

38A—Thetford loamy sand, 0 to 3 percent slopes. This somewhat poorly drained, nearly level soil is in depressions or on flat plains. Individual areas range from 5 to 80 acres.

Typically, the surface layer is black loamy sand about 4 inches thick. The subsoil is about 56 inches thick. It is yellowish brown to pale brown, mottled loamy sand in the upper part and brown sand with bands of brown sandy loam and loamy sand in the lower part. In some places, the loamy sand and sandy loam bands are absent.

Included with this soil in mapping are small areas of poorly drained Edmore and Roscommon soils and somewhat poorly drained Wixom soils. Edmore and Roscommon soils are in the lower depressions. Wixom soils have a clay loam substratum and are on landscape positions similar to those of the Thetford soil. These included soils make up 5 to 15 percent of the unit.

Permeability of this Thetford soil is moderately rapid, and the available water capacity is low. Surface runoff is slow or very slow. The seasonal high water table is at a depth of 1 foot to 2 feet in winter and spring.

Most areas of this soil are in woodland or pasture. Some areas are in cropland or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the seasonal high water table (fig. 15), midsummer droughtiness, and soil blowing. Crop yields commonly are improved by installing subsurface drainage. If tile lines are installed, a suitable filter material, such as grass clippings, fiberglass mats, or straw, is needed around the lines to prevent the flowing sand from plugging the drain. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and thereby leaves all or part of the crop residue on the surface. Irrigation can significantly increase yields of corn, potatoes, dry beans, and snap beans.

This soil is suited to pasture. Midsummer droughtiness is the major management concern. Because plant growth is limited by the droughtiness of the soil, rotational

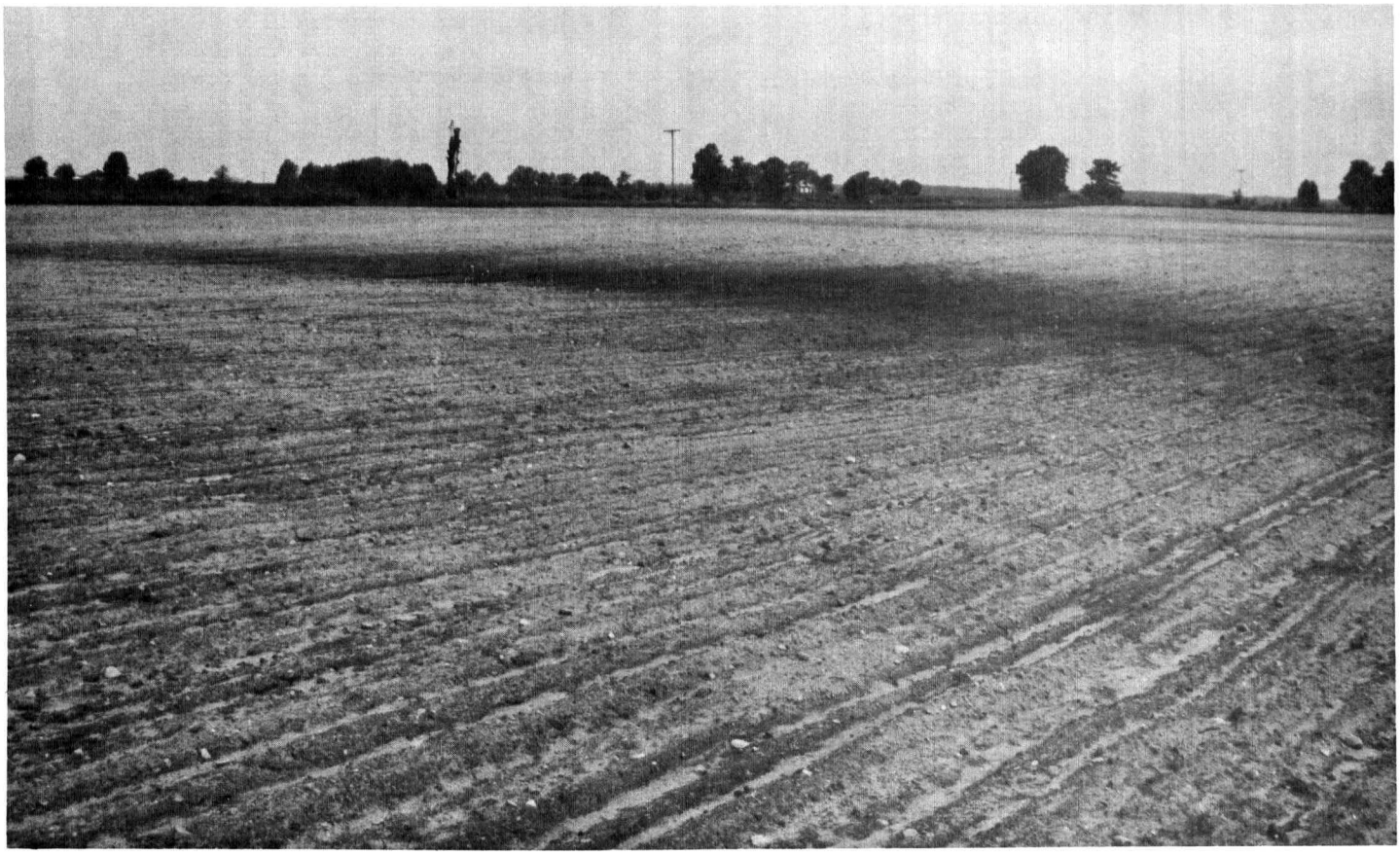


Figure 15.—Thetford soils have a seasonal high water table and a dark surface layer. Spinks soils have a lighter colored surface layer.

grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. There are no major management concerns.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. Filling areas with suitable material and lowering the water table with subsurface drainage can help overcome the wetness.

This soil is poorly suited to building site development and septic tank absorption fields. The major concern is the seasonal high water table. Poor filtering capacity is also a concern for septic tank absorption fields. This soil can be used as a site for buildings if surface or subsurface drainage is used to lower the water table and if well compacted fill is used to raise the level of the site. For septic tank absorption fields, special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site above the water table. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent, which can pollute ground water.

This soil is in capability subclass IIIw and Michigan soil management group 4b.

39B—Riverdale loamy sand, 0 to 4 percent slopes. This somewhat poorly drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 5 to 100 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The next part is yellowish brown, mottled loamy sand and sand, about 29 inches thick. The next part is yellowish brown, mottled, gravelly sandy clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous very gravelly sand.

Included with this soil in mapping are small areas of moderately well drained Covert soils and poorly drained Vestaburg soils. Covert soils are on slightly higher rises than the Riverdale soil. Vestaburg soils are in the lower depressions and are along drainageways. These included soils make up 5 to 15 percent of the unit.

Permeability of this Riverdale soil is moderately rapid in the upper part of the profile and very rapid in the lower part. The available water capacity is low, and

surface runoff is slow. The seasonal high water table is at a depth of 1 foot to 2 feet from late fall to spring.

Most areas of this soil are in cropland or are idle. Some areas are in woodland or pasture.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the seasonal high water table, midsummer droughtiness, and soil blowing. Crop yields are commonly improved by installing artificial subsurface drainage. If tile lines are installed, a suitable filter material, such as grass clippings, fiberglass mats, or straw, is needed around the lines to prevent the flowing sand from plugging the drain. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Irrigation can significantly increase yields of corn, potatoes, dry beans, and snap beans.

This soil is suited to pasture. Midsummer droughtiness is the major concern. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the year.

This soil is suitable for woodland. There are no major management concerns.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. Filling areas with suitable soil material and lowering the water table with subsurface drainage can help overcome the wetness.

This soil is poorly suited to building site development. Wetness is a limitation. This soil can be used as a site for buildings if the water table is lowered by tiling or by digging ditches and if well compacted fill is used to raise the level of the site. This soil is poorly suited to septic tank absorption fields. Wetness and poor filtering capacity are limitations. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent, which can pollute ground water. Special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site above the water table.

This soil is in capability subclass IIIw and Michigan soil management group 4b.

40B—Aubbeenaubbee fine sandy loam, 0 to 4 percent slopes. This somewhat poorly drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 5 to 30 acres.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsurface layer is yellowish brown, mottled fine sandy loam about 8 inches thick. The subsoil is about 22 inches thick. The upper part is brown, mottled sandy clay loam and clay loam, and the lower part is grayish brown and strong brown clay loam. The substratum to a depth of about 60 inches is gray, mottled, calcareous clay loam. In some places, the substratum is sandy loam or sandy clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Thetford soils and moderately well drained Marlette soils. Thetford soils are more droughty and are on landscape positions similar to those of the Aubbeenaubbee soil. Marlette soils are on the higher knolls and rises. These included soils make up 5 to 10 percent of the unit.

Permeability of this Aubbeenaubbee soil is moderately rapid in the upper part of the profile and moderately slow in the lower part. The available water capacity is high, and surface runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet in winter and spring.

Most areas of this soil are in cropland or are idle. Some areas are in pasture or woodland.

This soil is well suited to crops, such as corn, dry beans, winter wheat, oats, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the seasonal high water table and soil blowing. Crop yields are commonly improved by installing artificial drainage. Wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, can help prevent soil blowing. If the soil is irrigated, yields of corn, potatoes, dry beans, and snap beans are increased.

This soil is well suited to pasture. The major concern is the seasonal high water table. Grasses and legumes that are tolerant of wet conditions are the most suitable in undrained areas.

This soil is well suited to woodland. The major management concern is the equipment limitation. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. Filling areas with suitable soil material and lowering the water table with subsurface drainage can help overcome the wetness.

This soil is poorly suited to building site development because of wetness. This soil can be used as a site for buildings if surface or subsurface drainage is used to lower the water table and if well compacted fill is used to raise the level of the site. This soil is poorly suited to septic tank absorption fields because of wetness and moderately slow permeability. Special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site

above the water table and overcome the permeability concern.

This soil is in capability subclass IIw and Michigan soil management group 3/2b.

41—Corunna fine sandy loam. This poorly drained, nearly level soil is in depressions or on flat plains. It is subject to frequent ponding. Individual areas range from 5 to 100 acres.

Typically, the surface layer is very dark gray fine sandy loam about 11 inches thick. The subsoil is grayish brown sandy loam about 24 inches thick. The substratum to a depth of about 60 inches is grayish brown, calcareous sandy clay loam.

Included with this soil in mapping are small areas of the very poorly drained Palms soils. These included soils are in the lower depressions and make up 5 to 10 percent of the unit.

Permeability of this Corunna soil is moderate or moderately rapid in the upper part of the profile and moderately slow in the lower part. The available water capacity is high, and surface runoff is very slow to ponded. This soil has a high water table at or above the surface from fall to spring. The shrink-swell potential is moderate in the lower part of the profile.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland because of ponding and the high water table. Drainage outlets are not available in most areas.

This soil is poorly suited to pasture. Ponding is the major concern because most areas do not have drainage outlets. In some places, excess water can be removed by surface or subsurface drainage. Grasses that are tolerant of wet conditions are the most suitable in undrained areas.

This soil is suitable for woodland. The major management concerns are equipment limitations, the windthrow hazard, and seedling mortality. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is difficult because the soil is too wet.

This soil is generally not suitable for recreational development because of the high water table and the hazard of ponding. Drainage outlets are generally not available.

This soil is generally not suitable for building site development and septic tank absorption fields because of the high water table and ponding.

This soil is in capability subclass Vw and Michigan soil management group 3/2c.

42—Palms muck. This very poorly drained, nearly level soil is in depressions and swamps. It is subject to frequent ponding. Individual areas range from 5 to 20 acres.

Typically, the surface layer is slightly decomposed dark reddish brown muck about 2 inches thick. The subsurface layer is multicolored well decomposed muck about 32 inches thick. The olive gray substratum consists of two parts. The upper part is clay loam, and the lower part to a depth of about 60 inches is sandy clay loam. In some places, the substratum is loamy sand.

Included with this soil in mapping are small areas of poorly drained Edmore and Corunna soils. These included soils are slightly higher on the landscape than the Palms soil and make up 5 to 10 percent of the unit.

Permeability of this Palms soil is moderately slow to moderately rapid. The available water capacity is high, and surface runoff is very slow. The high water table is at or above the surface from late fall to spring.

Most areas of this soil are in woodland. Some areas are in marsh grass and shrubs.

This soil is generally not suited to cropland or pasture because of the low strength of the soil, the high water table, and ponding.

This soil is suitable for woodland. The major management concerns are the windthrow hazard, equipment limitation, and seedling mortality. Windthrow can be reduced by using harvest methods that do not leave trees standing alone or widely spaced. Equipment limitations can be partly overcome by timing woodland operations to seasons when the soil is relatively dry or frozen. Special harvesting methods may be needed because rubber-tired skidders and crawler tractors are not suited to use on muck soils. Seedling mortality generally exceeds 50 percent. Planting seedlings is generally difficult because of soil wetness and instability.

The use of this soil for recreational development is generally not practical because of the high water table, the hazard of ponding, and the low strength of the soil. These concerns are difficult to overcome. Drainage outlets are generally not available.

This soil is not suited to building site development and septic tank absorption fields because of ponding and low strength.

This soil is in capability subclass Vw and Michigan soil management group M/3c.

43B—Arkona loamy sand, 0 to 4 percent slopes. This somewhat poorly drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 5 to 100 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The mottled subsoil is about 32 inches thick. The upper part is brown or dark yellowish brown loamy sand, the middle part is yellowish brown sand, and the lower part is brown silty clay. The

substratum to a depth of about 60 inches is brown, mottled, calcareous silty clay. In some places, the lower part of the subsoil and the substratum are loam or clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Ithaca soils, well drained Tustin soils, and very poorly drained Wauseon soils. Ithaca soils are on landscape positions similar to those of the Arkona soil, and they have moderately slow permeability. The Tustin soils are on the higher rises, and the Wauseon soils are in the lower depressions. These included soils make up 5 to 15 percent of the unit.

Permeability of this Arkona soil is rapid in the upper part of the profile and slow in the lower part. The available water capacity is low, and surface runoff is slow. The seasonal high water table is at a depth of 1 foot to 2 feet from late fall to spring. The shrink-swell potential is high in the lower part of the profile.

Most areas of this soil are in woodland or are idle. Some areas are in cropland or pasture.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the seasonal high water table and soil blowing. Crop yields are commonly improved by installing artificial drainage. Subsurface drains are used to lower the water table. Wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, can help prevent soil blowing. Irrigation can increase yields of corn, potatoes, dry beans, and snap beans.

This soil is suited to pasture. Legumes and grasses that are tolerant of wet conditions are the most suitable in undrained areas.

This soil is suitable for woodland. The major management concern is the equipment limitation. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen.

This soil is poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The major management concern is excess water. In some places, the water table can be lowered with subsurface drainage. Filling areas with suitable soil material can help overcome the wetness concern.

This soil is poorly suited to building site development because of the wetness limitation and the shrink-swell potential. If this soil is used for building sites, surface or subsurface drainage can be used to lower the water table. Backfilling around foundations with coarse textured soil and providing footing drains help prevent structural damage caused by shrinking and swelling of the soil. This soil is poorly suited to septic tank absorption fields because of the seasonal high water table and slow permeability. Special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to overcome the wetness and permeability concerns.

This soil is in capability subclass IIIw and Michigan soil management group 4/1b.

44—Wauseon sandy loam. This very poorly drained, nearly level soil is in depressions or on flat plains. It is subject to frequent ponding. Individual areas range from 5 to 120 acres.

Typically, the surface layer is black sandy loam about 11 inches thick. The mottled subsoil is grayish brown to olive sandy loam about 13 inches thick. The substratum to a depth of about 60 inches is light olive brown, mottled, calcareous silty clay. In some places, the surface layer is muck or the subsoil is loamy sand.

Included with this soil in mapping are small areas of poorly drained Edmore soils, somewhat poorly drained Ithaca soils, and well drained Tustin soils. Edmore soils have moderately rapid permeability and are on landscape positions similar to those of the Wauseon soil. Ithaca soils are on slight rises, and Tustin soils are on the higher knolls. These included soils make up 10 to 15 percent of the unit.

Permeability of this Wauseon soil is moderately rapid in the upper part of the profile and very slow in the lower part. The available water capacity is moderate, and surface runoff is very slow to ponded. The high water table is at or above the surface in winter and spring. The shrink-swell potential is high in the lower part of the profile.

Most areas of this soil are in woodland. Some areas are in pasture or are idle.

This soil is generally not suited to cropland because of ponding and the high water table. Drainage outlets are not available in most areas.

This soil is poorly suited to pasture because of ponding. Drainage outlets are not available in most areas. Grasses that are tolerant of wet conditions are most suitable on this soil.

This soil is suited to woodland. The major management concerns are the windthrow hazard, equipment limitations, and seedling mortality. Windthrow can be reduced by using harvesting methods that do not leave trees standing alone or widely spaced. Road and trail systems should be planned to allow for salvage of blown-over trees. Equipment can form ruts when this soil is wet; therefore, woodland operations should be timed to seasons when the soil is relatively dry or frozen. Seedling mortality may be reduced by special site preparation, such as bedding. Planting seedlings is difficult because the soil is too wet.

This soil is generally not suitable for recreational development because of the high water table and the hazard of ponding. These limitations are difficult to overcome. Drainage outlets are generally not available.

This soil is generally not suitable for building site development and septic tank absorption fields because of the high water table and ponding.

This soil is in capability subclass Vw and Michigan soil management group 3/1c.

45B—Coloma loamy sand, loamy substratum, 0 to 6 percent slopes. This somewhat excessively drained, nearly level or undulating soil is on flat or slightly convex plains. Slopes are smooth and convex. Individual areas range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil, about 40 inches thick, is yellowish brown and brownish yellow sand with bands of brown loamy sand. The substratum to a depth of 60 inches is brown, mottled, calcareous clay loam. In some places, the substratum is loamy sand with sandy loam bands.

Included with this soil in mapping are small areas of well drained Metea soils and somewhat poorly drained Wixom soils. The Metea soils are less droughty and are on landscape positions similar to those of the Coloma soil. Wixom soils are in the lower depressions. These included soils make up 10 to 15 percent of the unit.

Permeability of this Coloma soil is rapid in the upper part of the profile and moderately slow or moderate in the lower part. The available water capacity is low, and surface runoff is slow.

Most areas of this soil are in pasture or are idle. Some areas are in cropland or woodland.

This soil is suited to corn, dry beans, winter wheat, oats, alfalfa, potatoes, asparagus, sunflowers, and snap beans. If irrigated, this soil is well suited to cropland. Overcoming droughtiness, increasing the organic matter content, and preventing soil blowing are the main management concerns. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Plowing under manure and green manure crops increases the organic matter content. Wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, can help prevent soil blowing. Irrigation can increase yields of corn, potatoes, dry beans, and snap beans.

This soil is fairly suited to pasture. The major concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the year.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought ranges from 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is well suited to recreational development. Land leveling and shaping may be needed for playgrounds.

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

This soil is in capability subclass IVs and Michigan soil management group 5/2a.

46B—Tustin loamy sand, 0 to 6 percent slopes. This well drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 3 to 40 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown to strong brown sand, and the lower part is dark yellowish brown clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous silty clay. In some places, the lower part of the subsoil and the substratum are loam or clay loam.

Included with this soil in mapping are small areas of somewhat excessively drained Coloma soils. Coloma soils are more droughty than the Tustin soil and are on similar positions on the landscape. These included soils make up 10 to 15 percent of the unit.

Permeability of this Tustin soil is rapid in the upper part of the profile and slow in the lower part. Surface runoff is slow, and the available water capacity is moderate. The shrink-swell potential is high in the lower part of the profile.

Most areas of this soil are in cropland or are idle. Some areas are in woodland or pasture.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are erosion and soil blowing. Erosion and soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Erosion is also reduced by using grassed waterways, cover crops, and diversions. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, and cover crops. Irrigation can increase yields of corn, potatoes, dry beans, and snap beans.

This soil is suited to pasture. The major management concern is droughtiness during the summer months. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to help protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is suitable for woodland. The major management concern is seedling mortality. Seedling mortality is generally between 25 and 50 percent. To

offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is generally suited to recreational development. Slow permeability in the lower part of the profile is a management concern for camp and picnic areas. Land leveling and shaping may be needed for playgrounds.

This soil is suited to buildings without basements. The shrink-swell potential of the soil is a concern for buildings with basements. Foundation trenches, therefore, should be wider than normal and should be backfilled with suitable coarse material. This soil is poorly suited to septic tank absorption fields because of its slow permeability. A special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, can overcome this limitation.

This soil is in capability subclass IIIe and Michigan soil management group 4/1a.

46C—Tustin loamy sand, 6 to 12 percent slopes. This well drained, gently rolling soil is on low to medium knolls or mounds. Most individual areas are dissected by shallow drainageways and range from 5 to 30 acres.

Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 27 inches thick. The upper part is brown and yellowish brown sand, and the lower part is brown, mottled clay. The substratum to a depth of about 60 inches is yellowish brown, calcareous silty clay. In some places, the substratum and the lower part of the subsoil are loam or clay loam.

Included with this soil in mapping are small areas of somewhat excessively drained Coloma soils. Coloma soils are more droughty than the Tustin soil and are on similar positions on the landscape. These included soils make up 5 to 15 percent of the unit.

Permeability of this Tustin soil is rapid in the upper part of the profile and slow in the lower part. The available water capacity is moderate, and surface runoff is medium. The lower part of the profile has high shrink-swell potential.

Most areas of this soil are in pasture or woodland. Some areas are in cropland or are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are erosion and soil blowing. Erosion and soil blowing can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Erosion is also reduced by using grassed waterways, cover crops, and diversions. Soil blowing can be reduced by using wind stripcropping, vegetative barriers, field windbreaks, and cropping systems that emphasize small grains, hay, and cover crops. Irrigation can increase yields of corn, potatoes, dry beans, and snap beans.

This soil is suitable for pasture. Droughtiness is a major management concern during the summer months. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pasture should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is suitable for woodland. The major management concern is seedling mortality. Seedling mortality can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is suited to paths and trails and fairly suited to camp areas and picnic areas. The major management concern is slope. Slow permeability is also a concern for camp areas and picnic areas. This soil is generally not suited to playgrounds because of the slope limitation. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is poorly suited to buildings with basements because of the slope limitation and the shrink-swell potential. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. Foundation trenches should be wider than normal and should be backfilled with suitable coarse material to control the shrink-swell potential of the soil. This soil is poorly suited to septic tank absorption fields because of slope and slow permeability. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of the septic tank absorption field. Also, a special structure, such as an absorption field that is larger than normal or a system containing alternating absorption fields, can overcome the limited permeability.

This soil is in capability subclass IVe and Michigan soil management group 4/1a.

47B—Mecosta sand, 0 to 4 percent slopes. This somewhat excessively drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 20 to 300 acres.

Typically, the surface layer is dark brown sand about 10 inches thick. The subsoil is about 12 inches thick. The upper part is strong brown and yellowish brown sand and gravelly sand, and the lower part is brown, gravelly coarse sand. The substratum to a depth of about 60 inches is pale brown, calcareous very gravelly and extremely gravelly coarse sand.

Included with this soil in mapping are small areas of well drained Spinks and Leoni soils. Spinks soils do not

have a gravelly sand substratum. Leoni soils are not as droughty. These soils are on landscape positions similar to those of the Mecosta soil. These included soils make up 5 to 15 percent of the unit.

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

Most areas of this soil are in woodland or are idle. Some areas are in pasture or cropland.

This soil is suited to small grains, asparagus, and alfalfa, but poorly suited to corn and dry beans. The major management concerns are overcoming droughtiness, preventing soil blowing, and increasing the organic matter content. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, can help prevent soil blowing. Plowing under green manure crops, manure, and crop residue can increase the organic matter content. Irrigation can greatly increase yields of such crops as corn, potatoes, dry beans, and snap beans.

This soil is fairly suited to pasture. The major management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should not be used or should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is suitable for woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is poorly suited to recreational development. The major management concern is the sandy surface layer. Slope may be a limitation for playgrounds. Loamy topsoil can be added and seeded with grasses and legumes. Paths and trails can be improved by a covering of wood chips or bark. Land shaping may be needed for playgrounds.

This soil is suited to building site development and septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass IVs and Michigan soil management group L-4a.

47C—Mecosta sand, 6 to 12 percent slopes. This somewhat excessively drained, gently rolling soil is on low to medium knolls or mounds. Individual areas range from 5 to 200 acres.

Typically, the surface layer is dark brown sand about 7 inches thick. The subsoil is about 15 inches thick. The upper part is strong brown sand, and the lower part is yellowish red gravelly sand. The substratum to a depth of about 60 inches is brownish yellow and light yellowish brown, calcareous very gravelly sand.

Included with this soil in mapping are small areas of well drained Spinks and Leoni soils. Spinks soils do not have a gravelly sand substratum. Leoni soils are not as droughty. These soils are on landscape positions similar to those of the Mecosta soil. These included soils make up 5 to 10 percent of the unit.

Permeability of this Mecosta soil is rapid in the upper part of the profile and very rapid in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to crops because of droughtiness and soil blowing. Many of the areas that have been under cultivation are being planted to tree seedlings or seeded to permanent pasture.

This soil is poorly suited to pasture. The major management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should not be grazed or should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is suitable for woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is poorly suited to camp areas, picnic areas, and paths and trails because of the sandy surface layer. It is generally not suited to playgrounds because of the slope limitation and sandy surface layer. Loamy topsoil can be added and seeded with grasses and legumes to improve the sandy surface layer for camp areas and picnic areas. Land leveling and shaping, though costly, can be used in constructing picnic areas and camp areas. Paths and trails can be improved by adding a covering of wood chips or bark.

This soil is fairly suited to building site development. Slope is a limitation. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is fairly suited to septic tank absorption fields. Slope and poor filtering capacity are limitations. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. This soil readily absorbs

the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass VIs and Michigan soil management group L-4a.

47D—Mecosta sand, 12 to 18 percent slopes. This somewhat excessively drained, rolling soil is on high knolls. Individual areas range from 5 to 20 acres.

Typically, the surface layer is dark brown sand about 6 inches thick. The subsoil is about 16 inches thick. The upper part is strong brown sand, and the lower part is brown gravelly sand. The substratum to a depth of about 60 inches is light yellowish brown, calcareous very gravelly sand.

Included with this soil in mapping are small areas of well drained Spinks and Leoni soils. Spinks soils do not have a gravelly sand substratum. Leoni soils are not as droughty. These soils are on landscape positions similar to those of the Mecosta soil. These included soils make up 5 to 10 percent of the unit.

Permeability of this Mecosta soil is rapid in the upper part of the profile and very rapid in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland because of droughtiness and excessive slope. Other concerns are erosion and soil blowing.

This soil is generally not suited to pasture because of droughtiness.

This soil is suitable for woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is generally not suited to camp areas, picnic areas, and playgrounds because of the slope and the sandy surface layer. It is poorly suited to paths and trails because of the sandy surface layer. Paths and trails can be improved by a covering of wood chips or bark.

This soil is poorly suited to building site development. Slope is a limitation. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is poorly suited to septic tank absorption fields. Slope and poor filtering capacity are limitations. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of the septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass VIIs and Michigan soil management group L-4a.

47E—Mecosta sand, 18 to 35 percent slopes. This somewhat excessively drained, hilly and steep soil is on low to high hills. Individual areas range from 5 to 80 acres.

Typically, the surface layer is very dark grayish brown sand about 3 inches thick. The subsoil is about 19 inches thick. The upper part is strong brown sand, and the lower part is brown gravelly sand. The substratum to a depth of about 60 inches is yellowish brown, calcareous very gravelly sand.

Included with this soil in mapping are small areas of well drained Leoni and Perrinton soils. Leoni and Perrinton soils are not as droughty as the Mecosta soil. These soils are on similar positions on the landscape. These soils make up 5 to 10 percent of the unit.

Permeability of this Mecosta soil is rapid in the upper part of the profile and very rapid in the lower part. Surface runoff is medium, and the available water capacity is low.

Most areas of this soil are in woodland or are idle. Some areas are in pasture.

This soil is generally not suited to cropland or pasture because of the steep slope. The use of equipment is restricted.

This soil is suitable for woodland. The major management concerns are equipment limitations, the hazard of erosion, and seedling mortality. The use of equipment to harvest logs increases the hazard of erosion. Hauling the logs uphill with a cable can reduce this hazard. If equipment is used, the logs should be hauled across the slope. Avoiding excessive removal of ground cover and placing roads, skidtrails, and landings on gentle grades can also reduce the erosion hazard. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

Recreational development of this soil is generally not practical because of the slope and the sandy surface layer.

This soil is generally not suited to building site development and septic tank absorption fields. Slope is a severe limitation for building sites. Slope and poor filtering capacity are limitations for septic tank absorption fields. Slope is a limitation that is difficult to overcome.

This soil is in capability subclass VIIs and Michigan soil management group L-4a.

48—Psammaquents, nearly level. This map unit consists of soils with a high water table that have been filled in with sandy material. In most areas the soils are somewhat poorly drained. Individual areas range from 2 to 30 acres.

The sandy fill material, which is 2 to 5 feet thick, covers the poorly drained mineral soils or the very poorly drained muck soils.

Permeability is rapid in the sandy fill material. The available water capacity commonly is low. Surface runoff is slow or very slow. The high water table is at a depth of 1 foot to 3 feet year round.

Most areas are idle or used for building sites.

The soils in this map unit are poorly suited to crops because of the high water table and the lack of topsoil. Drainage outlets are generally not available.

The soils in this map unit are fairly suitable for pasture. The major concern is the lack of topsoil.

These soils are suitable for woodland. The major concern is the equipment limitation. Roads tend to form ruts when the soil is wet. The equipment limitation can be overcome by timing woodland operations to seasons of the year when the soil is frozen.

These soils are poorly suited to camp areas and playgrounds and fairly suited to picnic areas and paths and trails. The high water table and the sandy surface layer are the main limitations to recreational uses. Adding additional sandy fill material may help overcome the wetness. Loamy topsoil should be added on top of the fill.

The suitability of these soils for building site development and septic tank absorption fields varies from poorly suited to generally not suited. Concerns include the high water table and the poor filtering capacity of the soil.

This map unit is not assigned to a capability subclass or a Michigan soil management group.

49A—Covert loamy sand, gravelly substratum, 0 to 3 percent slopes. This moderately well drained, nearly level soil is on flat plains and in small depressions. Individual areas range from 5 to 400 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil, to a depth of about 38 inches, is strong brown sand. Below a depth of 38 inches it is brown, mottled gravelly loamy sand and gravelly sand.

Included with this soil in mapping are small areas of somewhat excessively drained Mecosta soils and somewhat poorly drained Riverdale soils. Mecosta soils are on the higher rises, and Riverdale soils are in the lower depressions. These included soils make up 5 to 10 percent of the unit.

Permeability of this Covert soil is very rapid, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2 to 3 1/2 feet from late fall to spring.

Most areas of this soil are in pasture or are idle. Some areas are in cropland or woodland.

This soil is suited to small grains, asparagus, sunflowers, and alfalfa but poorly suited to corn and dry beans. The major management concerns are droughtiness, soil blowing, and wet depressions. Crops that mature early in the season, such as small grains, make good use of the soil moisture. Wind stripcropping, vegetative barriers, field windbreaks, cover crops, and conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, can help prevent soil blowing. Excess water in wet depressions can make the operation of machinery more difficult. Wet depressions can generally be drained by installing a random subsurface tile drainage system. Irrigation can greatly increase yields for such crops as corn, dry beans, snap beans, and potatoes.

This soil is fairly suited to pasture. The main management concern is droughtiness. Because plant growth is limited by the droughtiness of the soil, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the grazing season.

This soil is well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting also may be necessary.

This soil is fairly suited to recreational development. The major management concern is excess water. In some places, the water table can be lowered with subsurface drains, and wet spots can be filled with suitable material.

This soil is poorly suited to building site development because of the wetness concern. This soil can be used as a site for buildings if well compacted fill material is used to raise the level of the site and if artificial drainage is used to lower the water table. This soil is poorly suited to septic tank absorption fields because of the wetness concern and poor filtering capacity. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent, which can pollute ground water. Special construction, such as filling or mounding the absorption field site with suitable soil material, may be needed to raise the site above the water table.

This soil is in capability subclass IVs and Michigan soil management group 5a.

50C—Metea-Coloma loamy sands, 6 to 18 percent slopes. This map unit consists of well drained Metea loamy sand and somewhat excessively drained Coloma loamy sand. These gently rolling or rolling soils are

intermingled on knolls and low ridges. The areas of this complex are irregular in shape and range from 7 to 80 acres. The Metea soil makes up about 45 to 60 percent of the complex, and the Coloma soil makes up about 40 to 50 percent. The areas of the Metea soil and the areas of the Coloma soil are so intermingled that they could not be shown separately at the scale selected for mapping.

Typically, the surface layer of the Metea soil is very dark gray loamy sand about 4 inches thick. The subsoil is 29 inches thick. The upper layer is yellowish brown loamy sand, the middle layer is brown clay loam with a few loamy sand bands, and the lower layer is brown clay loam. The substratum to a depth of about 60 inches is brown, calcareous clay loam. In some places, the lower part of the subsoil and the substratum are clay.

Typically, the surface layer of the Coloma soil is very dark grayish brown loamy sand about 2 inches thick. The upper part of the subsoil is dark yellowish brown to light yellowish brown sand about 37 inches thick, and the lower part to a depth of about 60 inches is light yellowish brown sand with dark yellowish brown loamy sand bands. In some places, sandy loam bands or gravelly sand layers are present.

Included with these soils in mapping are small areas of well drained Perrinton soils. Perrinton soils are not as droughty, and they are on landscape positions similar to those of the Coloma and Metea soils. They make up 5 to 15 percent of the unit.

In the Metea soil, permeability is rapid in the upper part of the profile and moderate in the lower part. The available water capacity is moderate, and surface runoff is slow. In the Coloma soil, permeability is rapid, the available water capacity is low, and surface runoff is medium.

Most areas of these soils are in woodland. Some areas are idle.

These soils are generally not suited to cropland because of droughtiness, soil blowing, and erosion. These soils are fairly suitable for pasture. The major concern is droughtiness. Because plant growth is limited by the droughtiness of these soils, rotational grazing and other practices are needed to protect the plants. The pastures should be rotated more frequently during the dry summer months than during the rest of the year.

These soils are well suited to woodland. The major management concern is seedling mortality. The loss of planted or natural tree seedlings because of drought can be 25 to 50 percent. To offset this hazard, it may be necessary to use planting stock more than 2 years old or containerized planting stock or to use special site preparation, such as furrowing or use of chemicals. Reinforcement planting may be necessary.

These soils are suited to paths and trails and fairly suited to camp areas and picnic areas. The major management concern is slope. These soils are generally not suited to playgrounds because of the slope limitation. Land leveling and shaping, though costly, can be used in constructing picnic areas and camp areas.

These soils are fairly suited to building site development and septic tank absorption fields. Slope is the main limitation. The poor filtering capacity of the Coloma soil and the moderate permeability of the Metea soil are additional concerns for septic tank absorption fields. Buildings constructed on these soils should be designed to 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 are generally necessary for the proper operation of septic tank absorption fields. Special construction, such as enlarging the septic tank absorption field or alternating drainage fields, may be needed to overcome the limited permeability of the Metea soil. The Coloma soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

These soils are in capability subclass VIs and Michigan soil management groups 4/2a and 5a.

51B—Leoni gravelly sandy loam, 0 to 6 percent slopes. This well drained, nearly level or undulating soil is on flat or slightly convex plains. Individual areas range from 10 to 250 acres.

Typically, the surface layer is very dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is yellowish brown and brown very gravelly and extremely gravelly sandy loam; the middle part is reddish brown extremely gravelly clay loam; and the lower part is brown extremely gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown, calcareous extremely gravelly sand. In some places, the surface layer and the upper part of the subsoil contain less than 15 percent pebbles.

Included with this soil in mapping are small areas of somewhat excessively drained Mecosta soils. Mecosta soils have a sandy surface layer and subsoil and are more droughty than the Leoni soil. They are on similar positions on the landscape. These included soils make up 10 to 15 percent of the unit.

Permeability of this Leoni soil is moderate in the upper part of the profile and moderately rapid or rapid in the lower part. Surface runoff is slow, and the available water capacity is moderate.

Most areas of this soil are in woodland or are idle. Some areas are in pasture or cropland.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concern is an abundance of small stones. Stones can be removed by hand picking or with a mechanical rock picker. Irrigation can significantly increase yields of corn, dry beans, potatoes, and snap beans.

This soil is suited to pasture. Plant growth is reduced during the dry summer months. Timely rotation keeps pastures more productive.

This soil is well suited to woodland. There are no major management concerns.

This soil is well suited to recreational development. Land leveling and removing small stones may be necessary to prepare areas for playgrounds.

This soil is suited to building site development and septic tank absorption fields. Poor filtering capacity is a limitation for septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of ground water supplies.

This soil is in capability subclass IIIs and Michigan soil management group Ga.

51C—Leoni gravelly sandy loam, 6 to 12 percent slopes. This well drained, gently rolling soil is on low to high knolls. Most areas are dissected by shallow drainageways and range from 3 to 60 acres.

Typically, the surface layer is brown, gravelly sandy loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is brown very gravelly and extremely gravelly sandy loam, and the lower part is dark yellowish brown extremely gravelly clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous extremely gravelly loamy sand. In some places, the surface layer and the upper part of the subsoil contain less than 15 percent pebbles.

Included with this soil in mapping are small areas of somewhat excessively drained Mecosta soils and well drained Marlette soils. Mecosta soils have a sandy surface layer and subsoil and are more droughty than the Leoni soil. Marlette soils are less droughty. These soils are on positions on the landscape similar to those of the Leoni soil. These included soils make up 5 to 15 percent of the unit.

Permeability of this Leoni soil is moderate in the upper part of the profile and moderately rapid or rapid in the lower part. The available water capacity is moderate. Surface runoff is medium.

Most areas of this soil are in woodland. Some areas are idle.

This soil is suited to crops, such as corn, dry beans, winter wheat, oats, asparagus, sunflowers, potatoes, snap beans, and alfalfa. The major management concerns are the abundance of small stones and erosion. Stones can be removed by hand picking or with a mechanical rock picker. Erosion can be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface. Erosion is also reduced by using grassed waterways, cover crops, and diversions. Irrigation can increase yields of corn, dry beans, potatoes, and snap beans.

This soil is suitable for pasture. Plant growth is reduced during the dry summer months. Timely rotation during the summer helps to keep pastures productive.

This soil is well suited to woodland. There are no major management concerns.

This soil is suited to paths and trails and fairly suited to camp areas and picnic areas. It is generally not suited to playgrounds. The major management concern is slope. Land shaping and leveling, though costly, can be used in constructing camp areas and picnic areas.

This soil is fairly suited to building site development. Slope is a concern. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is fairly suited to septic tank absorption fields. Slope and poor filtering capacity are concerns. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass IIIe and Michigan soil management group Ga.

51D—Leoni gravelly sandy loam, 12 to 18 percent slopes. This well drained, rolling soil is on high knolls. Most areas of this soil are dissected by shallow drainageways. Individual areas range from 10 to 25 acres.

Typically, the surface layer is very dark grayish brown gravelly sandy loam about 5 inches thick. The subsoil is about 25 inches thick. The upper part is dark yellowish brown and yellowish brown very gravelly and extremely gravelly sandy loam, and the lower part is strong brown extremely gravelly clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous extremely gravelly sand. In some places, the surface layer and the upper part of the subsoil contain less than 15 percent pebbles.

Included with this soil in mapping are small areas of somewhat excessively drained Coloma soils and Mecosta soils. These soils are sandy throughout. They are more droughty than the Leoni soil. These soils are on positions on the landscape similar to those of the Leoni soil. These included soils make up 10 to 15 percent of the unit.

Permeability of this Leoni soil is moderate in the upper part of the profile and moderately rapid or rapid in the lower part. The available water capacity is moderate, and surface runoff is rapid.

Most areas of this soil are in woodland. Some areas are idle.

This soil is suited to corn, dry beans, winter wheat, oats, and alfalfa. The major management concerns are the abundance of small stones and erosion. Slopes are

too steep for intensive cropping. Stones can be removed by hand picking or with a mechanical rock picker. The erosion hazard is most effectively reduced by keeping the soil planted to grasses and legumes. The hazard of erosion can also be reduced by using conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, and by using cropping systems that emphasize small grains, hay, and cover crops.

This soil is suited to pasture. The rolling slopes make pasture maintenance difficult in some places.

This soil is well suited to woodland. There are no major management concerns.

This soil is poorly suited to camp areas and picnic areas and fairly suited to paths and trails. It is generally not suited to playgrounds. The major management concern is slope. Land shaping and leveling for camp and picnic areas are generally not practical. Paths and trails can be placed across the slope. Some stones may have to be removed.

This soil is poorly suited to building site development because of slope. Buildings constructed on this soil should be designed to conform to the natural slope of the land. Land shaping may be necessary in some areas. This soil is poorly suited to septic tank absorption fields. Slope and poor filtering capacity are limitations. Land shaping and installing the distribution lines across the slope are generally necessary for the proper operation of septic tank absorption fields. This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water supplies.

This soil is in capability subclass IVe and Michigan soil management group Ga.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited, and government at local, state, and federal levels, as well as individuals, must 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 producing food, feed, forage, fiber, and oilseed crops. When treated and managed using acceptable farming methods, it has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming this land results in the least damage to the environment.

Prime farmland may now be cropland, pasture, or woodland, or it may be in other uses, but it is not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually 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 favorable. 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 information on the criteria for prime farmland can be obtained at the local office of the Soil Conservation Service.

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. This loss to other uses puts pressure on marginal lands, which generally are more erodible, droughty, difficult to cultivate, and usually less productive.

The map units that make up prime farmland in Mecosta County are listed in table 5. The 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 in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

Soils that have a high water table, flooding, or inadequate rainfall may qualify for prime farmland if these limitations are overcome by drainage, flood control, or irrigation. The measures used to overcome these limitations, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to see if these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where wetness or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained (*10*); and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 80,900 acres (*13*) in the survey area was used for crops and pasture in 1974. Of this total, 17,050 acres was used for permanent pasture; 20,350 acres was used for row crops, mainly corn and dry beans; 6,650 acres was used for close-grown crops, mainly wheat and oats; 22,450 acres was used for hay crops; 3,650 acres was used for specialty crops, mainly potatoes, asparagus, sweet corn and other vegetables, and orchards; and the rest was idle cropland.

Soil erosion, including soil blowing, is the major hazard on about two-thirds of the cropland in Mecosta County. Where slopes are more than 2 percent, water erosion is a hazard. Perrinton and Marlette soils, for example, have slopes of 2 to 18 percent.

Loss of the surface layer by 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 clayey subsoil, such as the Perrinton soils. Erosion also reduces productivity on soils that tend to be droughty, such as the Coloma and Spinks soils. Second, erosion on farmland results in sedimentation of streams. Controlling erosion minimizes stream pollution by sediment and improves the quality of water for municipal and recreation uses, for fish, and for wildlife habitat.

In many sloping areas, preparing a good seedbed and tilling are difficult on spots of loamy soils that are high in clay content, because the original friable surface layer has been eroded. Such spots are common in the sloping areas of the Marlette, Metea, Perrinton, and Remus soils.

Erosion control practices provide a protective cover for the surface layer, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can hold erosion losses to amounts that do not reduce the productivity of the soils. On livestock farms, where pasture and hay are needed, the legume and grass forage crops reduce erosion on sloping land, provide nitrogen, and improve tilth for the following crop.

Terraces and diversions reduce runoff, erosion, and the length of slope. They are most practical on deep,

well drained soils that have regular slopes. Most soils in Mecosta County are suitable for diversions but not for terraces because of irregular slopes, excessive wetness in the terrace channels, a clayey subsoil, which would be exposed in terrace channels, or excessive droughtiness.

Contouring and contour stripcropping are also useful erosion control practices (fig. 16). They are best adapted to soils that have smooth, uniform slopes, such as a few areas of the sloping Marlette, Metea, Remus, and Spinks soils. In most areas, the slopes are too short and too irregular. On these soils, cropping systems that provide substantial vegetative cover are needed to control erosion, unless conservation tillage, which does not invert the soil and leaves all or part of the crop residue on the surface, is used. Minimizing tillage and leaving crop residue on the surface increase water infiltration and reduce runoff and erosion. Grassed waterways can be used to help control erosion and the formation of gullies.

No-tillage for corn, which is increasingly common, is effective in reducing erosion on sloping land and can be adapted to most of the soils in the survey area. No-tillage leaves crop residue on the soil as a mulch, which reduces soil blowing and water erosion. This allows high yields of corn in areas that had been considered marginal in production because of erosion.

Good management is necessary in any tillage system for satisfactory crop production. No-tillage requires the use of different skills for planting and for insect and weed control. Proper timing, selecting herbicides that are suited to the present vegetation, controlling insects, providing adequate nutrients, and selecting tillage systems on the basis of soil characteristics are important management requirements.

Soil blowing is a hazard on the sandy Plainfield, Coloma, Spinks, Metea, Covert, Wixom, Pipestone, Thetford, Riverdale, Arkona, Tustin, and Mecosta soils. Soil blowing can damage these soils in a few hours if the winds are strong and if the soils are dry and the surface layer is bare of vegetation or mulch. Maintaining a vegetative cover, no-tillage, wind stripcropping, vegetative barriers, field windbreaks, buffer strips of grain, cover crops, conservation tillage, or rough tillage minimizes soil blowing.

Figure 16.—Stripcropping on Marlette and Spinks soils. Marlette soils are on the ridge, and Spinks soils are in the foreground.

Information about the design of erosion control practices for each kind of soil is available in the local office of the Soil Conservation Service.

Soil drainage is a major management requirement for about one-fourth of the acreage used for crops and pasture. Drainage of cropland improves the air-water relationship in the root zone. Spring planting, spraying, and harvesting are delayed and weed control is more difficult where drainage is poor. Properly designed tile drains or surface drainageways, or both, can be used to remove excess water.

Some soils are naturally so wet that the production of crops common to the area generally is not possible. These soils generally cannot be drained because good outlets are not available. These are the poorly drained and very poorly drained Ziegenfuss, Roscommon, Vestaburg, Edmore, Edwards, Houghton, Loxley, Adrian, Glendora, Corunna, Palms, and Wauseon soils.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. These are the Ithaca, Algansee, Wixom, Pipestone, Capac, Locke, Thetford, Riverdale, Aubbeenaubbee, and Arkona soils.

Remus, Marlette, and Perrinton soils have good natural drainage most of the year, but they tend to dry slowly after rain. Small areas of wetter soils along drainageways and in swales are commonly included in some areas of these soils, especially where slopes are 0 to 6 percent. Artificial drainage is needed in some of these wetter areas.

The design of surface and subsurface drainage varies with the kind of soil. Tile drainage is needed in most areas of the somewhat poorly drained soils that are used intensively for row crops. Drains need to be more closely spaced in soils that have slow or moderately slow permeability than in the more permeable soils. Finding adequate outlets for tile drainage is difficult in some areas of the Ithaca, Algansee, Wixom, Pipestone, Capac, Locke, Thetford, Riverdale, Aubbeenaubbee, and Arkona soils. Diversions may be used in some areas to divert surface runoff from wet areas. Good soil tilth and an ample supply of organic matter also help soil drainage. The low-lying areas are subject to a shortened growing season because of frost late in spring and early in fall.

Information on drainage design for each kind of soil is available in the local office of the Soil Conservation Service.

Soil fertility is naturally medium to high in loamy soils and low in most sandy soils on uplands. The soils on flood plains, such as the Algansee and Glendora soils, range from medium acid to mildly alkaline and are naturally higher in plant nutrients than most soils on uplands.

Many sandy soils naturally range from strongly acid to slightly acid. If lime has never been applied, the soils require applications of ground limestone to raise the pH level sufficiently for good growth of alfalfa and other crops that grow only on almost neutral soils. Available phosphorus and potash levels are naturally low to medium in most of these soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply (*6*).

Soil tilth is an important factor in germination of seeds and in infiltration of water into the soil. Soils that have good tilth are granular and porous.

Some of the soils that are used for crops have a loamy surface layer that is light in color and low in organic matter content. Generally, the structure of such soils is weak, and intense rainfall causes the surface to crust. If a crust forms, infiltration is reduced and runoff is increased. Regular additions of crop residue, manure, and other organic matter can help to improve soil tilth and to reduce crust formation.

The darker colored Ithaca soils are sticky when wet, and tilth is difficult to maintain because the soils stay wet until late in spring. If these soils are wet when plowed, they tend to be very cloddy when dry, the subsoil compacts, and good seedbeds are difficult to prepare. Growing cover crops and green manure crops, proper use of crop residue, and the application of livestock manure help maintain and improve organic matter content and tilth. On nearly level, somewhat poorly drained soils, fall plowing at the proper moisture content can help to maintain tilth and can facilitate tillage earlier the following spring. Fall plowing should not be done on sloping soils or on soils that are subject to soil blowing. Grazing on wet, loamy soils that are high in clay content should be avoided because it results in compaction of the soil and poor tilth. Good management practices are needed if an intensive cropping system or continuous cultivation exists.

Field crops suited to use in the survey area include a few that presently are not commonly grown. Corn (fig. 17), dry beans, potatoes, and sunflowers are the row crops commonly grown in Mecosta County. Grain sorghum, soybeans, and similar crops can be grown if economic conditions are favorable.

Wheat and oats are common close-grown crops. Rye, barley, and buckwheat are not as common but have good potential. Grass seed can be produced from brome, fescue, red clover, redtop, and bluegrass. Alfalfa and red clover with mixtures of grass are the common hay crops.

Specialty crops grown commercially are apples, cherries, asparagus, and snap beans. A small acreage is used for peaches, carrots, peas, and a few other vegetables. In addition, large areas could be adapted to other specialty crops, such as blueberries, strawberries (fig. 18), raspberries, and other vegetables.

Deep soils that have good natural drainage and that warm early in spring are especially well suited to many

Figure 17.—Irrigation is often used for crops such as corn on Spinks soils.

vegetables and small fruits. These are the Coloma, Spinks, Metea, and Tustin soils, which have slopes of less than 6 percent. If they are irrigated, Mecosta and Plainfield soils that have slopes of less than 6 percent are well suited to vegetables and small fruits. Crops generally can be planted and harvested earlier on these soils than on the other soils in the survey area.

Most of the well drained soils in the survey area are suitable for orchards and nursery plants. Soils in low areas where frost action is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards. Fruit and vegetable crops require special and very intensive management, such as controlling erosion, maintaining soil moisture, and precise timing in order to obtain high yields. Irrigation of fruit and vegetable crops is very beneficial on most soils, because it provides frost protection and increases yields if rainfall is not adequate.

Latest information and suggestions for growing specialty crops can be obtained from the local office of the Cooperative Extension Service and the Soil Conservation Service.

Pasture.—Much of the permanent pasture in the county is on soils on which erosion is a hazard. These soils may be eroded, and many are low in natural fertility and are poor in tilth. Many other pastures are on wet soils.

Control of erosion is particularly important during seeding operations. Mulch seeding or use of a nurse crop can help to control erosion. The need for lime and fertilizer should be determined by soil tests.

Soil compaction, caused by grazing when the soil is wet, results in decreased growth of pasture. Harvesting methods such as those used for hay or silage increase plant growth and reduce soil compaction.

A pasture's productivity and its ability to protect the surface of the soil are influenced by the number of livestock it supports, the length of time it is grazed, and the amount of rainfall it receives. Good pasture management includes the use of stocking rates that maintain key forage species, pasture rotation, deferred grazing, grazing during the proper season, and supplying water at strategic locations for livestock.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in tables 6 and 7. Field crops are shown in

Figure 18.—Strawberries grow well on Remus soils.

table 6 and specialty crops are shown in table 7. 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 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 insures 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 tables 6 and 7 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 (*6*).

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 grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

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

class and subclass are used in this survey. These levels are defined in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 8. The capability classification of each map unit is given in the section "Detailed Soil Map Units." Also given at the end of each description is a Michigan soil management group. The soils are assigned to a group according to the need for lime and fertilizer and for artificial drainage and other practices. For soils making up a complex, the management groups are listed in the same order as the series named in the complex. For a detailed explanation of the Michigan soil management groups see Michigan State University Extension Bulletin E-1262 (*7*).

Woodland Management and Productivity

David J. Poe, forester, Soil Conservation Service, assisted in writing this section.

Virgin forest once covered almost all of the land in Mecosta County, but the trees have been cleared from most of the land suitable for cultivation. In much of the remaining woodland, the soils are too wet, too sandy, or too steep for farming. These soils produce trees of high quality if the woodland is managed properly.

Woodland now makes up about 100,000 acres, or about 28 percent of the county. Woodland is common in associations 2, 5, 6, 7, and 8 described in the section "General Soil Map Units." Woodlots are scattered throughout the other soil associations in the county. On the upland soils, mixed hardwoods consisting mainly of red oak, aspen, American beech, white oak, paper birch, bitternut hickory, sugar maple, black cherry, and white ash are the most common trees. In some areas of the upland soils, red maple and American basswood are abundant. On the mineral soils in low-lying areas and on bottom lands, red maple, basswood, cottonwood, balsam fir, eastern hemlock, northern white-cedar, ash, and aspen are the most common trees. On the very poorly drained organic soils, tamarack, paper birch, aspen, eastern hemlock, red maple, northern white-cedar, and green ash are the most common trees. Pine plantations, consisting of red, white, jack, and Scotch pine, and plantings of Norway spruce and white spruce are scattered throughout the county. A few areas in the county have been managed for Christmas tree plantations and fruit orchards.

Much of the existing woodland would benefit from thinning and other silvicultural practices such as the control of plant competition, disease, and insects. The Soil Conservation Service; Michigan Department of Natural Resources, Division of Forestry; soil conservation districts; and consultant and industrial foresters can help determine specific woodland management needs.

Table 9 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 (woodland suitability) 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 important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that

limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 9, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This 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.

Trees to plant are those that are suited to the soils and to commercial wood production.

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, hold 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 insure 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 nursery.

Recreation

The many water areas and approximately 30,000 acres of public and recreational land provide numerous opportunities for recreation.

Mecosta County has over 320 lakes and ponds (fig. 19) and over 450 miles of rivers and streams, which offer more than 9,000 acres for fishing, boating, and canoeing. Some of the public lands available for recreation include Manistee National Forest, Chippewa River State Forest, and Haymarsh Lake State Game Area. Other recreational areas include Canadian Lakes, 12 private campgrounds, 4 county parks, 6 golf courses, and several cross-country ski trails.

The use of recreation areas in the county has increased greatly in the past several years. Many soils are suited to the development of recreation facilities.

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 sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for

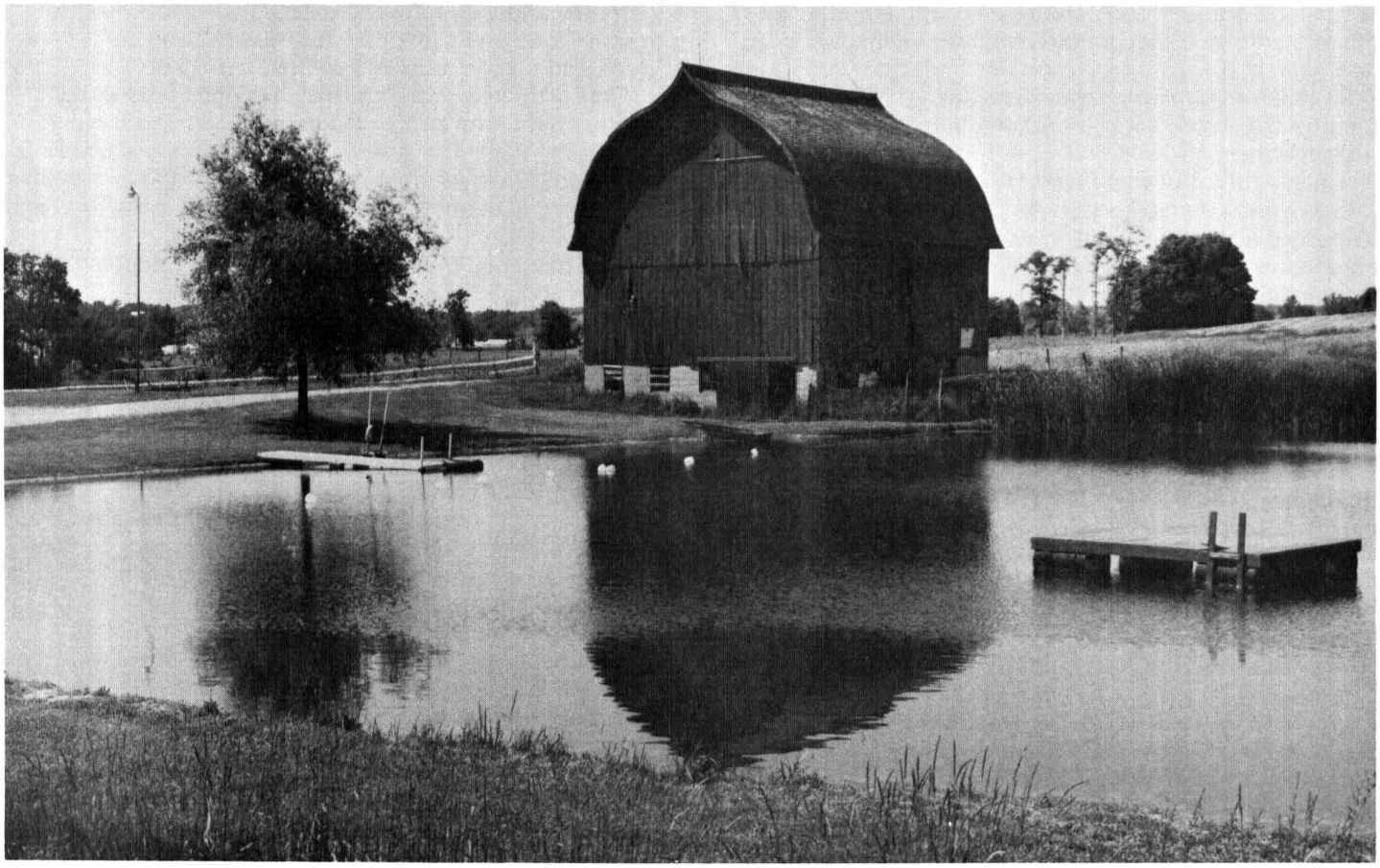


Figure 19.—A farm pond in an excavated area of Wauseon soils.

recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 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 mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry.

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.

Figure 20.—"Little John Flooding" was developed for wetland wildlife.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Charles M. Smith, wildlife biologist, Soil Conservation Service, assisted in writing this section.

Mecosta County has a large and varied population of fish and wildlife. The wooded areas are habitat for white-tailed deer, tree squirrels, woodpeckers, raccoon, porcupine, ruffed grouse, woodcock, owls, and thrushes. The farmed areas are habitat for pheasant, fox squirrel, cottontail rabbits, woodchuck, red fox, and songbirds. The streams and lakes support bluegill, sunfish, perch, bass, trout, northern pike, walleye, bullhead, sucker, and carp. Some of the lakes and wetland areas are nesting, breeding, and feeding areas for muskrats, mink, river otter, ducks, herons, and kingfishers.

Many areas in the county can be improved for use of wildlife habitat by increasing the food, cover, water, and living space that the wildlife need (fig. 20). Areas that are best suited for improvement of wildlife habitat are in soil associations 1, 2, 3, 4, and 8 described in the section "General Soil Map Units."

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, wild carrot, goldenrod, ragweed, thistle, burdock, dandelion, wild strawberry, and lambsquarter.

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, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, maple, apple, hawthorn, dogwood, hickory, birch, and ash. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, crabapple, dogwood, honeysuckle, sumac, and hawthorn.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, and cedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, arrowhead, pickerelweed, 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 wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include pheasant, meadowlark, field sparrow, cottontail, white-tailed deer, red fox, woodchuck, and opossum.

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 owl, ruffed grouse, woodcock, thrushes, woodpeckers, tree squirrels, raccoon, white-tailed deer, and porcupine.

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, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and

construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations (*12*). Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, and the available water capacity in the upper 40 inches affect plant growth. Flooding, wetness, slope, stoniness, and the amount of

sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and the 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, and flooding affect absorption of the effluent. Large stones interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel 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, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential

for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 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 determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 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 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, and rock fragments.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, 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 or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

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

Water Management

Table 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 ponds. The limitations are considered *slight* if soil

properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table and permeability of the aquifer. The content of large stones affects the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity in the root zone. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones. The performance of a system is affected by the depth of the root zone and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, and slope affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

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

Engineering Index Properties

Table 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. "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 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, SP-SM.

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.

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 earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

8. Stony or gravelly soils and other soils not subject to wind erosion.

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

Soil and Water Features

Table 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 intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

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

Some soils are assigned to two hydrologic groups because part of the acreage is drained and part is undrained.

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

Table 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, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than

that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 19.

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

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

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are 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 and acidity.

Characterization Data for Selected Soils

Samples of many of the soils in Mecosta County were analyzed by the Soil Research Laboratory, Ford Forestry Center, Michigan Technological University, L'Anse, Michigan. The laboratory data obtained from the soil samples include particle-size distribution analysis, coarse fragment analysis, and bulk density and moisture retention analyses. Complete chemical analyses were also performed on each sample, and spodic horizons were identified. Standard National Cooperative Soil Survey procedures were used for all analyses. Forest sites were sampled to estimate forest productivity on many of the sampled soils.

These data were used in the classification and correlation of these soils and in predicting their behavior under different uses, especially under forestry uses. The soils sampled in the county, and their laboratory identification numbers, are: Coloma (S79MI107-4), Covert (S79MI107-6), Mecosta (S78MI107-1, S78MI107-4), Plainfield (S78MI107-2, S78MI107-3, S78MI107-5), Remus (S79MI107-2, S79MI107-3), and Spinks (S79MI107-1).

Soil characterization data and forest site data are also available from nearby counties that have many of the soils that were not sampled in Mecosta County. These data and the Mecosta County data are available from the Ford Forestry Center; the Soil and Water Conservation Division, Michigan Department of Agriculture, Lansing, Michigan; and the Soil Conservation Service, State Office, East Lansing, Michigan.

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. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

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 Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

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 Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that have an aquic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed, mesic Typic Haplaquolls.

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. The soil is compared with similar soils and with nearby soils of other 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."

Adrian Series

The Adrian series consists of very poorly drained soils in bogs or depressions on outwash plains. These soils formed in organic sediments over sandy material. Permeability is moderately slow to moderately rapid in the organic material and rapid in the underlying layers. Slope is 0 to 1 percent.

Adrian soils are similar to Edwards, Houghton, Loxley, and Palms soils and are commonly adjacent to Houghton and Roscommon soils. Edwards soils are underlain by marl. Houghton and Loxley soils have organic material more than 51 inches deep. Palms soils

have a loamy C horizon. Roscommon soils are sandy and are on the margins of bogs.

A typical pedon of Adrian muck, 500 feet east and 40 feet south of the northwest corner of sec. 36, T. 13 N., R. 8 W.

Oa1—0 to 8 inches; black (10YR 2/1) broken face and rubbed sapric material; about 15 percent fiber, less than 5 percent rubbed; moderate medium granular structure; primarily herbaceous fibers; many very fine and many medium roots; mildly alkaline; clear smooth boundary.

Oa2—8 to 15 inches; black (10YR 2/1) broken face and rubbed sapric material; about 30 percent fiber, 5 percent rubbed; weak medium subangular blocky structure; primarily herbaceous fibers; many very fine roots; mildly alkaline; gradual smooth boundary.

Oa3—15 to 31 inches; black (10YR 2/1) broken face and rubbed sapric material; about 35 percent fiber, 5 percent rubbed; weak medium subangular blocky structure; primarily herbaceous fibers; common very fine roots; neutral; clear wavy boundary.

C1—31 to 44 inches; brown (10YR 5/3) gravelly sand; single grain; loose; 15 percent pebbles; slight effervescence; mildly alkaline; clear wavy boundary.

C2—44 to 60 inches; grayish brown (10YR 5/2) gravelly sand; single grain; loose; 15 percent pebbles; slight effervescence; mildly alkaline.

The depth to the sandy C horizon and carbonates ranges from 16 to 50 inches. The organic material ranges from medium acid to mildly alkaline.

The surface tier has hue of 7.5YR or 10YR and chroma of 0 to 1. It is dominantly sapric material, but the range includes hemic material. The subsurface tiers have hue of 5YR, 7.5YR, or 10YR; value of 2 or 3; and chroma of 0 to 2. The C horizon has value of 3 to 5 and chroma of 1 to 3. It is loamy sand, sand gravelly loamy sand, or gravelly sand with pebble content of 0 to 20 percent. It is slightly acid to mildly alkaline.

Algansee Series

The Algansee series consists of somewhat poorly drained, rapidly permeable soils. These soils formed in sandy deposits on flood plains. Slope ranges from 0 to 3 percent.

Algansee soils are commonly adjacent to the Glendora soils. Glendora soils are poorly drained and are on lower positions on the landscape than the Algansee soils.

A typical pedon of Algansee loamy sand, 0 to 3 percent slopes, 1,000 feet west and 100 feet south of the center of sec. 35, T. 13 N., R. 10 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine roots; neutral; clear smooth boundary.

C1—10 to 19 inches; yellowish brown (10YR 5/4) sand; common fine faint yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; very friable; few fine roots; neutral; gradual wavy boundary.

C2—19 to 40 inches; yellowish brown (10YR 5/4) sand; many fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; very friable; very few very fine roots; neutral; clear wavy boundary.

C3—40 to 47 inches; brown (10YR 5/3) sand; many fine faint yellowish brown (10YR 5/6) mottles; single grain; loose; neutral; clear wavy boundary.

C4—47 to 60 inches; grayish brown (10YR 5/2) sand; common fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; neutral.

The Ap horizon has chroma of 1 or 2. It is dominantly loamy sand, but the range includes sand. It is medium acid to neutral and is 7 to 10 inches thick. Some pedons have thin black (10YR 2/1) layers darkened by organic matter throughout the pedon. The C horizon has hue of 7.5YR or 10YR and value of 4 to 6. It is neutral or mildly alkaline.

Arkona Series

The Arkona series consists of somewhat poorly drained soils. These soils formed in sandy and clayey deposits on outwash plains or till plains. Permeability is rapid in the upper part of the pedon and slow in the lower part. Slope ranges from 0 to 4 percent.

Arkona soils are similar to the Wixom soils and are commonly adjacent to the Perrinton, Tustin, and Wauseon soils on the landscape. Wixom soils have a coarser texture in the substratum than the Arkona soils. Perrinton and Tustin soils are well drained and are on the higher knolls and rises. Wauseon soils are very poorly drained and are in depressions and along drainageways.

A typical pedon of Arkona loamy sand, 0 to 4 percent slopes, 660 feet south and 75 feet west of the northeast corner of sec. 31, T. 13 N., R. 8 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

Bs1—9 to 13 inches; brown (7.5YR 4/4) loamy sand; common fine distinct dark reddish brown (5YR 3/4) mottles; weak fine granular structure; very friable; few fine roots; strongly acid; clear smooth boundary.

Bs2—13 to 19 inches; dark yellowish brown (10YR 4/6) sand; common medium distinct dark brown (7.5YR 3/4) mottles; single grain; loose; slightly acid; gradual wavy boundary.

E—19 to 35 inches; yellowish brown (10YR 5/4) sand; common coarse distinct yellowish brown (10YR 5/8) mottles; single grain; loose; medium acid; gradual wavy boundary.
2Bt—35 to 41 inches; brown (10YR 5/3) silty clay; common medium distinct yellowish brown (10YR 5/8) and gray (5YR 6/1) mottles; weak medium subangular blocky structure; very firm; mildly alkaline; clear smooth boundary.
2C—41 to 60 inches; brown (10YR 5/3) silty clay; common fine distinct yellowish brown (10YR 5/8) and gray (5YR 5/1) mottles; massive; very firm; 3 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and depth to free carbonates range from 22 to 56 inches. The depth to the 2Bt horizon ranges from 20 to 40 inches. The solum has 0 to 5 percent pebbles.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is strongly acid to slightly acid and is 8 to 10 inches thick. The Bs horizon has value and chroma of 3 to 6. It ranges from strongly acid to neutral. The E horizon has value of 5 or 6 and chroma of 3 or 4. It is sand or loamy sand. The E horizon is strongly acid or medium acid. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is clay or silty clay and is neutral or mildly alkaline. The 2C horizon has hue of 10YR or 7.5YR and chroma of 2 to 4. It is clay or silty clay. Pebble content is 0 to 5 percent.

Aubbeenaubbee Series

The Aubbeenaubbee series consists of somewhat poorly drained soils formed in loamy outwash over loamy till on moraines. Permeability is moderately rapid in the upper part of the pedon and moderately slow in the lower part. Slope ranges from 0 to 4 percent.

Aubbeenaubbee soils are similar to Capac soils and are commonly adjacent to Corunna, Marlette, and Remus soils on the landscape. Capac soils have a finer texture in the A horizon and upper part of the B horizon. Corunna soils are poorly drained and are on slightly lower positions on the landscape than the Aubbeenaubbee soils. Marlette and Remus soils are well drained and are on the slightly higher positions.

A typical pedon of Aubbeenaubbee fine sandy loam, 0 to 4 percent slopes, 561 feet west and 150 feet south of the center of sec. 29, T. 14 N., R. 7 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, gray (10YR 6/1) dry; moderate medium granular structure; friable; many very fine roots; 2 percent pebbles; neutral; abrupt smooth boundary.
E—9 to 17 inches; yellowish brown (10YR 5/4) fine sandy loam; common fine faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; 2 percent pebbles; slightly acid; clear wavy boundary.
2Bt1—17 to 20 inches; brown (7.5YR 5/4) sandy clay loam; many fine faint strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; 60 percent thin grayish brown (10YR 5/2) clay films on surfaces of peds; few very fine roots; 2 percent pebbles; neutral; clear wavy boundary.
2Bt2—20 to 33 inches; brown (7.5YR 5/4) clay loam; many fine faint grayish brown (10YR 5/2) and strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; firm; 60 percent thin grayish brown (10YR 5/2) clay films on surfaces of peds; few very fine roots; 2 percent pebbles; neutral; gradual wavy boundary.
2BCg—33 to 42 inches; grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) clay loam; weak coarse subangular blocky structure; firm; 2 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.
2Cg—42 to 60 inches; gray (10YR 6/1) clay loam; common fine distinct reddish yellow (7.5YR 6/6) mottles; massive; firm; 2 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates range from 40 to 50 inches. The Ap and E horizons range from 17 to 30 inches in thickness. Pebble content in the solum is 0 to 3 percent.

The Ap horizon has chroma of 1 to 3. It is 7 to 10 inches thick and is dominantly fine sandy loam, but the range includes sandy loam. It is medium acid to neutral. Some pedons have an A or an EB horizon. The E horizon has value of 4 or 5. It is sandy loam or fine sandy loam. The 2Bt horizon has hue of 10YR or 7.5YR and value of 4 or 5. It is medium acid to neutral. The 2Bt horizon is sandy clay loam, clay loam, or loam. The 2C horizon has chroma of 1 to 6. It is clay loam or loam. Pebble content ranges from 0 to 3 percent.

Capac Series

The Capac series consists of somewhat poorly drained, moderately slowly permeable soils. These soils formed in loamy deposits on till plains. Slope ranges from 0 to 4 percent.

Capac soils are similar to Aubbeenaubbee soils and are commonly adjacent to Marlette and Thetford soils. Aubbeenaubbee soils are coarser in texture in the A horizon and upper part of the B horizon than the Capac soils. Marlette soils are well drained and are on the higher positions on the landscape. Thetford soils are coarser in texture and are on landscape positions similar to those of the Capac soils.

A typical pedon of Capac loam, 0 to 4 percent slopes, 495 feet south and 100 feet west of the northeast corner of sec. 20, T. 14 N., R. 7 W.

Ap—0 to 11 inches; very dark grayish brown (10YR 3/2) loam, gray (10YR 6/1) dry; moderate coarse granular structure; friable; many very fine roots; 1 percent pebbles; slightly acid; abrupt smooth boundary.

Bt1—11 to 22 inches; pale brown (10YR 6/3) clay loam; many medium distinct yellowish brown (10YR 5/8) and common medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; common thin grayish brown (10YR 5/2) clay films on surfaces of peds; few very fine roots; 1 percent pebbles; slightly acid; gradual wavy boundary.

Bt2—22 to 40 inches; light brownish gray (10YR 6/2) clay loam; many medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; common thin grayish brown (10YR 5/2) clay films on surfaces of peds; few very fine roots; 2 percent pebbles; neutral; gradual wavy boundary.

C—40 to 60 inches; light brownish gray (10YR 6/2) clay loam; many medium distinct yellowish brown (10YR 5/8) mottles; massive; firm; light gray (10YR 7/1) lime streaks; 1 percent pebbles; slightly effervescent; mildly alkaline.

The thickness of the solum and depth to carbonates range from 26 to 40 inches. Pebble content in the solum is 0 to 10 percent.

The Ap horizon has chroma of 1 or 2 and is 6 to 11 inches thick. Some pedons have an A horizon that is 2 to 4 inches thick. The A horizon is medium acid to neutral. The Bt horizon has value of 5 or 6 and chroma of 2 to 6. It is loam, clay loam, or silty clay loam. It ranges from slightly acid to mildly alkaline. Some pedons have a B/E and a BC horizon. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is loam or clay loam. Pebble content ranges from 0 to 5 percent.

Coloma Series

The Coloma series consists of somewhat excessively drained soils on outwash plains and moraines. Typically, permeability is rapid; but in the loamy substratum phase, it is moderate in the upper part of the profile and moderate or moderately slow in the lower part. Slope ranges from 0 to 35 percent.

Coloma soils are similar to Plainfield, Mecosta, and Spinks soils and are commonly adjacent to the Perrinton, Remus, Spinks, and Tustin soils on the landscape. Plainfield and Mecosta soils do not have loamy sand bands. Mecosta soils have an extremely gravelly coarse sand substratum. Spinks soils have thicker bands in the subsoil. Perrinton soils are loamy and clayey. Remus soils are loamy. Tustin soils have a clayey substratum. Perrinton, Spinks, and Tustin soils are on landscape positions similar to those of the Coloma soils. Remus soils are on the slightly lower landscape positions.

Typical pedon of Coloma sand, 0 to 6 percent slopes, 891 feet east and 760 feet north of the southwest corner of sec. 16, T. 14 N., R. 10 W.

Ap—0 to 10 inches; brown (10YR 4/3) sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; many very fine roots; 1 percent pebbles; strongly acid; abrupt smooth boundary.

E1—10 to 17 inches; yellowish brown (10YR 5/6) sand; weak very fine subangular blocky structure; very friable; common medium and very fine roots; 1 percent pebbles; medium acid; gradual wavy boundary.

E2—17 to 22 inches; yellowish brown (10YR 5/6) sand; weak very fine subangular blocky structure; very friable; common very fine roots; 2 percent pebbles; medium acid; gradual wavy boundary.

E3—22 to 39 inches; brownish yellow (10YR 6/6) sand; weak very fine subangular blocky structure; very friable; common very fine roots; 2 percent pebbles; strongly acid; abrupt smooth boundary.

E&Bt—39 to 60 inches; light yellowish brown (10YR 6/4) sand (E); single grain; loose; lamellae of strong brown (7.5YR 5/6) loamy sand (Bt); weak very fine subangular blocky structure; very friable; medium acid.

Lamellae are at depths of 34 to 50 inches. Pebble content ranges from 0 to 10 percent. The solum ranges from strongly acid to slightly acid.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It is 6 to 10 inches thick. Some pedons have an A horizon with a value of 2 or 3 and chroma of 1 to 3. It is 2 to 5 inches thick. The Ap or A horizon is dominantly sand, but the range includes loamy sand. The E horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The E part of the E&Bt horizon has value of 5 to 7 and chroma of 4 to 6. The B part consists of lamellae that have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. Some pedons have a C horizon. In some pedons, horizons of loam, clay loam, sandy clay loam, and silty clay loam are at depths of 40 to 60 inches.

Corunna Series

The Corunna series consists of poorly drained soils formed in loamy deposits on till plains. Permeability is moderate or moderately rapid in the upper part of the pedon and moderately slow in the lower part. Slope ranges from 0 to 2 percent.

Corunna soils are commonly adjacent to Aubbeenaubbee, Marlette, and Wixom soils. Aubbeenaubbee and Wixom soils are somewhat poorly drained and are on slightly higher positions on the landscape than the Corunna soils. Marlette soils are well drained or moderately well drained and are on the higher knolls and rises.

A typical pedon of Corunna fine sandy loam, 50 feet east and 1,254 feet south of the northwest corner of sec. 28, T. 14 N., R. 7 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; common fine roots; 1 percent pebbles; mildly alkaline; abrupt smooth boundary.

Bg—11 to 35 inches; grayish brown (2.5Y 5/2) sandy loam; common fine faint gray (10YR 5/1) and light olive brown (2.5Y 5/4) and common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; 3 percent pebbles; mildly alkaline; abrupt wavy boundary.

2Cg—35 to 60 inches; grayish brown (2.5Y 5/2) sandy clay loam; common fine faint gray (10YR 5/1) and many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; 3 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates range from 20 to 40 inches. Pebble content in the solum is 0 to 5 percent. The depth to the C horizon ranges from 26 to 40 inches. The solum ranges from slightly acid to mildly alkaline.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It ranges from 10 to 12 inches in thickness. It is dominantly fine sandy loam, but the range includes sandy loam and loam. Some pedons have an A horizon with similar properties. The Bg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or 3. The 2Cg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is sandy clay loam or clay loam. Pebble content is 0 to 5 percent.

Covert Series

The Covert series consists of moderately well drained, rapidly or very rapidly permeable soils. These soils formed in sandy deposits on till plains and outwash plains. Slope ranges from 0 to 3 percent.

Covert soils are commonly adjacent to Pipestone and Plainfield soils. Pipestone soils are somewhat poorly drained and are slightly lower on the landscape than the Covert soils. Plainfield soils are excessively drained and are slightly higher on the landscape.

A typical pedon of Covert sand, 0 to 3 percent slopes, 2,310 feet west and 30 feet north of the southeast corner of sec. 28, T. 13 N., R. 10 W.

A—0 to 3 inches; black (10YR 2/1) sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many fine roots; strongly acid; abrupt smooth boundary.

E—3 to 4 inches; brown (7.5YR 5/2) sand; weak medium subangular blocky structure; very friable; common fine roots; medium acid; abrupt irregular boundary.

Bs1—4 to 10 inches; brown (7.5YR 4/4) sand; weak medium subangular blocky structure; very friable; few fine roots; medium acid; clear wavy boundary.

Bs2—10 to 35 inches; strong brown (7.5YR 5/6) sand; single grain; loose; few fine roots; medium acid; gradual wavy boundary.

BC—35 to 54 inches; reddish yellow (7.5YR 6/6) sand; many medium faint strong brown (7.5YR 5/8) mottles; single grain; loose; very few fine roots; medium acid; gradual wavy boundary.

C—54 to 60 inches; light yellowish brown (10YR 6/4) sand; common medium faint yellowish brown (10YR 5/6) mottles; single grain; loose; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. Pebble content in the solum is 0 to 15 percent. The solum ranges from strongly acid to neutral.

The A horizon has value of 2 to 4 and chroma of 1 or 2. It is 1 inch to 6 inches thick. Some pedons have an Ap horizon with hue of 10YR, value of 3, and chroma of 2 or 3. The Ap horizon is 6 to 10 inches thick. The E horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 or 2. It is 1 inch to 7 inches thick. The A and E horizons are dominantly sand, but the range includes loamy sand. The Bs horizon has hue of 5YR, 7.5YR, or 10YR and value of 4 to 6. In some pedons, ortstein makes up 0 to 5 percent of this horizon. The C horizon has value of 5 to 7 and chroma of 3 to 8. It is sand or fine sand and contains 0 to 15 percent pebbles. It ranges from medium acid to mildly alkaline. In some pedons, horizons of gravelly sand occur at a depth below 40 inches. Some pedons have 20 to 40 percent pebbles.

Edmore Series

The Edmore series consists of poorly drained, moderately rapidly permeable soils. These soils formed in sandy and loamy deposits on till plains. Slope is 0 to 2 percent.

Edmore soils are similar to Roscommon soils and are commonly adjacent to Locke, Remus, Spinks, and Thetford soils. Roscommon soils do not have the sandy loam lenses in the subsoil. Locke and Thetford soils are somewhat poorly drained and are on slightly higher positions on the landscape than the Edmore soils. Remus and Spinks soils are well drained and are on the higher landforms.

A typical pedon of Edmore sandy loam, 500 feet north and 1,200 feet east of the southwest corner of sec. 1, T. 14 N., R. 8 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, gray (10YR 5/1) dry; moderate medium granular structure; friable; many fine roots; 3 percent pebbles; neutral; abrupt smooth boundary.

Bg—8 to 34 inches; grayish brown (10YR 5/2) sand with lenses of dark grayish brown (10YR 4/2) sandy loam; common medium distinct dark yellowish brown (10YR 4/6) and dark brown (10YR 3/3) mottles; weak fine subangular blocky structure; very friable; 5 percent pebbles; neutral; clear wavy boundary.

Cg1—34 to 40 inches; grayish brown (10YR 5/2) sand; single grain; loose; 5 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

Cg2—40 to 60 inches; grayish brown (10YR 5/2) sand; single grain; loose; 5 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates range from 26 to 45 inches. Pebble content in the solum is 0 to 5 percent. The solum ranges from slightly acid to mildly alkaline, with alkalinity increasing with depth.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is 8 or 9 inches thick. Some pedons have an A horizon with color of 10YR 2/1. The A horizon is 5 to 9 inches thick. The Bg horizon has value of 5 to 7 and chroma of 1 or 2. It is sand, loamy sand, or sandy loam. The Cg horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 1 or 2. It is sand or loamy sand with strata of sand, loamy sand, or sandy loam. Pebble content ranges from 0 to 15 percent.

Edwards Series

The Edwards series consists of very poorly drained soils in bogs or in depressions on outwash plains and moraines. These soils formed in organic material 16 to 40 inches thick over marl deposits. Permeability is moderately slow to moderately rapid in the organic material. Slope is 0 to 1 percent.

Edwards soils are similar to Adrian, Houghton, Loxley, and Palms soils and are commonly adjacent to Houghton soils. Adrian soils have a sandy C horizon. Houghton and Loxley soils have organic material more than 51 inches deep. Palms soils have a loamy C horizon.

A typical pedon of Edwards muck, 1,000 feet east and 50 feet south of the northwest corner of sec. 12, T. 14 N., R. 9 W.

Oa1—0 to 9 inches; black (10YR 2/1) broken face and rubbed sapric material; about 10 percent fiber, trace after rubbing; moderate medium granular structure; friable; herbaceous fibers; many fine roots; neutral; clear smooth boundary.

Oa2—9 to 20 inches; black (10YR 2/1) broken face and rubbed sapric material; about 30 percent fiber, 10 percent rubbed; weak coarse prismatic structure; friable; herbaceous fibers; few fine roots; neutral; gradual smooth boundary.

Oa3—20 to 28 inches; black (10YR 2/1) broken face and rubbed sapric material; about 20 percent fiber, 5 percent rubbed; weak medium subangular blocky structure; very friable; herbaceous fibers; few snail shells; mildly alkaline; diffuse wavy boundary.

C—28 to 60 inches; grayish brown (2.5Y 5/2) marl; massive; friable; violent effervescence; moderately alkaline.

The thickness of the sapric material and depth to marl range from 16 to 40 inches.

All the organic layers have chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It commonly contains snail shells.

Glendora Series

The Glendora series consists of poorly drained, rapidly permeable soils. These soils formed in sandy deposits on flood plains. Slope is 0 to 2 percent.

Glendora soils are similar to Roscommon and Vestaburg soils and are commonly adjacent to the Algansee soils. Algansee soils are somewhat poorly drained and are on slightly higher positions on the landscape than the Glendora soils. Roscommon soils have less stratification. Vestaburg soils have a gravelly substratum.

A typical pedon of Glendora loamy sand, 50 feet east and 858 feet south of the northwest corner of sec. 5, T. 13 N., R. 8 W.

A—0 to 6 inches; black (10YR 2/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine roots; 5 percent pebbles; medium acid; abrupt smooth boundary.

C1—6 to 20 inches; grayish brown (10YR 5/2) sand; few fine distinct yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; very friable; common fine roots; 5 percent pebbles; medium acid; abrupt irregular boundary.

C2—20 to 24 inches; very dark grayish brown (10YR 3/2) loamy sand; weak very fine subangular blocky structure; very friable; few fine roots; 5 percent pebbles; slightly acid; abrupt irregular boundary.

C3—24 to 38 inches; brown (10YR 4/3) sand; few fine faint yellowish brown (10YR 5/6) and many fine faint grayish brown (10YR 5/2) mottles; single grain; loose; few very fine roots; 1 percent pebbles; medium acid; clear wavy boundary.

C4—38 to 60 inches; grayish brown (2.5Y 5/2) sand; few fine faint yellowish brown (10YR 5/6) mottles; single grain; loose; 1 percent pebbles; slightly acid.

The content of pebbles ranges from 0 to 10 percent in the solum. Reaction ranges from medium acid to mildly alkaline.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It ranges from 6 to 9 inches in thickness. It is dominantly loamy sand, but the range includes sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 2 or 3. It is sand or loamy sand.

Houghton Series

The Houghton series consists of very poorly drained soils in bogs and depressions on outwash plains and moraines. These soils formed in organic material more than 51 inches thick. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Houghton soils are similar to Adrian, Edwards, Loxley, and Palms soils and are commonly adjacent to Adrian, Edwards, Palms, and Remus soils. Loxley soils have a more acid solum. Adrian soils have a sandy C horizon, and Edwards soils are underlain with marl. Palms soils have a loamy C horizon. Remus soils are well drained and are on higher areas of the landscape than the Houghton soils.

A typical pedon of Houghton muck, 100 feet north and 2,310 feet west of the southeast corner of sec. 28, T. 13 N., R. 7 W.

Oa1—0 to 18 inches; black (10YR 2/1) broken face and rubbed sapric material; about 15 percent fiber, 0 percent rubbed; weak fine subangular blocky structure; friable; herbaceous fibers; many fine and few coarse roots; neutral; clear smooth boundary.

Oa2—18 to 27 inches; black (10YR 2/1) broken face and rubbed sapric material; about 50 percent fiber, 10 percent rubbed; massive; friable; herbaceous fibers; mildly alkaline; clear smooth boundary.

Oa3—27 to 60 inches; black (10YR 2/1) broken face and rubbed sapric material; about 35 percent fiber, 5 percent rubbed; massive; friable; herbaceous fibers; mildly alkaline; clear smooth boundary.

The organic layers are more than 51 inches thick. The organic material primarily consists of herbaceous fibers, but some pedons contain up to 30 percent woody fibers and fragments. The organic material ranges from slightly acid to mildly alkaline.

The surface tier has hue of 7.5YR to 10YR and chroma of 0 to 2. The subsurface tier and underlying tier have hue of 5YR, 7.5YR, or 10YR; value of 2 or 3; and chroma of 0 to 3. Some pedons contain 2 to 10 inches of hemic material.

Ithaca Series

The Ithaca series consists of somewhat poorly drained, moderately slowly permeable soils. These soils formed in loamy and clayey deposits on till plains. Slope ranges from 0 to 4 percent.

Ithaca soils are commonly adjacent to the Ziegenfuss and Perrinton soils. Ziegenfuss soils are poorly drained and are in depressions and along drainageways. Perrinton soils are well drained and are on the higher rises.

A typical pedon of Ithaca loam, 0 to 4 percent slopes, 2,300 feet south and 100 feet west of the northeast corner of sec. 20, T. 15 N., R. 10 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; friable; many fine roots; 10 percent pebbles; neutral; clear smooth boundary.

B/E—9 to 14 inches; brown (7.5YR 4/4) clay (Bt); brown (10YR 5/3) sandy loam (E) that interfingers into and surrounds some peds; common fine faint strong brown (7.5YR 4/6) and few fine faint light brownish gray (10YR 6/2) mottles; strong medium subangular blocky structure; friable; common fine roots; 10 percent pebbles; slightly acid; clear wavy boundary.

Bt1—14 to 20 inches; brown (7.5YR 5/4) clay; few fine faint light brownish gray (10YR 6/2) and strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous dark brown (7.5YR 4/2) clay films on surfaces of peds; few very fine roots; 5 percent pebbles; neutral; clear wavy boundary.

Bt2—20 to 28 inches; brown (7.5YR 4/4) clay; few fine faint strong brown (7.5YR 4/6) mottles; massive; firm; thin discontinuous dark brown (7.5YR 4/2) clay films on surfaces of peds; 5 percent pebbles; neutral; clear wavy boundary.

C—28 to 60 inches; brown (7.5YR 5/4) clay; few fine faint strong brown (7.5YR 5/6) mottles; massive; very firm; light gray (10YR 7/3) lime streaks; 5 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 40 inches. Pebble content in the solum is 0 to 10 percent. The solum ranges from slightly acid to mildly alkaline.

The Ap horizon has chroma of 1 or 2. It is 6 to 9 inches thick and is dominantly loam, but the range includes silt loam. Some pedons have an A horizon 4 to 5 inches thick. It is similar to the Ap horizon in color and texture. Some pedons have a separate E horizon. The E part of the B/E horizon has value of 4 to 6 and chroma of 3 or 4. It is sandy loam, loam, or silt loam. The Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6, and

chroma of 3 or 4. It is clay or silty clay loam. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 4. It is clay, clay loam, or silty clay loam. Pebble content ranges from 0 to 8 percent.

Leoni Series

The Leoni series consists of well drained soils formed in sandy and loamy deposits on outwash plains and moraines. Permeability is moderate in the upper part of the pedon and rapid or moderately rapid in the lower part. Slope ranges from 0 to 18 percent.

Leoni soils are commonly adjacent to Coloma, Houghton, and Marlette soils on the landscape. Pedons of Coloma soils are sandy. Houghton soils are very poorly drained and are in very wet depressions. Marlette soils do not have a sandy C horizon. Coloma and Marlette soils are on landscape positions similar to those of the Leoni soils.

A typical pedon of Leoni gravelly sandy loam, 0 to 6 percent slopes, 231 feet west and 132 feet north of the center of sec. 35, T. 15 N., R. 8 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; 25 percent pebbles; many very fine roots; neutral; abrupt smooth boundary.

BE—6 to 9 inches; yellowish brown (10YR 5/6) very gravelly sandy loam; weak fine subangular blocky structure; friable; 50 percent pebbles; common very fine roots; neutral; abrupt smooth boundary.

Bt1—9 to 14 inches; brown (7.5YR 4/4) extremely gravelly sandy loam; weak fine subangular blocky structure; friable; clay bridging between sand grains; 65 percent pebbles; common very fine roots; neutral; abrupt wavy boundary.

Bt2—14 to 22 inches; reddish brown (5YR 4/3) extremely gravelly clay loam; moderate fine subangular blocky structure; firm; common thin reddish brown clay (5YR 4/4) films on pebble surfaces; 70 percent pebbles; few very fine roots; neutral; clear irregular boundary.

BC—22 to 30 inches; brown (7.5YR 4/4) extremely gravelly sandy loam; weak fine subangular blocky structure; friable; 70 percent pebbles; few very fine roots; strong effervescence; moderately alkaline; clear irregular boundary.

C—30 to 60 inches; yellowish brown (10YR 5/4) extremely gravelly sand; single grain; loose; 65 percent pebbles; few very fine roots; strong effervescence; moderately alkaline.

The solum ranges from 25 to 35 inches in thickness. Pebble content in the solum is 15 to 75 percent. Reaction is medium acid to neutral.

The Ap horizon has chroma of 2 or 3. It is 6 to 9 inches thick. Some pedons have an A horizon that is 2 to 3 inches thick and is similar in color and texture to the Ap horizon. The Bt horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 3 to 6. It is gravelly, very gravelly, or extremely gravelly analogs of sandy loam, clay loam, or sandy clay loam. The C horizon has value of 4 to 6 and chroma of 3 or 4. It is gravelly, very gravelly, or extremely gravelly analogs of sand or loamy sand. Pebble content ranges from 30 to 75 percent.

Locke Series

The Locke series consists of somewhat poorly drained, moderately permeable soils. These soils formed in loamy till on moraines. Slope ranges from 0 to 3 percent.

Locke soils are commonly adjacent to Edmore and Remus soils on the landscape. Edmore soils are poorly drained and are in wet depressions. Remus soils are well drained and are on higher positions on the landscape than the Locke soils.

A typical pedon of Locke sandy loam, 0 to 3 percent slopes, 1,386 feet north and 50 feet west of the southeast corner of sec. 24, T. 13 N., R. 8 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; 2 percent pebbles; neutral; abrupt smooth boundary.

BE—8 to 15 inches; brown (7.5YR 5/4) sandy loam; common fine distinct strong brown (7.5YR 4/6) and grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; friable; 2 percent pebbles; neutral; clear wavy boundary.

Bt—15 to 25 inches; brown (7.5YR 4/4) sandy clay loam; common fine distinct strong brown (7.5YR 4/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few thin brown (7.5YR 4/4) clay films on faces of peds; 2 percent pebbles; neutral; clear wavy boundary.

C1—25 to 32 inches; yellowish brown (10YR 5/4) loam; many medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; massive; firm; 2 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—32 to 60 inches; yellowish brown (10YR 5/4) sandy loam; common medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; friable; 2 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 25 to 40 inches. Pebble and cobble content in the solum is 2 to 10 percent. The solum ranges from medium acid to neutral.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly sandy loam, but the range includes fine sandy loam. The Ap horizon ranges from 7 to 10 inches in thickness. The BE horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is sandy loam or loamy sand. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is sandy loam, loam, or sandy clay loam. The C horizon has value of 5 or 6 and chroma of 2 to 4. It is mainly sandy loam with pockets and lenses of loamy sand and loam.

Loxley Series

The Loxley series consists of very poorly drained soils in bogs and depressions on outwash plains and moraines. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Loxley soils are similar to Adrian, Edwards, Houghton, and Palms soils, and are commonly adjacent to the Coloma and Roscommon soils. Adrian soils have a sandy C horizon. Edwards soils are underlain with marl. Houghton soils are more alkaline than Loxley soils. Palms soils have a loamy C horizon. Coloma and Roscommon soils are sandy. Coloma soils are somewhat excessively drained and are on the higher knolls and rises. Roscommon soils are on landscape positions similar to those of the Loxley soils.

A typical pedon of Loxley muck, 2,046 feet south and 50 feet west of the northeast corner of sec. 24, T. 15 N., R. 9 W.

Oi—0 to 2 inches; brown (7.5YR 5/4) broken face and rubbed fibric material; 100 percent fiber, 100 percent after rubbing; massive; friable; primarily live roots and sphagnum moss; extremely acid; clear smooth boundary.

Oa1—2 to 9 inches; black (5YR 2/1) broken face and rubbed sapric material; 15 percent fiber, 5 percent after rubbing; moderate medium granular structure; friable; herbaceous fibers; many fine roots; extremely acid; clear smooth boundary.

Oa2—9 to 40 inches; dark reddish brown (5YR 3/2) broken face and (5YR 2/2) rubbed sapric material; 70 percent fiber, 15 percent after rubbing; massive; friable; herbaceous fibers; few fine roots; extremely acid; clear wavy boundary.

Oa3—40 to 60 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material; 50 percent fiber, 10 percent rubbed; massive; friable; herbaceous fibers; extremely acid.

The thickness of the sapric material ranges from 51 to more than 60 inches.

All the organic layers have hue of 5YR, 7.5YR, or 10YR; value of 2 to 5; and chroma of 1 to 4.

Marlette Series

The Marlette series consists of well drained or moderately well drained, moderately slowly permeable soils. These soils formed in calcareous loamy deposits on moraines. Slope ranges from 2 to 18 percent.

Marlette soils are similar to Perrinton and Remus soils and are commonly adjacent to Aubbeenaubbee, Capac, and Metea soils. Aubbeenaubbee and Capac soils are somewhat poorly drained and are slightly lower on the landscape than the Marlette soils. Metea and Remus soils are coarser in texture in the upper part of the solum and are on similar positions on the landscape. Perrinton soils are finer in texture in the subsoil and substratum.

A typical pedon of Marlette sandy loam, 2 to 6 percent slopes, 1,512 feet west and 264 feet south of the northeast corner of sec. 20, T. 14 N., R. 7 W.

Ap—0 to 11 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; few very fine roots; 2 percent pebbles; medium acid; abrupt smooth boundary.

B/E—11 to 22 inches; brown (7.5YR 4/4) clay loam (Bt); moderate medium subangular blocky structure; firm; pale brown (10YR 6/3) sandy loam (E) as coatings on surfaces of peds and along root channels; friable; few very fine roots; 2 percent pebbles; slightly acid; gradual wavy boundary.

Bt—22 to 38 inches; brown (7.5YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; common thin brown (10YR 5/3) clay films on ped faces; few very fine roots; 2 percent pebbles; medium acid; gradual wavy boundary.

C—38 to 60 inches; brown (10YR 5/3) clay loam; few medium distinct yellowish brown (10YR 5/8) mottles; massive; firm; 2 percent pebbles; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 25 to 40 inches. Pebble content in the solum is 0 to 8 percent. The solum ranges from medium acid to mildly alkaline.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It ranges from 6 to 11 inches in thickness. The E horizon is present as a separate horizon in some pedons. It has value of 5 or 6 and chroma of 3 or 4. The A and E horizons are dominantly sandy loam, but the range includes loam and fine sandy loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 or 6. It is clay loam or loam. The C horizon has hue of 7.5YR or 10YR and chroma of 3 to 6. It is loam or clay loam. Pebble content ranges from 0 to 5 percent.

Mecosta Series

The Mecosta series consists of somewhat excessively drained soils that are rapidly permeable in the upper part of the pedon and very rapidly permeable in the lower part. These soils formed in calcareous sandy and gravelly deposits on outwash plains and moraines. Slope ranges from 0 to 35 percent.

Mecosta soils are similar to Coloma and Plainfield soils and are commonly adjacent to the Coloma, Plainfield, and Spinks soils. Spinks soils have sandy loam and loamy sand lamellae, and Coloma soils have loamy sand lamellae. Plainfield soils do not have a gravelly sand substratum. All of these soils are on landscape positions similar to those of the Mecosta soils.

A typical pedon of Mecosta sand, 0 to 4 percent slopes, 1,815 feet north and 230 feet west of the center of sec. 15, T. 14 N., R. 10 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common very fine roots; 5 percent pebbles; strongly acid; abrupt smooth boundary.

Bw1—10 to 15 inches; strong brown (7.5YR 5/6) sand; weak medium subangular blocky structure; very friable; few very fine roots; 5 percent pebbles; strongly acid; gradual wavy boundary.

Bw2—15 to 20 inches; yellowish brown (10YR 5/6) gravelly sand; weak very fine subangular blocky structure; very friable; few very fine roots; 15 percent pebbles; medium acid; abrupt wavy boundary.

Bw3—20 to 22 inches; brown (7.5YR 5/4) gravelly coarse sand; weak fine subangular blocky structure; very friable; common very fine roots; 30 percent pebbles; slightly acid; abrupt wavy boundary.

C1—22 to 33 inches; pale brown (10YR 6/3) very gravelly coarse sand; single grain; loose; few very fine roots; 50 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C2—33 to 60 inches; pale brown (10YR 6/3) extremely gravelly coarse sand; single grain; loose; few very fine roots; 65 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. Pebble content ranges from 1 to 25 percent in the upper part of the solum and from 25 to 50 percent in the lower part. The solum ranges from strongly acid to neutral.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It is 5 to 10 inches thick. Uncultivated areas have an A horizon 2 to 3 inches thick. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is most commonly sand, but the range includes loamy sand. The Bw horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 to 8. It is sand, coarse sand, or loamy sand, and gravelly to very gravelly analogs. The C horizon has value of 5 or 6 and chroma of 3 or 4. It is gravelly sand or gravelly coarse sand, or a very gravelly to extremely gravelly analog. Pebble content ranges from 35 to 65 percent. In some pedons the C horizon is neutral or mildly alkaline.

Metea Series

The Metea series consists of well drained soils. These soils formed in sandy and loamy deposits on moraines. Permeability is rapid in the upper part of the pedon and moderate in the lower part. Slope ranges from 0 to 18 percent.

Metea soils are similar to the loamy substratum phase of the Coloma soils and to the Tustin soils and are commonly adjacent to Coloma, Remus, Wixom, and Spinks soils. Tustin soils have a clayey 2C horizon. Coloma soils are sandy. Remus soils are loamy. Spinks soils have loamy sand and sandy loam bands. These soils, except the Wixom soils, are on landscape positions similar to those of the Metea soils. Wixom soils are somewhat poorly drained and are in the slightly lower positions on the landscape.

A typical pedon of Metea loamy sand, 0 to 6 percent slopes, 1,947 feet east and 150 feet north of the southwest corner of sec. 8, T. 14 N., R. 7 W.

Ap—0 to 10 inches; brown (10YR 4/3) loamy sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common very fine roots; 1 percent pebbles; neutral; abrupt smooth boundary.

Bw—10 to 21 inches; brownish yellow (10YR 6/6) loamy sand; weak very fine subangular blocky structure; very friable; common very fine roots; 1 percent pebbles; slightly acid; abrupt wavy boundary.

E/B—21 to 25 inches; pale brown (10YR 6/3) loamy sand (E); very friable; brown (7.5YR 5/4) clay loam (Bt); firm; weak very fine subangular blocky structure; few very fine roots; thin brown (7.5YR 4/4) clay films on surfaces of peds; 1 percent pebbles; neutral; abrupt wavy boundary.

2Bt—25 to 33 inches; brown (7.5YR 5/4) clay loam; common fine distinct strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; firm; thin brown (7.5YR 4/4) clay films on surfaces of peds; 3 percent pebbles; neutral; clear wavy boundary.

2C—33 to 60 inches; brown (10YR 5/4) clay loam; massive; firm; 3 percent pebbles; strong effervescence; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. Depth to the 2Bt horizon ranges from 20 to 37 inches. Pebble content in the solum is 0 to 5 percent. The sandy

upper part of the solum ranges from medium acid to neutral, and the loamy lower part ranges from medium acid to mildly alkaline. Depth to carbonates ranges from 30 to more than 60 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. It is 6 to 10 inches thick. Some pedons have an A horizon with hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It is 1 to 3 inches thick. The A horizon is dominantly loamy sand, but the range includes sand. Some pedons have an E horizon. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is loamy sand or sand. The E part of the E/B horizon has chroma of 3 or 4. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam, loam, or sandy clay loam. The 2C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or sandy clay loam with pebble content of 0 to 3 percent. It is mildly alkaline or moderately alkaline.

Palms Series

The Palms series consists of very poorly drained soils in bogs and depressions on till plains and outwash plains. These soils formed in organic sediments over loamy deposits. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent.

Palms soils are similar to Adrian, Edwards, Houghton, and Loxley soils and are commonly adjacent to Houghton, Marlette, Remus, and Spinks soils. Adrian soils have a sandy C horizon. Edwards soils are underlain with marl. Houghton and Loxley soils have organic material to a depth of more than 51 inches. Marlette, Remus, and Spinks soils are well drained and are on higher positions on the landscape than the Palms soils.

A typical pedon of Palms muck, 1,450 feet west and 75 feet south of the center of sec. 23, T. 13 N., R. 8 W.

Oi—0 to 2 inches; dark reddish brown (5YR 3/3) broken face and rubbed fibric material; about 95 percent fiber, 90 percent rubbed; massive; friable; strongly acid; abrupt smooth boundary.

Oa1—2 to 6 inches; black (10YR 2/1) broken face and rubbed sapric material; about 40 percent fiber, trace rubbed; weak fine granular structure; friable; herbaceous fibers; many fine roots; strongly acid; clear smooth boundary.

Oa2—6 to 17 inches; dark reddish brown (5YR 3/2) broken face and black (10YR 2/1) rubbed sapric material; about 50 percent fiber, trace rubbed; moderate very thick platy structure; friable; herbaceous fibers; common very fine roots; strongly acid; abrupt wavy boundary.

Oa3—17 to 27 inches; black (5YR 2/1) broken face and rubbed sapric material; about 60 percent fiber, trace rubbed; strong very thick platy structure; friable; herbaceous fibers; common very fine roots; strongly acid; clear wavy boundary.

Oa4—27 to 34 inches; dark yellowish brown (10YR 4/4) broken face and dark brown (10YR 3/3) rubbed sapric material; 50 percent mineral content; weak medium subangular blocky structure; friable; herbaceous fibers; few very fine roots; strongly acid; abrupt wavy boundary.

Cg1—34 to 52 inches; olive gray (5Y 5/2) clay loam; massive; firm; slightly acid; gradual wavy boundary.

Cg2—52 to 60 inches; olive gray (5Y 5/2) sandy clay loam; massive; friable; slightly acid.

The thickness of the sapric material and the depth to the loamy C horizon range from 16 to 40 inches. The sapric material ranges from strongly acid to neutral.

Some pedons contain layers of hemic material, but their total thickness is 5 inches or less.

The Cg horizon has hue of 2.5Y, 5Y, or 10YR; value of 4 or 5; and chroma of 1 or 2. It is sandy clay loam, clay loam, loam, or silt loam. It ranges from slightly acid to moderately alkaline.

Perrinton Series

The Perrinton series consists of well drained, moderately slowly permeable soils. These soils formed in clayey and silty deposits on moraines. Slope ranges from 2 to 35 percent.

Perrinton soils are commonly adjacent to Coloma, Ithaca, Tustin, and Ziegenfuss soils. Coloma soils have a sandy pedon. Tustin soils are sandy in the upper part of the solum. Coloma and Tustin soils are on landscape positions similar to those of the Perrinton soils. Ithaca soils are somewhat poorly drained and are in depressions and along drainageways. Ziegenfuss soils are poorly drained and are in very wet depressions.

A typical pedon of Perrinton loam, 2 to 6 percent slopes, 1,550 feet east and 150 feet north of the southwest corner of sec. 16, T. 15 N., R. 10 W.

Ap—0 to 8 inches; dark brown (7.5YR 3/2) loam, brown (7.5YR 5/2) dry; weak fine subangular blocky structure; friable; many fine roots; neutral; abrupt smooth boundary.

B/E—8 to 13 inches; brown (7.5YR 4/4) silty clay loam (Bt); moderate medium subangular blocky structure; brown (10YR 5/3) silt loam (E) that interfingers into and surrounds some of the peds; firm; common very fine roots; neutral; clear smooth boundary.

Bt1—13 to 24 inches; brown (7.5YR 4/4) clay; strong coarse subangular blocky structure; firm; common thin brown (7.5YR 4/4) clay films on surfaces of peds; common very fine roots; neutral; clear wavy boundary.

Bt2—24 to 30 inches; brown (7.5YR 5/4) silty clay; strong coarse subangular blocky structure; firm; few very fine roots; mildly alkaline; clear wavy boundary.
C—30 to 60 inches; brown (7.5YR 5/4) silty clay; massive; firm; slight effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. Pebble content in the solum is 0 to 5 percent. The solum ranges from slightly acid to mildly alkaline.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 1 to 3. It is 7 to 11 inches thick. Some pedons have an A horizon 3 to 4 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A horizon is dominantly loam, but the range includes silt loam and sandy loam. Some pedons have a separate E horizon. The E part of the B/E horizon has value of 4 to 6 and chroma of 2 to 4. The Bt part of the B/E horizon and the Bt horizon have hue of 7.5YR or 10YR and chroma of 3 or 4. The Bt material is silty clay loam, silty clay, or clay. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam, silty clay, or clay. Pebble content is 0 to 5 percent.

Pipestone Series

The Pipestone series consists of somewhat poorly drained, rapidly permeable soils. These soils formed in sandy deposits on till plains and outwash plains. Slope ranges from 0 to 3 percent.

Pipestone soils are similar to Thetford soils and are commonly adjacent to Covert and Roscommon soils on the landscape. Thetford soils have loamy and sandy bands in the subsoil. Covert soils are moderately well drained and are on slightly higher rises than the Pipestone soils. Roscommon soils are poorly drained and are in the slightly lower depressions.

A typical pedon of Pipestone loamy sand, 0 to 3 percent slopes, 2,640 feet south and 660 feet east of the northwest corner of sec. 32, T. 14 N., R. 8 W.

A1—0 to 5 inches; very dark brown (10YR 2/2) loamy sand, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; very friable; common fine roots; strongly acid; clear smooth boundary.
A2—5 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; very friable; few fine roots; strongly acid; abrupt smooth boundary.
Bs1—9 to 17 inches; brown (7.5YR 4/4) loamy sand; few medium faint brown (7.5YR 5/4) mottles; weak fine subangular blocky structure; very friable; few fine roots; strongly acid; gradual smooth boundary.
Bs2—17 to 24 inches; dark yellowish brown (10YR 4/6) sand; few medium faint yellowish brown (10YR 5/8) mottles; single grain; loose; strongly acid; gradual smooth boundary.
C—24 to 60 inches; yellowish brown (10YR 5/6) sand; common medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; neutral.

The thickness of the solum ranges from 20 to 50 inches. Pebble content of the solum is 0 to 5 percent. Reaction in the solum is strongly acid to neutral.

The A horizon has chroma of 1 or 2. It is 4 to 9 inches thick. Some pedons have an E horizon with hue of 10YR, value of 5 to 7, and chroma of 1 or 2. The E horizon is 0 to 7 inches thick. The A and E horizons are dominantly loamy sand, but the range includes sand. The Bs horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 3 to 6. The upper part of the Bs horizon has the darker colors. The C horizon has value of 5 or 6 and chroma of 3 to 6. It has pebble content of 0 to 5 percent, and it is slightly acid or neutral.

Plainfield Series

The Plainfield series consists of excessively drained, rapidly permeable soils. These soils formed in sandy deposits on outwash plains, stream terraces, and moraines. Slope ranges from 0 to 35 percent.

Plainfield soils are similar to Coloma and Mecosta soils and are commonly adjacent to the Coloma and Covert soils on the landscape. Pedons of Coloma soils have loamy sand bands. Mecosta soils have a substratum that is extremely gravelly coarse sand. Covert soils are moderately well drained and are slightly lower on the landscape than the Plainfield soils.

A typical pedon of Plainfield sand, 0 to 6 percent slopes, 200 feet north and 100 feet west of the southeast corner of sec. 19, T. 15 N., R. 10 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many fine and medium roots; strongly acid; clear wavy boundary.
Bw1—3 to 8 inches; dark yellowish brown (10YR 4/4) sand; weak very fine granular structure; very friable; common fine and medium roots; slightly acid; clear wavy boundary.
Bw2—8 to 22 inches; yellowish brown (10YR 5/6) sand; single grain; loose; common fine and medium roots; slightly acid; gradual wavy boundary.
C1—22 to 38 inches; brownish yellow (10YR 6/6) sand; single grain; loose; common fine roots; slightly acid; gradual wavy boundary.
C2—38 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few very fine roots; slightly acid.

The thickness of the solum ranges from 18 to 34 inches. Pebble content in the solum is 0 to 4 percent. The solum ranges from slightly acid to very strongly acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is 1 to 4 inches thick. Some pedons have an Ap horizon 6 to 10 inches thick. It has value of 3 or 4 and chroma of 2 or 3. Some pedons have an E horizon. The A and E horizons are dominantly sand, but the range includes fine sand, loamy sand, or loamy fine sand. The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 8, and chroma of 3 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 8. It is sand or fine sand. Pebble content is 0 to 15 percent. The C horizon ranges from slightly acid to very strongly acid.

Remus Series

The Remus series consists of well drained, moderately permeable soils. These soils formed in loamy deposits on moraines. Slope ranges from 0 to 35 percent.

Remus soils are similar to Marlette soils and are commonly adjacent to Coloma, Locke, Spinks, and Thetford soils. Marlette soils are finer in texture in the upper part of the solum. Pedons of Coloma and Spinks soils have loamy sand bands and are on landscape positions similar to those of the Remus soils. Locke and Thetford soils are somewhat poorly drained and are on the slightly lower positions on the landscape.

A typical pedon of Remus sandy loam, 0 to 6 percent slopes, 1,716 feet north and 150 feet east of the southwest corner of sec. 23, T. 13 N., R. 7 W.

Ap—0 to 6 inches; dark brown (10YR 3/3) sandy loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many very fine roots; 5 percent pebbles and cobbles; neutral; abrupt smooth boundary.

E—6 to 9 inches; light yellowish brown (10YR 6/4) sandy loam; moderate medium granular structure; friable; common very fine roots; 5 percent pebbles and cobbles; slightly acid; abrupt wavy boundary.

E/B—9 to 18 inches; pale brown (10YR 6/3) sandy loam (E); moderate very fine subangular blocky structure; common very fine pores; very hard when dry; friable, moist; brown (7.5YR 5/4) sandy clay loam (Bt); moderate fine subangular blocky structure; firm; thin clay films on vertical faces of peds; few very fine roots; 5 percent pebbles; neutral; clear wavy boundary.

B/E—18 to 23 inches; brown (7.5YR 5/4) sandy clay loam (Bt); weak fine subangular blocky structure; firm; thin clay films on some of the peds; pale brown (10YR 6/3) sandy loam (E) that interfingers into and surrounds some of the peds; few very fine roots; 5 percent pebbles; neutral; clear wavy boundary.

Bt—23 to 32 inches; brown (7.5YR 5/4) sandy clay loam; weak medium subangular blocky structure; firm; few very fine roots; thin dark yellowish brown (10YR 4/4) clay films on faces of peds; 2 percent pebbles; neutral; gradual wavy boundary.

BC—32 to 60 inches; brown (7.5YR 5/4) sandy clay loam; weak fine subangular blocky structure; firm; neutral.

The thickness of the solum and the depth to free carbonates range from 40 to more than 60 inches. The content of pebbles and cobbles ranges from 0 to 15 percent in these soils. The solum ranges from strongly acid to neutral.

The Ap horizon has value of 2 to 4 and chroma of 2 or 3. It is 6 to 10 inches thick. Uncultivated areas have an A horizon 2 to 5 inches thick. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has value of 5 to 7 and chroma of 2 to 4. The A and E horizons are commonly sandy loam, but the range includes fine sandy loam and loamy sand. The B part of the E/B and B/E horizons has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam or sandy clay loam. The E part of the E/B and B/E horizons is brittle when dry. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 or 6. It is sandy clay loam or sandy loam. The BC horizon has hue of 7.5YR or 10YR and chroma of 4 or 6. It is sandy clay loam or sandy loam. Some pedons have a C horizon within a depth of 60 inches. If there is a C horizon, it has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is sandy loam or sandy clay loam; however, pockets of sand or loamy sand are in some pedons. It is mildly alkaline or moderately alkaline.

Riverdale Series

The Riverdale series consists of somewhat poorly drained soils. These soils formed in sandy and loamy deposits on outwash plains. Permeability is moderately rapid in the upper part of the pedon and very rapid in the lower part. Slope ranges from 0 to 4 percent.

Riverdale soils are commonly adjacent to the Mecosta and Vestaburg soils. Mecosta soils are somewhat excessively drained and are higher on the landscape than the Riverdale soils. Vestaburg soils are poorly drained and are slightly lower on the landscape.

A typical pedon of Riverdale loamy sand, 0 to 4 percent slopes, 1,080 feet north and 1,980 feet west of the southeast corner of sec. 12, T. 14 N., R. 8 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; moderate fine granular structure; very friable; common very fine roots; 4 percent pebbles; neutral; abrupt smooth boundary.

E1—9 to 14 inches; yellowish brown (10YR 5/4) loamy sand; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; few very fine roots; 4 percent pebbles; neutral; clear smooth boundary.

E2—14 to 25 inches; yellowish brown (10YR 5/6) loamy sand; common fine faint brown and yellowish brown (10YR 5/3 & 5/8) mottles; weak fine subangular structure; very friable; few very fine roots; 5 percent pebbles; neutral; gradual wavy boundary.
E3—25 to 32 inches; yellowish brown (10YR 5/6) loamy sand with globular masses of sandy loam; common fine faint brown and yellowish brown (10YR 5/3 & 5/8) mottles; weak medium subangular blocky structure; very friable; few very fine roots; 5 percent pebbles; slightly acid; gradual wavy boundary.
E4—32 to 38 inches; yellowish brown (10YR 5/4) sand; many fine faint brown (10YR 5/3) mottles; weak medium subangular blocky structure; very friable; few very fine roots; 10 percent pebbles; slightly acid; abrupt wavy boundary.
Bt—38 to 42 inches; yellowish brown (10YR 5/6) gravelly sandy clay loam; many fine faint grayish brown and yellowish brown (10YR 5/2 & 5/8) mottles; weak coarse subangular blocky structure; firm; 20 percent pebbles; neutral; abrupt wavy boundary.
2C—42 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; common fine faint yellowish brown (10YR 5/6) mottles; single grain; loose; 50 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 45 inches. The solum ranges from slightly acid to mildly alkaline.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is 6 to 10 inches thick. Some pedons have A and E horizons. Pebble content is 0 to 10 percent. The A and E horizons are dominantly loamy sand, but the range includes sand and sandy loam. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is sand, loamy sand, or sandy loam. Pebble content is 0 to 14 percent. The Bt horizon is gravelly sandy clay loam, gravelly sandy loam, or sandy loam. A gravelly E&B horizon of banded loamy sand and sandy loam is sometimes present. Some pedons have a BC horizon. The 2C horizon has value of 5 or 6 and chroma of 2 to 4. Pebble content is 15 to 60 percent.

Roscommon Series

The Roscommon series consists of poorly drained, rapidly permeable soils. These soils formed in sandy deposits on outwash plains. Slope is 0 to 2 percent.

Roscommon soils are similar to Edmore, Glendora, and Vestaburg soils and are commonly adjacent to Adrian, Coloma, and Pipestone soils. Edmore soils have sandy loam lenses in the subsoil. Glendora soils have more stratification throughout than the Roscommon soils. Vestaburg soils have a gravelly sand C horizon. Adrian soils have an organic horizon more than 16 inches thick and are on landscape positions similar to those of the Roscommon soils. Coloma soils are somewhat excessively drained and are higher on the landscape. Pipestone soils are somewhat poorly drained and are slightly higher on the landscape.

A typical pedon of Roscommon loamy sand, 50 feet north and 1,980 feet east of the southwest corner of sec. 5, T. 14 N., R. 8 W.

A—0 to 7 inches; black (10YR 2/1) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; common medium roots; 2 percent pebbles; slightly acid; clear wavy boundary.
Cg1—7 to 10 inches; dark grayish brown (10YR 4/2) sand; weak fine granular structure; very friable; few fine roots; 5 percent pebbles; slightly acid; clear wavy boundary.
Cg2—10 to 20 inches; grayish brown (10YR 5/2) sand; common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; 5 percent pebbles; neutral; clear wavy boundary.
Cg3—20 to 60 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; 10 percent pebbles; neutral.

Pebble content ranges from 0 to 10 percent throughout these soils.

The A horizon has value of 2 or 3. It is dominantly loamy sand, but the range includes sand and mucky loamy sand. Some pedons have an Oa horizon about 8 inches thick. The C horizon has chroma of 2 or 3.

Spinks Series

The Spinks series consists of well drained, moderately rapidly permeable soils. These soils formed in sandy and loamy deposits on moraines and outwash plains. Slope ranges from 0 to 18 percent.

Spinks soils are similar to Coloma soils and are commonly adjacent to Coloma, Edmore, Metea, and Remus soils. Coloma soils have thinner and fewer loamy sand bands in the subsoil. Edmore soils are poorly drained and are in wet depressions and along drainageways. Metea soils have a loamy substratum. Remus soils are loamy. Coloma, Metea, and Remus soils are on landscape positions similar to those of the Spinks soils.

A typical pedon of Spinks loamy sand, 0 to 6 percent slopes, 1,450 feet west and 150 feet south of the center of sec. 30, T. 14 N., R. 8 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, brown (10YR 5/3) dry; moderate medium subangular blocky structure; friable; many fine roots; 5 percent pebbles; neutral; abrupt smooth boundary.
E1—9 to 15 inches; dark yellowish brown (10YR 4/6) loamy sand; weak fine subangular blocky structure;

very friable; few fine roots; 5 percent pebbles; slightly acid; clear smooth boundary.
E2—15 to 31 inches; yellowish brown (10YR 5/4) loamy sand; weak fine subangular blocky structure; very friable; few very fine roots; 5 percent pebbles; slightly acid; clear wavy boundary.
E&Bt—31 to 60 inches; yellowish brown (10YR 5/4) loamy sand (E); weak granular structure; very friable; bands of strong brown (7.5YR 5/6) loamy sand and sandy loam (Bt); moderate medium subangular blocky structure; friable; 5 percent pebbles; neutral.

Bands occur between depths of 15 and 60 inches. Pebble content in the solum is 0 to 8 percent. The solum ranges from medium acid to neutral.

The Ap horizon has value of 3 or 5 and chroma of 2 or 3. It is 6 to 11 inches thick. Some pedons have an A horizon 2 to 3 inches thick. It has value of 2 or 3 and chroma of 1 or 2. The Ap and A horizons are dominantly loamy sand, but the range includes loamy fine sand. The E horizon has value of 4 to 6 and chroma of 3 to 6. It is loamy sand, fine sand, or sand. The E&Bt horizon consists of bands that have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 or 6. The bands are sandy loam, loamy sand, or loamy fine sand. Some pedons have a C horizon.

Thetford Series

The Thetford series consists of somewhat poorly drained, moderately rapidly permeable soils. These soils formed in sandy and loamy deposits on till plains and outwash plains. Slope ranges from 0 to 3 percent.

Thetford soils are similar to Pipestone soils and are commonly adjacent to Edmore, Remus, and Spinks soils. Pipestone soils do not have loamy sand or sandy loam bands. Edmore soils are poorly drained and are on lower positions on the landscape than the Thetford soils. Remus and Spinks soils are well drained and are on the higher knolls and rises.

A typical pedon of Thetford loamy sand, 0 to 3 percent slopes, 2,211 feet east and 165 feet south of the northwest corner of sec. 4, T. 14 N., R. 7 W.

A—0 to 4 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine and few coarse roots; 1 percent pebbles; strongly acid; abrupt smooth boundary.
E1—4 to 15 inches; yellowish brown (10YR 5/4) loamy sand; common fine faint yellowish brown (7.5YR 5/8) and brown (10YR 5/3) mottles; weak medium granular structure; very friable; common fine roots; 1 percent pebbles; strongly acid; clear wavy boundary.
E2—15 to 25 inches; pale brown (10YR 6/3) loamy sand; common fine faint yellowish brown (10YR 5/6) mottles; weak medium granular structure; very friable; few very fine roots; 1 percent pebbles; medium acid; clear wavy boundary.
E3—25 to 30 inches; yellowish brown (10YR 5/6) sand; common fine faint strong brown (7.5YR 5/8) mottles; weak medium granular structure; very friable; few very fine roots; 1 percent pebbles; medium acid; clear wavy boundary.
E&Bt—30 to 60 inches; brown (10YR 5/3) sand; common medium distinct strong brown (7.5YR 5/6) mottles (E); single grain; loose; with 1/8- to 3-inch-thick brown (7.5YR 5/4) sandy loam and loamy sand bands with common fine distinct grayish brown (10YR 5/2) mottles (Bt); weak fine subangular blocky structure; friable; few very fine roots; clay bridging between sand grains; 5 percent pebbles; strongly acid.

The solum is 40 to more than 60 inches thick. Pebble and cobble content in the solum is 0 to 10 percent. The solum ranges from strongly acid to neutral.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is 2 to 5 inches thick. The Ap horizon has hue of 10YR, value of 3, and chroma of 1 to 3. It is 7 to 10 inches thick. The A horizon is dominantly loamy sand, but the range includes sand. The E horizon has hue of 7.5YR or 10YR and value of 4 or 6. The Bt part of the E&Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 8. It is loamy sand or sandy loam.

Tustin Series

The Tustin series consists of well drained soils. These soils formed in sandy and clayey deposits on moraines and outwash plains. Permeability is rapid in the upper part of the pedon and slow in the lower part. Slope ranges from 0 to 12 percent.

Tustin soils are similar to the Coloma soils that have a loamy substratum and to the Metea soils and are commonly adjacent to Arkona, Coloma, and Perrinton soils on the landscape. Coloma soils have a loamy substratum and are coarser in texture in the subsoil and substratum than the Tustin soils. Metea soils have a loamy substratum. Arkona soils are somewhat poorly drained and are in depressions and along drainageways. Coloma soils are slightly higher on the landscape. Perrinton soils do not have a sandy solum and are on similar positions on the landscape.

A typical pedon of Tustin loamy sand, 0 to 6 percent slopes, 660 feet west and 260 feet south of the northeast corner of sec. 28, T. 14 N., R. 8 W.

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; many fine roots; strongly acid; abrupt smooth boundary.
Bw1—10 to 19 inches; yellowish brown (10YR 5/6) sand; moderate fine subangular blocky structure;

very friable; common fine roots; medium acid; clear wavy boundary.
Bw2—19 to 30 inches; strong brown (7.5YR 5/6) sand; weak fine subangular blocky structure; very friable; few fine roots; 15 percent pebbles; medium acid; abrupt smooth boundary.
2Bt—30 to 36 inches; dark yellowish brown (10YR 4/4) clay; strong coarse subangular blocky structure; firm; common thin dark yellowish brown (10YR 4/4) clay films on surfaces of peds; few fine roots; neutral; clear wavy boundary.
2C—36 to 60 inches; yellowish brown (10YR 5/4) silty clay; massive; firm; few fine roots; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 30 to 50 inches. The sandy upper part of the solum is 21 to 38 inches thick. Pebble and cobble content in the solum is 0 to 15 percent.

The Ap horizon has chroma of 2 or 3. It is 6 to 10 inches thick. Some areas have an A horizon 2 to 4 inches thick. It has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Bw horizon has value of 4 to 6. The A and Bw horizons are dominantly loamy sand, but the range includes sand. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 or 6. It is clay or silty clay. The 2C horizon has hue of 7.5YR or 10YR and value of 4 or 5. It is silty clay or clay. Pebble content is 0 to 2 percent.

Vestaburg Series

The Vestaburg series consists of poorly drained, very rapidly permeable soils. These soils formed in sandy and loamy deposits on outwash plains. Slope is 0 to 2 percent. These soils are finer in texture in the upper part of the control section than is defined for the Vestaburg series, but this difference does not alter the use or behavior of the soils.

Vestaburg soils are similar to Glendora and Roscommon soils and are commonly adjacent to Mecosta and Riverdale soils. Glendora and Roscommon soils do not have a gravelly sand substratum. Mecosta soils are somewhat excessively drained and are on the higher knolls. Riverdale soils are somewhat poorly drained and are slightly higher on the landscape than the Vestaburg soils.

A typical pedon of Vestaburg sandy loam, 1,220 feet east and 265 feet south of the northwest corner of sec. 24, T. 13 N., R. 9 W.

A—0 to 8 inches; black (10YR 2/1) sandy loam, gray (10YR 5/1) dry; weak medium granular structure; friable; many fine roots; 5 percent pebbles; slightly acid; clear wavy boundary.
Bg—8 to 14 inches; dark grayish brown (10YR 4/2) sandy loam; common fine distinct yellowish brown (10YR 5/6) and many medium distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; common fine roots; 10 percent pebbles; slightly acid; abrupt wavy boundary.
Cg1—14 to 35 inches; grayish brown (10YR 5/2) gravelly sand with sandy loam globular masses 1 to 2 inches in diameter; single grain; loose; few very fine roots; 15 percent pebbles; neutral; gradual wavy boundary.
Cg2—35 to 60 inches; grayish brown (10YR 5/2) very gravelly sand; single grain; loose; 40 to 50 percent pebbles; strong effervescence; moderately alkaline.

Depth to free carbonates ranges from 20 to 40 inches.

The A horizon is 4 to 8 inches thick. This horizon has a pebble content of 5 to 20 percent. It is slightly acid or neutral. Some pedons have an Ap horizon. The C horizon has value of 4 or 5 and chroma of 1 or 2. It is gravelly sand, gravelly loamy sand, very gravelly sand, or gravelly coarse sand. Pebble content ranges from 10 to 25 percent in the upper part of the C horizon and from 40 to 50 percent in the lower part.

Wauseon Series

The Wauseon series consists of very poorly drained soils formed in loamy deposits and underlying clayey deposits on outwash plains. Permeability is moderately rapid in the upper part of the pedon and very slow in the lower part. Slope is 0 to 2 percent.

Wauseon soils are commonly adjacent to Arkona soils and Ithaca soils on the landscape. Arkona and Ithaca soils are somewhat poorly drained and are on higher positions on the landscape than the Wauseon soils.

A typical pedon of Wauseon sandy loam, 1,320 feet west and 200 feet south of the center of sec. 30, T. 13 N., R. 8 W.

Ap—0 to 11 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; common fine roots; slightly acid; abrupt wavy boundary.
Bg1—11 to 14 inches; grayish brown (2.5Y 5/2) sandy loam; common fine distinct light olive brown (2.5Y 5/6) mottles; moderate fine subangular blocky structure; very friable; few fine roots; neutral; clear smooth boundary.
Bg2—14 to 20 inches; olive (5Y 5/3) sandy loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; very friable; neutral; gradual smooth boundary.
Bg3—20 to 24 inches; grayish brown (2.5Y 5/2) sandy loam; common fine faint light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; very friable; 3 percent pebbles and cobbles; slight effervescence; mildly alkaline; gradual wavy boundary.

2C—24 to 60 inches; light olive brown (2.5Y 5/4) silty clay; common medium distinct light olive brown (2.5Y 5/6) and gray (2.5Y 6/1) mottles; massive; very firm; 3 percent pebbles and cobbles; strong effervescence; moderately alkaline.

The depth to the 2C horizon and free carbonates ranges from 24 to 36 inches. The content of pebbles and cobbles is 0 to 10 percent in the solum.

The Ap horizon has color value of 2 or 3 and is 8 to 12 inches thick. Some pedons have an A horizon with hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 6 to 12 inches thick. The A horizon is dominantly sandy loam, but the range includes loamy sand and loam. The Bg horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 1 to 3. The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 to 4. It is silty clay or clay and contains 0 to 3 percent pebbles.

Wixom Series

The Wixom series consists of somewhat poorly drained soils formed in sandy and loamy deposits on till plains. Permeability is rapid in the upper part of the pedon and moderately slow in the lower part. Slope ranges from 0 to 3 percent.

Wixom soils are similar to Arkona soils and are commonly adjacent to Corunna and Metea soils. Arkona soils are finer in texture in the lower part of the subsoil than the Wixom soils. Corunna soils are poorly drained and are lower on the landscape. Metea soils are well drained and are on higher positions on the landscape.

A typical pedon of Wixom loamy sand, 0 to 3 percent slopes, 150 feet south and 400 feet west of the northeast corner of sec. 22, T. 13 N., R. 8 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; medium acid; abrupt smooth boundary.

Bs1—10 to 15 inches; strong brown (7.5YR 5/8) sand; common fine distinct yellowish red (5YR 5/6) and common fine faint reddish yellow (7.5YR 6/6) mottles; weak fine granular structure; very friable; medium acid; clear wavy boundary.

Bs2—15 to 22 inches; strong brown (7.5YR 5/8) sand; common fine faint reddish yellow (7.5YR 6/6) mottles; 50 percent cemented reddish brown (5YR 4/4) ortstein; weak very fine subangular blocky structure; very friable; medium acid; abrupt wavy boundary.

2Bt1—22 to 25 inches; pale brown (10YR 6/3) clay loam; common fine faint grayish brown (10YR 5/2) and many medium distinct brown (7.5YR 5/4) mottles; weak fine subangular blocky structure; firm; 3 percent pebbles; slightly acid; clear wavy boundary.

2Bt2—25 to 35 inches; brown (7.5YR 5/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; common thin grayish brown (10YR 5/2) clay films on ped surfaces; 3 percent pebbles; slightly acid; gradual wavy boundary.

2C—35 to 60 inches; brown (7.5YR 5/4) clay loam; many medium distinct grayish brown (10YR 5/2) mottles; massive; firm; 3 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 32 to 40 inches. The depth to the 2Bt horizon ranges from 9 to 28 inches. Pebble content in the solum is 0 to 10 percent. The sandy part of the solum ranges from strongly acid to slightly acid.

The Ap horizon has chroma of 2 or 3 and is 8 to 10 inches thick. Some pedons have an A horizon with hue of 10YR, value of 2, and chroma of 1 or 2. It is 3 or 4 inches thick. The A horizon is dominantly loamy sand, but the range includes sand. Some pedons have an E horizon. The Bs horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. It is sand or loamy sand. In some pedons, bands of sandy loam are between depths of 30 and 40 inches. The 2Bt horizon is slightly acid or neutral. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. It is clay loam or loam. This horizon has a pebble content of 0 to 3 percent. It is mildly alkaline or moderately alkaline.

Ziegenfuss Series

The Ziegenfuss series consists of poorly drained, slowly permeable soils. These soils formed in clayey and silty deposits on till plains. Slope is 0 to 2 percent.

Ziegenfuss soils are commonly adjacent to the Ithaca and Perrinton soils. Ithaca soils are somewhat poorly drained and are slightly higher on the landscape than the Ziegenfuss soils. Perrinton soils are well drained and are on the higher positions on the landscape.

A typical pedon of Ziegenfuss silty clay loam, 1,320 feet west and 130 feet south of the center of sec. 28, T. 16 N., R. 10 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong medium granular structure; firm; many fine roots; 5 percent pebbles; slightly acid; clear smooth boundary.

Bg1—6 to 11 inches; dark gray (10YR 4/1) clay; common fine distinct gray (10YR 5/1) mottles; moderate medium subangular blocky structure; very firm; few fine roots; 5 percent pebbles; slightly acid; clear irregular boundary.

Bg2—11 to 15 inches; gray (10YR 5/1) clay; many medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very

firm; very few very fine roots; 5 percent pebbles; neutral; clear wavy boundary.

Bg3—15 to 21 inches; gray (10YR 6/1) clay; many medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; 2 percent pebbles; neutral; clear wavy boundary.

Cg—21 to 60 inches; gray (10YR 6/1) clay; many medium distinct strong brown (7.5YR 5/6) mottles; massive; very firm; few fine distinct white (N 8/0) lime streaks; 2 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 30 inches. Pebble content in the solum is 2 to 5 percent. The solum ranges from slightly acid to mildly alkaline, and alkalinity increases with depth.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is 6 to 8 inches thick. Some pedons have an A horizon. The A horizon is dominantly silty clay loam, but the range includes clay loam and silt loam. The Bg horizon has chroma of 1 or 2. It is clay or silty clay. The Cg horizon has value of 5 or 6 and chroma of 1 or 2. It is clay or silty clay. Pebble content in the Cg horizon ranges from 2 to 5 percent.

Formation of the Soils

The paragraphs that follow describe the factors of soil formation and relate them to the formation of soils in the survey area, and they explain 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; relief, or topography; and the length of time that the processes of soil formation have acted on the parent material.

Climate and plant and animal life are the active forces in 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 also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It can be long or short, but some time is required for differentiation of soil horizons. Generally, a long time is required for the formation of distinct 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. Many of the processes of soil formation are unknown.

Parent Material

Parent material is the unconsolidated mass from which a soil forms. The parent materials of the soils of Mecosta County were deposited by meltwater from glaciers that covered the county from about 12,000 to 10,000 years ago. These parent materials were reworked and redeposited by subsequent actions of water and wind. Parent material determines the limit of the chemical and mineralogical composition of the soil. Although most parent materials 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 Mecosta County were deposited as glacial till, glacial outwash, alluvium, and organic material.

Glacial till is material that was deposited directly by glaciers with a minimum of water action. It is a mixture of particles of different sizes. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Mecosta County is generally calcareous. The texture of the till is loamy sand, sandy loam, loam, silty clay loam, clay, or clay loam. The Marlette and Perrinton soils are examples of soils that formed in calcareous glacial till. Some of the soils that formed in till have been deeply leached of carbonates. The Remus and Spinks soils are examples.

Outwash material is deposited by running water from melting glaciers. The size of the particles that make up outwash material depends upon the speed of the stream of water that carried them. When the water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slowly moving water. Outwash deposits generally consist of layers of particles of similar size, such as sandy loam, sand, gravel, or other coarse particles. The Mecosta soils, for example, formed in deposits of outwash material.

Alluvium is material recently deposited by floodwaters of present streams. This material varies in texture, depending on the speed of the water from which it was deposited. An example of an alluvial soil is the Glendora soil.

Organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water remained in depressions in outwash plains, flood plains, moraines, and till plains. Grasses and sedges growing around the edges of these lakes died, and the residue fell to the bottom. Because the areas were wet, the plant remains did not decompose but remained around the edge of the lake. Later, water-tolerant trees grew on the areas. After these trees died, their residue became part of the organic accumulation. Eventually the lakes became filled with organic material and developed into areas of muck. Houghton and Edwards soils formed in organic material.

Plant and Animal Life

Green plants have been the principal organisms influencing the soils in Mecosta County. Bacteria, fungi, earthworms, and the activities of man, however, have

also been important. The chief contribution of plant and animal life has been the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends upon the kinds of plants that grow on the soil. Residue of these plants accumulate on the surface of the soil, decay, and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The vegetation in Mecosta County has been a mixture of deciduous and coniferous forest. Differences in natural soil drainage and changes in chemical and physical makeup of the parent material affect the composition of the forest species.

In general, the well drained upland soils, such as the Remus, Marlette, and Spinks soils, were mainly covered by northern red oak, sugar maple, and white pine.

The wet soils were covered mainly by soft maple, aspen, white cedar, elm, and ash. The Roscommon and Vestaburg soils formed under wet conditions, and they contain considerable organic matter.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil, and it determines the amount of water available for weathering minerals and for transporting soil material. Climate, through its influence on soil temperature, determines the rate of chemical reaction in the soil. These influences affect large areas rather than a relatively small area such as a county.

The climate in Mecosta County is cool and humid. This is presumably similar to that which existed when the soils formed. The soils in Mecosta County differ from soils that formed in a dry, warm climate or from those that formed in a moist, hot climate. Climate is uniform throughout the county. Only minor differences in the soils of Mecosta County are the result of the differences in climate.

Relief

Relief, or topography, has an influence on the natural drainage, erosion, plant cover, and soil temperature. In this county, slope ranges from 0 to 35 percent. Natural soil drainage ranges from excessively drained on the hilltops to very poorly drained in the depressions.

Relief influences the formation of soils by affecting runoff and drainage. Drainage, in turn, through its effect on aeration of the soil, determines the color of the soil. Runoff is greatest on the steeper slopes. In low areas, water is temporarily ponded. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. In poorly aerated soils, the color is dull gray and mottled. Spinks soils are an example of well drained, well aerated soils. Edmore soils are an example of poorly drained, poorly aerated soils. Both soils formed in similar parent material.

Time

Generally, a long time is required for development of distinct horizons from parent material. The differences in the length of time that the parent material has been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Mecosta County range from young to mature. The glacial deposits in which many of the soils formed have been exposed to soil forming factors long enough to allow distinct horizons to develop. Some soils forming in recent alluvial sediment have not been in place long enough for distinct horizons to develop. The Glendora soils, for example, are young soils that formed in alluvial material. The Remus soils are an example of mature soils that have been leached of lime.

Processes of Soil Formation

Several processes were involved in the development of soil horizons in Mecosta County: (1) accumulation of organic matter, (2) leaching of lime (calcium carbonate) and other bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in the development of the horizon.

Organic matter accumulates at the surface to form an A horizon. If the soil is plowed, the material in the A horizon may be mixed with the material in underlying horizons. In the soils of Mecosta County, the surface layer ranges from high to low in organic matter content. Edmore soils, for example, have high organic matter content in the surface layer, and the Plainfield soils have low organic matter content.

Leaching of carbonates and other bases occurred in most of the soils. The leaching of bases in soils usually precedes the translocation of silicate clay minerals. Many of the soils are moderately to strongly leached. For example, Remus soils are leached of carbonates to a depth of more than 60 inches, whereas Locke soils are leached to a depth of only 25 inches. Differences in the depth of leaching are a result of time.

The reduction and transfer of iron, a process called gleying, is evident in the somewhat poorly drained, poorly drained, and very poorly drained soils. The gray color in the subsoil indicates the reduction and loss of iron. Ziegenfuss soils, for example, exhibit gleying.

Translocation of clay minerals has contributed to horizon development. An eluviated, or leached, E horizon above an illuviated B horizon has a platy structure, is lower in content of clay, and typically is lighter in color.

The B horizon typically has an accumulation of clay, or clay films, in pores and on ped surfaces. Soils displaying this translocation of clay were probably leached of carbonates and soluble salts to a considerable extent before translocation of silicate clay took place. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation. The Marlette soils are an example of soils that have translocated silicate clays in the form of clay films accumulated in the B horizon.

In some soils, iron, aluminum, and humus have moved from the surface layer to the B horizon. The color of the B horizon in these soils is brown. The Pipestone soils are an example of soils in which translocated iron, aluminum, and humus have affected the B horizon.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, pt. 19, 464 pp., illus.

(3) Bedell, D.J., and R.L. Van Til. 1979. Irrigation in Michigan: 1977. Mich. Dept. Nat. Res., 37 pp.

(4) Michigan Pioneer Historical Society. 1906. Michigan pioneer historical society. Vol. 30, pp. 27-30.

(5) Michigan State University. 1962. Mecosta County lake inventory.

(6) Michigan State University. 1976. Fertilizer recommendations for vegetables and field crops in Michigan. Ext. Bull. E-550, 20 pp.

(7) Mokma, D.L., E.P. Whiteside, and I.F. Schneider. 1978. Soil management units and land use planning. Mich. State Univ. Ext. Bull. E-1262, 12 pp.

(8) United States Department of Agriculture. 1927. Soil survey of Mecosta County, Michigan. Bur. of Chem. and Soils in coop. with Mich. Agric. Exp. Stn. Ser. 1927. No. 18, 30 pp.

(9) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dept. Agric. Handb. 18, 503 pp., illus.

(10) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(11) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(12) United States Department of Agriculture. 1980. Soil survey laboratory data and descriptions for some soils of Michigan. Soil Conserv. Serv., Soil Surv. Invest. Rep. 36, 181 pp.

(13) United States Department of Commerce. 1977. 1974 Census of agriculture: Michigan state and county data. Bureau of Census. Vol. 1, pt. 22., 4 pp.

Glossary

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—

	Inches
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.

Blinding material. Material such as grass clippings, fiberglass mats, or straw that is used to surround tile lines to keep flowing sand from plugging the tile.

Bottom land. The normal flood plain of a stream, subject to flooding.

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.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures 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.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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 grazingland for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

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.

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 upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of another horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock 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.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Large stones (in tables). Rock fragments 3 inches (7.5 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.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

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 colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

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.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction

because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Reinforcement planting. Planting in an understocked stand of trees.

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. 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.

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.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

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 (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single 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.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. 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.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

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.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Wind stripcropping. Stripcropping at right angles to the prevailing wind.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1949-78 at Big Rapids, Michigan]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	28.6	11.8	20.2	51	-19	0	2.05	1.2	2.8	6	19.9
February	31.4	12.0	21.7	50	-17	0	1.64	.8	2.4	5	14.0
March	40.2	20.7	30.4	69	-6	4	2.18	1.3	3.0	6	11.3
April	55.6	32.4	44.0	81	13	52	3.12	2.0	4.2	7	1.9
May	68.5	42.6	55.6	88	25	224	2.92	1.7	4.0	7	T[2]
June	77.9	52.2	65.1	94	34	461	3.30	1.6	4.7	7	0
July	81.8	56.1	68.9	94	41	595	2.76	1.7	3.8	6	0
August	79.6	54.3	67.0	94	38	533	3.26	1.5	4.8	6	0
September	70.7	46.8	58.7	90	28	284	3.31	1.8	4.6	7	T
October	60.2	37.7	48.9	82	20	98	2.74	1.4	3.9	6	.5
November	44.5	28.3	36.4	69	3	11	2.67	1.6	3.6	7	6.5
December	32.5	17.7	25.1	57	-9	0	2.28	1.4	3.1	6	16.3
Year	55.9	34.4	45.2	97	-21	2,262	32.23	28.4	35.9	76	70.4

[1] A growing degree day is an index of the amount 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° F).

[2] T indicates trace.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1930-79 at Big Rapids, Michigan]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 3	May 17	May 31
2 years in 10 later than--	April 29	May 13	May 27
5 years in 10 later than--	April 21	May 4	May 19
First freezing temperature in fall:			
1 year in 10 earlier than--	October 8	September 25	September 12
2 years in 10 earlier than--	October 14	September 30	September 17
5 years in 10 earlier than--	October 26	October 10	September 26

TABLE 3.--GROWING SEASON

[Recorded in the period 1930-74 at Big Rapids, Michigan]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	164	138	112
8 years in 10	172	145	118
5 years in 10	188	158	129
2 years in 10	204	171	140
1 year in 10	212	177	145

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
10B	Plainfield sand, 0 to 6 percent slopes	12,210	3.4
10C	Plainfield sand, 6 to 18 percent slopes	7,280	2.0
10E	Plainfield sand, 18 to 35 percent slopes	970	0.3
11B	Coloma sand, 0 to 6 percent slopes	43,530	12.1
11C	Coloma sand, 6 to 18 percent slopes	35,975	10.0
11E	Coloma sand, 18 to 35 percent slopes	3,535	1.0
12B	Spinks loamy sand, 0 to 6 percent slopes	21,950	6.1
12C	Spinks loamy sand, 6 to 12 percent slopes	7,565	2.1
12D	Spinks loamy sand, 12 to 18 percent slopes	1,510	0.4
13B	Metea loamy sand, 0 to 6 percent slopes	10,265	2.9
13C	Metea loamy sand, 6 to 12 percent slopes	4,465	1.2
13D	Metea loamy sand, 12 to 18 percent slopes	910	0.3
14A	Covert sand, 0 to 3 percent slopes	10,580	3.0
16B	Remus sandy loam, 0 to 6 percent slopes	19,985	5.6
16C	Remus sandy loam, 6 to 12 percent slopes	7,715	2.2
16D	Remus sandy loam, 12 to 18 percent slopes	1,235	0.3
16E	Remus sandy loam, 18 to 35 percent slopes	1,025	0.3
17B	Marlette sandy loam, 2 to 6 percent slopes	11,390	3.2
17C	Marlette sandy loam, 6 to 12 percent slopes	5,470	1.5
17D	Marlette sandy loam, 12 to 18 percent slopes	1,795	0.5
19B	Perrinton loam, 2 to 6 percent slopes	5,760	1.6
19C	Perrinton loam, 6 to 12 percent slopes	4,590	1.3
19D	Perrinton loam, 12 to 18 percent slopes	1,100	0.3
19E	Perrinton loam, 18 to 35 percent slopes	620	0.2
20	Pits, sand and gravel	820	0.2
21B	Ithaca loam, 0 to 4 percent slopes	4,350	1.2
22	Ziegenfuss silty clay loam	1,165	0.3
23	Roscommon loamy sand	2,200	0.6
24	Vestaburg sandy loam	2,300	0.6
25	Edmore sandy loam	4,500	1.3
26	Edwards muck	640	0.2
27	Houghton muck	14,650	4.1
28	Houghton muck, ponded	4,350	1.2
29	Loxley muck	2,700	0.8
30	Adrian muck	8,245	2.3
31A	Algansee loamy sand, 0 to 3 percent slopes	1,400	0.4
32	Glendora loamy sand	4,180	1.2
33A	Wixom loamy sand, 0 to 3 percent slopes	3,385	0.9
34A	Pipestone loamy sand, 0 to 3 percent slopes	3,830	1.1
35B	Capac loam, 0 to 4 percent slopes	1,985	0.6
37A	Locke sandy loam, 0 to 3 percent slopes	5,165	1.4
38A	Thetford loamy sand, 0 to 3 percent slopes	7,030	2.0
39B	Riverdale loamy sand, 0 to 4 percent slopes	2,830	0.8
40B	Aubbeenaubbee fine sandy loam, 0 to 4 percent slopes	3,750	1.0
41	Corunna fine sandy loam	2,020	0.6
42	Palms muck	1,710	0.5
43B	Arkona loamy sand, 0 to 4 percent slopes	4,460	1.2
44	Wauseon sandy loam	2,245	0.6
45B	Coloma loamy sand, loamy substratum, 0 to 6 percent slopes	1,785	0.5
46B	Tustin loamy sand, 0 to 6 percent slopes	2,900	0.8
46C	Tustin loamy sand, 6 to 12 percent slopes	1,320	0.4
47B	Mecosta sand, 0 to 4 percent slopes	19,075	5.3
47C	Mecosta sand, 6 to 12 percent slopes	4,620	1.3
47D	Mecosta sand, 12 to 18 percent slopes	1,340	0.4
47E	Mecosta sand, 18 to 35 percent slopes	1,580	0.4
48	Psammaquents, nearly level	400	0.1
49A	Covert loamy sand, gravelly substratum, 0 to 3 percent slopes	3,565	1.0
50C	Metea-Coloma loamy sands, 6 to 18 percent slopes	1,225	0.3
51B	Leoni gravelly sandy loam, 0 to 6 percent slopes	2,350	0.7
51C	Leoni gravelly sandy loam, 6 to 12 percent slopes	1,350	0.4
51D	Leoni gravelly sandy loam, 12 to 18 percent slopes	800	0.2
	Water	4,750	1.3
	Total	358,400	100.0

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
13B	Metea loamy sand, 0 to 6 percent slopes
16B	Remus sandy loam, 0 to 6 percent slopes
17B	Marlette sandy loam, 2 to 6 percent slopes
19B	Perrinton loam, 2 to 6 percent slopes
21B	Ithaca loam, 0 to 4 percent slopes (where drained)
22	Ziegenfuss silty clay loam (where drained)
35B	Capac loam, 0 to 4 percent slopes (where drained)
37A	Locke sandy loam, 0 to 3 percent slopes
40B	Aubbeenaubbee fine sandy loam, 0 to 4 percent slopes (where drained)
41	Corunna fine sandy loam (where drained)
44	Wauseon sandy loam (where drained)

TABLE 6.--YIELDS PER ACRE OF FIELD 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	Corn		Corn silage		Oats	Winter wheat		Dry beans		Grass-legume hay	
	N	I	N	I	N	N	I	N	I	N	I
	Bu	Bu	Ton	Ton	Bu	Bu	Bu	Bu	Bu	Ton	Ton
10B---------- Plainfield	---	130	---	22	35	20	---	13	35	2.0	5.0
10C, 10E---------- Plainfield	---	---	---	---	---	---	---	---	---	---	---
11B---------- Coloma	60	130	10	22	50	25	---	15	35	2.8	6.0
11C---------- Coloma	---	---	---	---	---	---	---	---	---	---	---
11E---------- Coloma	---	---	---	---	---	---	---	---	---	---	---
12B---------- Spinks	75	165	13	24	60	30	---	---	---	3.0	7.0
12C---------- Spinks	68	155	12	23	55	30	---	---	---	2.4	7.0
12D---------- Spinks	---	---	---	---	50	24	---	---	---	1.8	---
13B---------- Metea	85	145	13	24	75	42	---	25	50	2.8	6.5
13C---------- Metea	75	140	12	23	70	38	---	22	47	3.0	6.2
13D---------- Metea	60	---	10	---	60	34	---	18	---	2.8	---
14A---------- Covert	60	130	11	22	60	30	---	18	35	3.0	6.0
16B---------- Remus	85	155	14	26	75	40	---	30	60	3.7	7.0
16C---------- Remus	80	145	13	24	70	37	---	26	55	3.5	6.5
16D---------- Remus	75	---	12	---	60	32	---	20	---	3.1	---
16E---------- Remus	---	---	---	---	---	---	---	---	---	---	---
17B---------- Marlette	100	160	16	27	85	60	---	35	60	4.0	8.0
17C---------- Marlette	95	150	14	25	85	56	---	30	55	3.5	7.5
17D---------- Marlette	75	---	12	---	75	48	---	---	---	3.2	---
19B---------- Perrinton	95	---	16	---	70	45	---	---	---	4.5	---
19C---------- Perrinton	90	---	15	---	70	42	---	---	---	4.2	---
19D---------- Perrinton	80	---	14	---	85	38	---	---	---	3.4	---

TABLE 6.--YIELDS PER ACRE OF FIELD CROPS--Continued

Soil name and map symbol	Corn		Corn silage		Oats	Winter wheat		Dry beans		Grass-legume hay	
	N	I	N	I	N	N	I	N	I	N	I
	Bu	Bu	Ton	Ton	Bu	Bu	Bu	Bu	Bu	Ton	Ton
19E---------- Perrinton	---	---	---	---	---	---	---	---	---	---	---
20*. Pits											
21B---------- Ithaca	100	---	16	---	90	50	---	30	---	4.2	---
22---------- Ziegenfuss	---	---	---	---	---	---	---	---	---	---	---
23---------- Roscommon	---	---	---	---	---	---	---	---	---	---	---
24---------- Vestaburg	---	---	---	---	---	---	---	---	---	---	---
25---------- Edmore	---	---	---	---	---	---	---	---	---	---	---
26---------- Edwards	---	---	---	---	---	---	---	---	---	---	---
27, 28---------- Houghton	---	---	---	---	---	---	---	---	---	---	---
29---------- Loxley	---	---	---	---	---	---	---	---	---	---	---
30---------- Adrian	---	---	---	---	---	---	---	---	---	---	---
31A---------- Algansee	80	---	13	---	65	35	---	24	---	3.5	---
32---------- Glendora	---	---	---	---	---	---	---	---	---	---	---
33A---------- Wixom	95	150	16	27	80	45	---	32	55	3.8	7.0
34A---------- Pipestone	50	130	12	22	50	30	---	20	35	3.0	5.5
35B---------- Capac	120	155	18	26	100	65	---	---	---	4.5	7.0
37A---------- Locke	105	160	17	27	80	45	---	33	60	4.0	7.0
38A---------- Thetford	80	140	12	22	60	35	---	50	28	3.0	6.5
39B---------- Riverdale	75	140	14	60	60	32	---	22	40	3.5	6.0
40B---------- Aubbeenaubbee	110	160	18	27	85	50	---	37	60	3.6	7.0
41---------- Corunna	---	---	---	---	---	---	---	---	---	---	---
42---------- Palms	---	---	---	---	---	---	---	---	---	---	---
43B---------- Arkona	100	150	16	27	80	45	---	34	55	3.8	6.5

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF FIELD CROPS--Continued

Soil name and map symbol	Corn		Corn silage		Oats	Winter wheat		Dry beans		Grass-legume hay	
	N	I	N	I	N	N	I	N	I	N	I
	Bu	Bu	Ton	Ton	Bu	Bu	Bu	Bu	Bu	Ton	Ton
44---------- Wauseon	---	---	---	---	---	---	---	---	---	---	---
45B---------- Coloma	60	135	10	22	60	27	---	20	35	2.8	6.0
46B---------- Tustin	70	140	11	23	70	40	---	34	55	4.0	7.0
46C---------- Tustin	60	---	10	---	50	40	---	25	50	3.5	7.0
47B---------- Mecosta	50	130	8	22	40	20	---	15	35	2.7	6.0
47C, 47D, 47E---------- Mecosta	---	---	---	---	---	---	---	---	---	---	---
48. Psammaquents											
49A---------- Covert	65	135	11	22	60	32	18	35	---	3.0	6.0
50C---------- Metea-Coloma	---	---	---	---	---	---	---	---	---	---	---
51B---------- Leoni	70	150	12	25	50	30	50	25	40	2.5	6.5
51C---------- Leoni	65	145	11	24	45	28	45	20	35	2.2	6.0
51D---------- Leoni	50	---	10	---	40	24	---	17	---	2.0	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--YIELDS PER ACRE OF SPECIALTY 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	Irish potatoes		Sunflowers		Asparagus		Canning peas		Carrots		Snap beans	
	N	I	N	I	N	I	N	I	N	I	N	I
	Cwt	Cwt	Lb	Lb	Lb	Lb	Ton	Ton	Ton	Ton	Ton	Ton
10B---------- Plainfield	100	250	---	---	1,000	---	---	---	10	20	1.5	2.5
10C, 10E---------- Plainfield	---	---	---	---	---	---	---	---	---	---	---	---
11B---------- Coloma	150	225	800	---	1,400	---	1.0	1.5	15	28	2.0	3.0
11C---------- Coloma	---	---	---	---	---	---	---	---	---	---	---	---
11E---------- Coloma	---	---	---	---	---	---	---	---	---	---	---	---
12B---------- Spinks	175	300	900	---	1,500	---	1.0	1.5	15	28	2.0	3.0
12C---------- Spinks	160	285	700	---	1,300	---	---	---	---	---	1.5	2.5
12D---------- Spinks	---	---	---	---	---	---	---	---	---	---	---	---
13B---------- Metea	200	325	1,400	---	1,800	---	1.0	1.5	15	28	2.5	3.0
13C---------- Metea	190	310	1,100	---	1,500	---	---	---	---	---	2.0	2.5
13D---------- Metea	---	---	---	---	---	---	---	---	---	---	---	---
14A---------- Covert	150	275	800	---	1,400	---	1.0	1.5	15	28	2.0	3.0
16B---------- Remus	200	350	1,500	---	1,700	---	1.0	1.5	15	28	3.0	3.5
16C---------- Remus	190	340	1,200	---	1,500	---	---	---	---	---	2.5	3.0
16D---------- Remus	---	---	---	---	---	---	---	---	---	---	---	---
16E---------- Remus	---	---	---	---	---	---	---	---	---	---	---	---
17B---------- Marlette	150	250	1,800	---	---	---	1.0	1.5	15	28	3.0	3.5
17C---------- Marlette	140	240	1,500	---	---	---	---	---	---	---	2.5	3.0
17D---------- Marlette	---	---	---	---	---	---	---	---	---	---	---	---
19B---------- Perrinton	---	---	---	---	---	---	---	---	---	---	---	---
19C---------- Perrinton	---	---	---	---	---	---	---	---	---	---	---	---
19D---------- Perrinton	---	---	---	---	---	---	---	---	---	---	---	---
19E---------- Perrinton	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 7.--YIELDS PER ACRE OF SPECIALTY CROPS--Continued

Soil name and map symbol	Irish potatoes		Sunflowers		Asparagus		Canning peas		Carrots		Snap beans	
	N	I	N	I	N	I	N	I	N	I	N	I
	Cwt	Cwt	Lb	Lb	Lb	Lb	Ton	Ton	Ton	Ton	Ton	Ton
20*. Pits												
21B---------- Ithaca	---	---	---	---	---	---	---	---	---	---	---	---
22---------- Ziegenfuss	---	---	---	---	---	---	---	---	---	---	---	---
23---------- Roscommon	---	---	---	---	---	---	---	---	---	---	---	---
24---------- Vestaburg	---	---	---	---	---	---	---	---	---	---	---	---
25---------- Edmore	---	---	---	---	---	---	---	---	---	---	---	---
26---------- Edwards	---	---	---	---	---	---	---	---	---	---	---	---
27, 28---------- Houghton	---	---	---	---	---	---	---	---	---	---	---	---
29---------- Loxley	---	---	---	---	---	---	---	---	---	---	---	---
30---------- Adrian	---	---	---	---	---	---	---	---	---	---	---	---
31A---------- Algansee	---	---	---	---	---	---	---	---	---	---	---	---
32---------- Glendora	---	---	---	---	---	---	---	---	---	---	---	---
33A---------- Wixom	225	350	1,500	---	1,900	---	1.0	1.5	15	28	2.5	3.0
34A---------- Pipestone	175	300	1,000	---	1,600	---	---	---	10	20	1.5	2.5
35B---------- Capac	175	250	1,800	---	---	---	---	---	---	---	---	---
37A---------- Locke	225	325	1,600	---	1,800	---	1.0	1.5	15	28	3.0	3.5
38A---------- Thetford	175	300	1,000	---	1,700	---	1.0	1.5	15	28	2.0	3.0
39B---------- Riverdale	170	300	1,000	---	1,700	---	---	---	---	---	2.0	3.0
40B---------- Aubbeenaubbee	200	325	1,800	---	---	---	1.0	1.5	15	28	3.0	3.5
41---------- Corunna	---	---	---	---	---	---	---	---	---	---	---	---
42---------- Palms	---	---	---	---	---	---	---	---	---	---	---	---
43B---------- Arkona	225	350	1,500	---	1,900	---	1.0	1.5	15	28	2.5	3.0
44---------- Wauseon	---	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 7.--YIELDS PER ACRE OF SPECIALTY CROPS-- Continued

Soil name and map symbol	Irish potatoes		Sunflowers		Asparagus		Canning peas		Carrots		Snap beans	
	N	I	N	I	N	I	N	I	N	I	N	I
	Cwt	Cwt	Lb	Lb	Lb	Lb	Ton	Ton	Ton	Ton	Ton	Ton
45B---------- Coloma	150	275	800	---	1,400	---	1.0	1.5	15	28	2.0	3.0
46B---------- Tustin	200	325	1,400	---	1,800	---	1.0	1.5	15	28	2.5	3.0
46C---------- Tustin	190	310	1,100	---	1,500	---	---	---	---	---	2.0	2.5
47B---------- Mecosta	130	260	700	---	1,200	---	0.8	1.3	10	20	1.8	2.3
47C, 47D, 47E---------- Mecosta	---	---	---	---	---	---	---	---	---	---	---	---
49A---------- Covert	150	275	800	---	1,400	---	1.0	1.5	15	28	2.0	3.0
50C---------- Metea-Coloma	---	---	---	---	---	---	---	---	---	---	---	---
51B---------- Leoni	190	325	1,400	---	1,700	---	1.0	1.5	15	28	3.0	3.5
51C---------- Leoni	170	310	1,100	---	1,500	---	---	---	---	---	2.5	3.0
51D---------- Leoni	---	---	---	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--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	52,385	37,135	15,250	---
III	87,725	44,320	19,105	24,300
IV	103,210	8,670	3,830	90,745
V	37,475	---	37,475	---
VI	56,505	1,025	6,380	49,100
VII	10,745	620	2,700	7,425
VIII	4,350	---	4,350	---

TABLE 9.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Dashes indicate 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	
10B, 10C---------- Plainfield	2s	Slight	Slight	Severe	Slight	Red pine----------	64	Red pine, eastern white pine, jack pine, Carolina poplar.
						Eastern white pine--	---	
						Quaking aspen-------	---	
						Northern red oak----	---	
10E---------- Plainfield	2s	Moderate	Severe	Severe	Slight	Red pine----------	64	Red pine, eastern white pine, jack pine, Carolina poplar.
						Eastern white pine--	---	
						Quaking aspen-------	---	
						Northern red oak----	---	
11B, 11C---------- Coloma	2s	Slight	Slight	Severe	Slight	Northern red oak----	66	Red pine, eastern white pine, jack pine, Carolina poplar.
						Quaking aspen-------	---	
						Black oak----------	---	
						White oak----------	---	
						Red pine----------	---	
						Eastern white pine--	---	
11E---------- Coloma	2s	Moderate	Moderate	Severe	Slight	Northern red oak----	66	Red pine, eastern white pine, jack pine, Carolina poplar.
						Quaking aspen-------	---	
						Black oak----------	---	
						White oak----------	---	
						Red pine----------	---	
						Eastern white pine--	---	
12B, 12C, 12D------ Spinks	2s	Slight	Slight	Moderate	Slight	Northern red oak----	66	Red pine, eastern white pine, Carolina poplar, jack pine.
						White oak----------	---	
						Black cherry--------	---	
						American beech------	---	
13B, 13C, 13D------ Metea	2s	Slight	Slight	Moderate	Slight	Northern red oak----	66	Eastern white pine, red pine, white spruce, Norway spruce, Carolina poplar.
						White oak----------	---	
						Sugar maple---------	---	
						American basswood---	---	
						Black cherry--------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
14A---------- Covert	2s	Slight	Slight	Severe	Slight	Northern red oak----	67	Red pine, Carolina poplar, eastern white pine, Carolina poplar.
						Red maple----------	66	
						Black cherry--------	---	
						Eastern cottonwood--	---	
						American basswood---	---	
						Quaking aspen-------	---	
						American beech------	---	
						Eastern white pine--	---	
16B, 16C, 16D------ Remus	2o	Slight	Slight	Slight	Slight	Sugar maple---------	61	White spruce, eastern white pine, Norway spruce, red pine, Carolina poplar.
						Northern red oak----	---	
						American basswood---	---	
						Eastern hemlock-----	---	
						Quaking aspen-------	---	
						White ash----------	---	
						Red maple----------	---	
						Black cherry--------	---	
16E---------- Remus	2r	Moderate	Moderate	Slight	Slight	Sugar maple---------	61	White spruce, eastern white pine, Norway spruce, red pine, Carolina poplar.
						Northern red oak----	---	
						American basswood---	---	
						Eastern hemlock-----	---	
						Quaking aspen-------	---	
						White ash----------	---	
						Red maple----------	---	
						Black cherry--------	---	

TABLE 9.--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	
17B, 17C, 17D---- Marlette	2o	Slight	Slight	Slight	Slight	Sugar maple	61	Eastern white pine, red pine, Carolina poplar.
						Northern red oak	---	
						White ash	---	
						American beech	---	
						American basswood	---	
						Black cherry	---	
						White oak	---	
19B, 19C, 19D---- Perrinton	2o	Slight	Slight	Slight	Slight	Northern red oak	65	Norway spruce, eastern white pine, northern white-cedar, white spruce, Carolina poplar.
						Sugar maple	---	
						Red maple	---	
						White ash	---	
						American basswood	---	
						Bitternut hickory	---	
						Black cherry	---	
19E---- Perrinton	2r	Moderate	Moderate	Slight	Slight	Northern red oak	65	Norway spruce, eastern white pine, northern white-cedar, white spruce, Carolina poplar.
						Sugar maple	---	
						Red maple	---	
						White ash	---	
						American basswood	---	
						Bitternut hickory	---	
						Shagbark hickory	---	
21B---- Ithaca	2w	Slight	Moderate	Slight	Slight	Northern red oak	65	White spruce, Norway spruce, eastern white pine, northern white-cedar, Carolina poplar.
						Sugar maple	---	
						American basswood	---	
						White ash	---	
						Green ash	---	
						Red maple	---	
						Bitternut hickory	---	
22---- Ziegenfuss	4w	Slight	Severe	Moderate	Moderate	Red maple	45	Eastern white pine, white spruce, Norway spruce, Carolina poplar.
						White ash	---	
						American basswood	---	
						Green ash	---	
						Eastern cottonwood	---	
						Eastern hemlock	---	
23---- Roscommon	3w	Slight	Severe	Severe	Moderate	Quaking aspen	58	Eastern white pine, white spruce, Norway spruce, Carolina poplar, northern white-cedar.
						Northern white-cedar	---	
						Red maple	---	
						Balsam fir	---	
						Eastern hemlock	---	
						Green ash	---	
24---- Vestaburg	5w	Slight	Severe	Severe	Severe	Quaking aspen	44	
						Green ash	---	
						Balsam fir	---	
						Eastern hemlock	---	
						Red maple	---	
25---- Edmore	3w	Slight	Severe	Severe	Severe	Red maple	56	Eastern white pine, white spruce, Norway spruce, Carolina poplar, northern white-cedar.
						Green ash	---	
						Eastern cottonwood	---	
						Quaking aspen	---	
						Balsam fir	---	
						Eastern hemlock	---	
						Northern white-cedar	---	
26---- Edwards	3w	Slight	Severe	Severe	Severe	Red maple	56	
						Quaking aspen	---	
						Green ash	---	
						Tamarack	---	
						Northern white-cedar	---	

TABLE 9.--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	
27---------- Houghton	3w	Slight	Severe	Severe	Severe	Red maple----------	56	
						Balsam fir----------	---	
						Paper birch---------	---	
						Quaking aspen-------	---	
						Tamarack----------	---	
						Green ash----------	---	
						Northern white-cedar	---	
30---------- Adrian	3w	Slight	Severe	Severe	Severe	Balsam fir----------	53	
						Black spruce--------	---	
						Northern white-cedar	---	
						Quaking aspen-------	---	
						Tamarack----------	---	
						Black ash----------	---	
31A---------- Algansee	3o	Slight	Slight	Slight	Slight	Quaking aspen-------	60	White spruce, Carolina poplar, Norway spruce, eastern white pine, northern white-cedar.
						Balsam fir----------	---	
						Eastern hemlock-----	---	
						Red maple----------	56	
						American basswood---	---	
						Green ash----------	---	
32---------- Glendora	3w	Slight	Severe	Moderate	Severe	Red maple----------	55	Eastern white pine, white spruce, northern white-cedar, Carolina poplar, Norway spruce.
						Northern white-cedar	---	
						Quaking aspen-------	---	
						Black ash----------	---	
						Eastern cottonwood--	---	
33A---------- Wixom	3w	Slight	Moderate	Slight	Slight	Quaking aspen-------	60	Eastern white pine, Norway spruce, Carolina poplar, white spruce, northern white-cedar.
						American beech------	---	
						Northern red oak----	---	
						Red maple----------	---	
						American basswood---	---	
34A---------- Pipestone	2o	Slight	Slight	Slight	Slight	Red maple----------	65	White spruce, eastern white pine, Norway spruce, Carolina poplar, northern white-cedar.
						White ash----------	---	
						American beech------	---	
						Quaking aspen-------	---	
						Paper birch---------	---	
						American basswood---	---	
35B---------- Capac	2w	Slight	Moderate	Slight	Slight	Northern red oak----	65	Eastern white pine, white spruce, Norway spruce, Carolina poplar.
						American basswood---	---	
						Northern pin oak----	---	
						White ash----------	---	
						Red maple----------	---	
						Sugar maple---------	---	
						Black cherry--------	---	
						American beech------	---	
37A---------- Locke	2w	Slight	Moderate	Slight	Slight	Northern red oak----	66	White spruce, eastern white pine, Norway spruce, Carolina poplar.
						White oak----------	---	
						White ash----------	---	
						Red maple----------	---	
						American basswood---	---	
38A---------- Thetford	2o	Slight	Slight	Slight	Slight	Red maple----------	61	White spruce, Norway spruce, eastern white pine, Carolina poplar.
						White ash----------	---	
						Quaking aspen-------	---	
						American beech------	---	
						Northern red oak----	---	
						Eastern hemlock-----	---	
						American basswood---	---	
39B---------- Riverdale	3o	Slight	Slight	Slight	Moderate	Red maple----------	56	White spruce, Norway spruce, eastern white pine.
						Northern red oak----	---	
						White ash----------	---	
						American beech------	---	
						Sugar maple---------	---	
						American basswood---	---	

TABLE 9.--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	
40B---- Aubbeenaubbee	2w	Slight	Moderate	Slight	Slight	Sugar maple----	62	Eastern white pine, Carolina poplar, white spruce, Norway spruce.
						Red maple----	---	
						Black cherry----	---	
						American basswood---	---	
						American beech----	---	
41---- Corunna	3w	Slight	Severe	Moderate	Moderate	Red maple----	56	Eastern white pine, Norway spruce, Carolina poplar, white spruce.
						Green ash----	---	
						American basswood---	---	
						Silver maple----	---	
						American sycamore---	---	
						Eastern hemlock----	---	
						Eastern cottonwood--	---	
42---- Palms	3w	Slight	Severe	Severe	Severe	Red maple----	55	
						Silver maple----	---	
						Green ash----	---	
						Quaking aspen----	---	
						Northern white-cedar	---	
						Tamarack----	---	
						Black ash----	---	
43B---- Arkona	3w	Slight	Moderate	Slight	Slight	Red maple----	56	White spruce, Norway spruce, eastern white pine, Carolina poplar.
						Quaking aspen----	---	
						Paper birch----	---	
						Eastern cottonwood--	---	
						American beech----	---	
						Black cherry----	---	
						Northern red oak----	---	
						Sugar maple----	---	
44---- Wauseon	3w	Slight	Severe	Severe	Severe	Red maple----	55	Eastern white pine, white spruce, northern white-cedar.
						Eastern cottonwood--	---	
						Green ash----	---	
45B---- Coloma	2s	Slight	Slight	Moderate	Slight	Red pine----	64	Red pine, eastern white pine, Carolina poplar.
						Eastern white pine--	64	
						Red maple----	---	
						Northern red oak----	---	
						Quaking aspen----	---	
						White oak----	---	
46B, 46C---- Tustin	3s	Slight	Slight	Moderate	Slight	White oak----	55	Red pine, eastern white pine, Norway spruce, white spruce, Carolina poplar.
						American beech----	---	
						Eastern white pine--	---	
						Northern red oak----	---	
47B, 47C, 47D---- Mecosta	3s	Slight	Slight	Severe	Slight	Red pine----	55	Red pine, eastern white pine, jack pine.
						White oak----	---	
						Northern red oak----	---	
						Quaking aspen----	---	
						Black oak----	---	
47E---- Mecosta	3s	Moderate	Moderate	Severe	Slight	Red pine----	55	Red pine, eastern white pine, jack pine.
						White oak----	---	
						Northern red oak----	---	
						Quaking aspen----	---	
						Black oak----	---	
49A---- Covert	3s	Slight	Slight	Moderate	Slight	Sugar maple----	56	Red pine, eastern white pine, Carolina poplar, Norway spruce, white spruce.
						Red pine----	---	
						Northern red oak----	---	
						Quaking aspen----	---	
						Eastern white pine--	---	
						American beech----	---	
						American basswood---	---	
						Red maple----	---	
						Black cherry----	---	

TABLE 9.--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	
50C*:								
Metea	2s	Slight	Slight	Moderate	Slight	Northern red oak	66	Eastern white pine, red pine, white spruce, Norway spruce, Carolina poplar.
						White oak	---	
						Sugar maple	---	
						American basswood	---	
						Black cherry	---	
						Quaking aspen	---	
						Paper birch	---	
Coloma	2s	Slight	Slight	Moderate	Slight	Northern pin oak	66	Red pine, eastern white pine, jack pine.
						Jack pine	---	
						Black oak	---	
						White oak	---	
						Red pine	---	
						Eastern white pine	---	
51B, 51C, 51D----- Leoni	2o	Slight	Slight	Slight	Slight	Northern red oak	65	Red pine, eastern white pine, Norway spruce, Carolina poplar.
						White oak	---	
						American basswood	---	
						Sugar maple	---	
						White ash	---	
						Quaking aspen	---	
						Black cherry	---	

* 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]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
10B, 10C, 10E----- Plainfield	Manyflower cotoneaster, Vanhoutte spirea.	Siberian peashrub, lilac, Tatarian honeysuckle, silver buffaloberry, autumnolive.	Manchurian crabapple, eastern redcedar.	Red pine, eastern white pine, Norway spruce, Austrian pine.	Carolina poplar.
11B, 11C, 11E----- Coloma	Vanhoutte spirea	Siberian peashrub, lilac, Tatarian honeysuckle.	Eastern redcedar, Manchurian crabapple.	Eastern white pine, red pine, Austrian pine.	Carolina poplar.
12B, 12C, 12D----- Spinks	Vanhoutte spirea	Tatarian honeysuckle, Amur privet, autumnolive, Siberian peashrub, sargent crabapple.	White spruce, eastern redcedar.	Eastern white pine, red pine, Austrian pine.	Carolina poplar.
13B, 13C, 13D----- Metea	Vanhoutte spirea	Autumn-olive, Amur privet, Tatarian honeysuckle, lilac.	White spruce, Manchurian crabapple, eastern, redcedar.	Eastern white pine, Norway spruce, red pine.	Carolina poplar.
14A---------- Covert	Vanhoutte spirea	Lilac, arrowwood, autumn-olive, Amur privet, Tatarian honeysuckle, silky dogwood, nannyberry viburnum.	Manchurian crabapple, eastern redcedar.	Eastern white pine, Norway spruce, Austrian pine.	Carolina poplar.
16B, 16C, 16D, 16E---------- Remus	Vanhoutte spirea	Autumn-olive, American cranberrybush, Tatarian honeysuckle, hawthorn, Amur privet.	White spruce, northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, red pine.	Carolina poplar.
17B, 17C, 17D----- Marlette	Vanhoutte spirea	Autumn-olive, Tatarian honeysuckle, silky dogwood, nannyberry viburnum.	White spruce, Manchurian crabapple.	Norway spruce, red pine, Austrian pine, eastern white pine, green ash.	Carolina poplar.
19B, 19C, 19D, 19E---------- Perrinton	Vanhoutte spirea	Autumn-olive, lilac, silky dogwood, Amur privet, American cranberrybush, Siberian crabapple, nannyberry viburnum.	White spruce, Manchurian crabapple.	Eastern white pine, green ash, Austrian pine, Norway spruce.	Carolina poplar.
20*. Pits					

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	8-15	16-25	26-35	>35
21B---------- Ithaca	Vanhoutte spirea	Silky dogwood, American cranberrybush, Tatarian honeysuckle.	Northern white-cedar, white spruce, Manchurian crabapple.	Eastern white pine, green ash, Norway spruce.	Carolina poplar, golden willow.
22. Ziegenfuss					
23. Roscommon					
24. Vestaburg					
25. Edmore					
26. Edwards					
27. Houghton					
28. Houghton					
29. Loxley					
30. Adrian					
31A---------- Algansee	---	Amur privet, Tatarian honeysuckle, American cranberrybush.	Northern white-cedar, Manchurian crabapple, white spruce.	Green ash, eastern white pine, Norway spruce, golden willow.	Carolina poplar.
32. Glendora					
33A---------- Wixom	---	Silky dogwood, Amur privet, American cranberrybush, Tatarian honeysuckle.	Manchurian crabapple, northern white-cedar, white spruce.	Eastern white pine, Norway spruce, green ash, golden willow.	Carolina poplar.
34A---------- Pipestone	Vanhoutte spirea	American cranberrybush, Tatarian honeysuckle, silky dogwood.	White spruce, northern white-cedar, Manchurian crabapple.	Eastern white pine, green ash, Norway spruce.	Carolina poplar, golden willow.
35B---------- Capac	Vanhoutte spirea	Silky dogwood, American cranberrybush, Amur privet, Tatarian honeysuckle.	White spruce, northern white-cedar, Manchurian crabapple.	Eastern white pine, Austrian pine, Norway spruce, green ash.	Carolina poplar, golden willow.
37A---------- Locke	Vanhoutte spirea	Silky dogwood, Amur privet, American cranberrybush, Tatarian honeysuckle.	Northern white-cedar, white spruce, Manchurian crabapple.	Eastern white pine, Norway spruce, green ash.	Carolina poplar, golden willow.

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	8-15	16-25	26-35	>35
38A---------- Thetford	Vanhoutte spirea	Silky dogwood, Tatarian honeysuckle, American cranberrybush.	Northern white-cedar, Manchurian crabapple, white spruce.	Norway spruce, eastern white pine, green ash.	Carolina poplar, golden willow.
39B---------- Riverdale	---	Silky dogwood, Tatarian honeysuckle, American cranberrybush, nannyberry viburnum, Amur privet.	Northern white-cedar, Austrian pine, Manchurian crabapple, white spruce.	Norway spruce, eastern white pine.	Carolina poplar, golden willow.
40B---------- Aubbeenaubbee	Vanhoutte spirea	Silky dogwood, American cranberrybush, Amur privet, Tatarian honeysuckle, nannyberry viburnum.	White spruce, Manchurian crabapple, northern white-cedar.	Eastern white pine, green ash, Norway spruce.	Golden willow, Carolina poplar.
41. Corunna					
42. Palms					
43B---------- Arkona	---	American cranberrybush, silky dogwood, Tatarian honeysuckle, blue spruce.	Northern white-cedar, Manchurian crabapple, white spruce.	Eastern white pine, Norway spruce, green ash.	Carolina poplar.
44. Wauseon					
45B---------- Coloma	Vanhoutte spirea	Siberian peashrub, lilac, hedge cotoneaster, sargent crabapple, autumn-olive.	Eastern redcedar, Manchurian crabapple.	Austrian pine, red pine.	Carolina poplar.
46B, 46C---------- Tustin	Manyflower cotoneaster, Vanhoutte spirea.	Siberian peashrub, lilac, eastern redcedar, silky dogwood, Amur maple, American cranberrybush.	Eastern redcedar, Manchurian crabapple.	Eastern white pine, red pine, Norway spruce.	Carolina poplar.
47B, 47C, 47D, 47E---------- Mecosta	Vanhoutte spirea	Tatarian honeysuckle, Siberian crabapple, autumn-olive, Amur privet, lilac.	Eastern redcedar, Manchurian crabapple.	Red pine, Austrian pine, eastern white pine.	Carolina poplar.
48. Psammaquents					

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	8-15	16-25	26-35	>35
49A---------- Covert	Vanhoutte spirea	Amur privet, autumn-olive, Tatarian honeysuckle, lilac, silky dogwood, sargent crabapple, American cranberrybush, nannyberry viburnum.	Eastern redcedar, Manchurian crabapple.	Red pine, eastern white pine.	Carolina poplar.
50C*: Metea----------	Vanhoutte spirea	Siberian peashrub, lilac, hedge cotoneaster, sargent, crabapple, autumn-olive.	Eastern redcedar, Manchurian crabapple.	Austrian pine, red pine.	Carolina poplar.
Coloma----------	Vanhoutte spirea	Autumn-olive, silky dogwood, Tatarian honeysuckle, Amur privet, lilac.	Eastern redcedar, Manchurian crabapple.	Eastern white pine, Austrian pine, red pine.	Carolina poplar.
51B, 51C, 51D----- Leoni	Vanhoutte spirea	Autumn-olive, Tatarian honeysuckle, Amur privet, nannyberry viburnum, lilac, sargent crabapple, silky dogwood.	Eastern redcedar, Manchurian crabapple, white spruce.	Red pine, Norway spruce.	Carolina poplar.

* 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	Golf fairways
10B Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
10C Plainfield	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
10E Plainfield	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: droughty, slope.
11B Coloma	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
11C Coloma	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, slope, too sandy.
11E Coloma	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: slope.
12B Spinks	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
12C Spinks	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
12D Spinks	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
13B Metea	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
13C Metea	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
13D Metea	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
14A Covert	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
16B Remus	Slight	Slight	Moderate: slope.	Slight	Slight.
16C Remus	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
16D Remus	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
16E Remus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
17B---------- Marlette	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
17C---------- Marlette	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
17D---------- Marlette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
19B---------- Perrinton	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
19C---------- Perrinton	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
19D---------- Perrinton	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
19E---------- Perrinton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
20*. Pits					
21B---------- Ithaca	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
22---------- Ziegenfuss	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
23---------- Roscommon	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
24. Vestaburg					
25---------- Edmore	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
26---------- Edwards	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
27---------- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
28---------- Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
29---------- Loxley	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
30---------- Adrian	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
31A---------- Algansee	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: flooding, wetness.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
32--- Glendora	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
33A--- Wixom	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
34A--- Pipestone	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
35B--- Capac	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
37A--- Locke	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
38A--- Thetford	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
39B--- Riverdale	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: droughty.
40B--- Aubbeenaubbee	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
41--- Corunna	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
42--- Palms	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
43B--- Arkona	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
44--- Wauseon	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
45B--- Coloma	Slight---	Slight---	Moderate: slope.	Slight---	Moderate: droughty.
46B--- Tustin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight---	Slight.
46C--- Tustin	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight---	Moderate: slope.
47B--- Mecosta	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
47C--- Mecosta	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
47D--- Mecosta	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty, 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	Golf fairways
47E---------- Mecosta	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: droughty, slope.
48. Psammaquents					
49A---------- Covert	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
50C*:					
Metea----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
Coloma----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
51B---------- Leoni	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: small stones, droughty.
51C---------- Leoni	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: small stones, droughty, slope.
51D---------- Leoni	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

* 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
10B---------- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
10C, 10E---------- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
11B---------- Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
11C---------- Coloma	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
11E---------- Coloma	Very poor.	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
12B---------- Spinks	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Fair	Very poor.
12C, 12D---------- Spinks	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
13B---------- Metea	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
13C, 13D---------- Metea	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
14A---------- Covert	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Poor	Poor.
16B---------- Remus	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16C, 16D---------- Remus	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
16E---------- Remus	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
17B---------- Marlette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
17C---------- Marlette	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
17D---------- Marlette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
19B---------- Perrinton	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
19C---------- Perrinton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
19D---------- Perrinton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
19E---------- Perrinton	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
20*. Pits										

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
21B---------- Ithaca	Fair	Good	Good	Good	Good	Good	Fair	Good	Good	Fair.
22---------- Ziegenfuss	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
23---------- Roscommon	Poor	Poor	Fair	Poor	Poor	Fair	Good	Poor	Poor	Fair.
24---------- Vestaburg	Poor	Poor	Fair	Poor	Poor	Fair	Good	Poor	Poor	Fair.
25---------- Edmore	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
26---------- Edwards	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
27---------- Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
28---------- Houghton	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
29---------- Loxley	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
30---------- Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
31A---------- Algansee	Poor	Fair	Fair	Poor	Poor	Fair	Fair	Fair	Poor	Fair.
32---------- Glendora	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair.
33A---------- Wixom	Poor	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
34A---------- Pipestone	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair	Poor	Poor.
35B---------- Capac	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
37A---------- Locke	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
38A---------- Thetford	Poor	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
39B---------- Riverdale	Poor	Fair	Good	Fair	Fair	Fair	Poor	Fair	Fair	Poor.
40B---------- Aubbeenaubbee	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
41---------- Corunna	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
42---------- Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
43B---------- Arkona	Poor	Poor	Good	Fair	Fair	Poor	Fair	Fair	Fair	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
44---------- Wauseon	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
45B---------- Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
46B, 46C---------- Tustin	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
47B, 47C, 47D, 47E- Mecosta	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
48. Psammaquents										
49A---------- Covert	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor.
50C*:										
Metea----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Coloma----------	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
51B---------- Leoni	Poor	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
51C---------- Leoni	Poor	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
51D---------- Leoni	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

* 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 and 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
10B Plainfield	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
10C Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
10E Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
11B Coloma	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty, too sandy.
11C Coloma	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, too sandy.
11E Coloma	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
12B Spinks	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
12C Spinks	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
12D Spinks	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
13B Metea	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: droughty.
13C Metea	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
13D Metea	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14A Covert	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: droughty, too sandy.
16B Remus	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
16C Remus	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
16D, 16E Remus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
17B Marlette	Moderate: wetness.	Slight	Moderate: wetness.	Moderate: slope.	Severe: low strength.	Slight.
17C Marlette	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
17D---------- Marlette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
19B---------- Perrinton	Moderate: too clayey, dense layer.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
19C---------- Perrinton	Moderate: too clayey, dense layer, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
19D, 19E---------- Perrinton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
20*. Pits						
21B---------- Ithaca	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
22---------- Ziegenfuss	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
23---------- Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
24---------- Vestaburg	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	
25---------- Edmore	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
26---------- Edwards	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action, low strength.	Severe: excess humus, ponding.
27---------- Houghton	Severe: ponding, excess humus.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: excess humus, ponding.
28---------- Houghton	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
29---------- Loxley	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: too acid, ponding, excess humus.
30---------- Adrian	Severe: ponding, cutbanks cave, excess humus.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: excess humus, ponding.
31A---------- Algansee	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Moderate: flooding, wetness.

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
32---- Glendora	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
33A---- Wixom	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
34A---- Pipestone	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
35B---- Capac	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
37A---- Locke	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
38A---- Thetford	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
39B---- Riverdale	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Severe: droughty.
40B---- Aubbeenaubbee	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
41---- Corunna	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
42---- Palms	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
43B---- Arkona	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
44---- Wauseon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
45B---- Coloma	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Slight----	Moderate: droughty.
46B---- Tustin	Severe: cutbanks cave.	Slight----	Severe: shrink-swell.	Slight----	Moderate: frost action.	Slight.
46C---- Tustin	Severe: cutbanks cave.	Moderate: slope.	Severe: shrink-swell.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
47B---- Mecosta	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Slight----	Severe: droughty.
47C---- Mecosta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
47D, 47E---- Mecosta	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
48. Psammaquents						

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
49A---------- Covert	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
50C*:						
Metea----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Coloma----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
51B---------- Leoni	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: large stones, droughty.
51C---------- Leoni	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
51D---------- Leoni	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* 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," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant condition and 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
10B Plainfield	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
10C Plainfield	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
10E Plainfield	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
11B Coloma	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
11C Coloma	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
11E Coloma	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope.
12B Spinks	Slight	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
12C Spinks	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
12D Spinks	Severe: slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
13B Metea	Moderate: percs slowly.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
13C Metea	Moderate: slope, percs slowly.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
13D Metea	Severe: slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
14A Covert	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
16B Remus	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
16C Remus	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: 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
16D, 16E---------- Remus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
17B---------- Marlette	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
17C---------- Marlette	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
17D---------- Marlette	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
19B---------- Perrinton	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
19C---------- Perrinton	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
19D, 19E---------- Perrinton	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
20*. Pits					
21B---------- Ithaca	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
22---------- Ziegenfuss	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
23---------- Roscommon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
24---------- Vestaburg	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
25---------- Edmore	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.
26---------- Edwards	Severe: ponding, percs slowly.	Severe: ponding, seepage, excess humus.	Severe: ponding.	Severe: ponding, seepage.	Poor: ponding, excess humus.
27---------- Houghton	Severe: ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
28---------- Houghton	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.

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
29--Loxley	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
30--Adrian	Severe: ponding, poor filter.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Severe: ponding, seepage.	Poor: ponding, excess humus.
31A--Algansee	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
32--Glendora	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
33A--Wixom	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
34A--Pipestone	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
35B--Capac	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
37A--Locke	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
38A--Thetford	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness, thin layer.
39B--Riverdale	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
40B--Aubbeenaubbee	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
41--Corunna	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
42--Palms	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
43B--Arkona	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
44--Wauseon	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
45B---------- Coloma	Severe: percs slowly, poor filter.	Severe: seepage.	Moderate: too sandy.	Severe: seepage.	Fair: too sandy.
46B---------- Tustin	Severe: percs slowly.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
46C---------- Tustin	Severe: percs slowly.	Severe: seepage, slope.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
47B---------- Mecosta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
47C---------- Mecosta	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
47D, 47E---------- Mecosta	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
48. Psammaquents					
49A---------- Covert	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
50C*:					
Metea----------	Moderate: slope, percs slowly.	Severe: seepage, slope.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Coloma----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
51B---------- Leoni	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
51C---------- Leoni	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones.
51D---------- Leoni	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.

* 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," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
10B, 10C Plainfield	Good	Probable	Improbable: too sandy.	Poor: too sandy.
10E Plainfield	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
11B, 11C Coloma	Good	Probable	Improbable: too sandy.	Poor: too sandy.
11E Coloma	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
12B Spinks	Good	Probable	Improbable: too sandy.	Fair: too sandy.
12C Spinks	Good	Probable	Improbable: too sandy.	Fair: slope, too sandy.
12D Spinks	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope.
13B Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy.
13C Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, slope.
13D Metea	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Poor: slope.
14A Covert	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
16B, 16C Remus	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
16D Remus	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
16E Remus	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
17B Marlette	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
17C Marlette	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
17D Marlette	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
19B, 19C Perrinton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
19D---------- Perrinton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
19E---------- Perrinton	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
20*. Pits				
21B---------- Ithaca	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
22---------- Ziegenfuss	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
23---------- Roscommon	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: wetness.
24---------- Vestaburg	Poor: wetness.	Probable----------	Probable----------	
25---------- Edmore	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
26---------- Edwards	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
27---------- Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.
28---------- Houghton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
29---------- Loxley	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness, too acid.
30---------- Adrian	Poor: wetness, low strength.	Probable----------	Improbable: too sandy.	Poor: wetness, excess humus.
31A---------- Algansee	Fair: wetness.	Probable----------	Improbable: too sandy.	Fair: too sandy.
32---------- Glendora	Poor: wetness.	Probable----------	Improbable: too sandy.	Poor: wetness.
33A---------- Wixom	Poor: low strength.	Improbable: thin layer.	Improbable: thin layer.	Fair: too sandy.
34A---------- Pipestone	Fair: wetness.	Probable----------	Improbable: too sandy.	Fair: too sandy, small stones.
35B---------- Capac	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
37A---------- Locke	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
38A---------- Thetford	Fair: wetness.	Probable----------	Improbable: too sandy.	Fair: too sandy, small stones.
39B---------- Riverdale	Fair: wetness.	Probable----------	Probable----------	Poor: small stones, area reclaim.
40B---------- Aubbeenaubbee	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
41---------- Corunna	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness.
42---------- Palms	Poor: wetness.	Improbable: excess humus, excess fines.	Improbable: excess humus, excess fines.	Poor: wetness, excess humus.
43B---------- Arkona	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
44---------- Wauseon	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
45B---------- Coloma	Good----------	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, small stones.
46B---------- Tustin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
46C---------- Tustin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too sandy.
47B, 47C---------- Mecosta	Good----------	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
47D---------- Mecosta	Fair: slope.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
47E---------- Mecosta	Poor: slope.	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
48. Psammaquents				
49A---------- Covert	Fair: wetness.	Probable----------	Improbable: too sandy.	Poor: area reclaim.
50C*: Metea----------	Poor: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, slope.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
50C*: Coloma	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones, slope.
51B, 51C Leoni	Good	Improbable: small stones.	Probable	Poor: large stones, area reclaim.
51D Leoni	Fair: small stones. slope.	Improbable: small stones.	Probable	Poor: large stones, area reclaim, slope.

* 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 and 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
10B---------- Plainfield	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
10C, 10E---------- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty, slope.
11B---------- Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
11C, 11E---------- Coloma	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
12B---------- Spinks	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
12C, 12D---------- Spinks	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
13B---------- Metea	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
13C, 13D---------- Metea	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
14A---------- Covert	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Droughty.
16B---------- Remus	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Droughty, soil blowing.	Droughty, rooting depth.
16C, 16D, 16E----- Remus	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Droughty, soil blowing.	Slope, droughty, rooting depth.
17B---------- Marlette	Moderate: slope.	Severe: piping.	Severe: slow refill.	Slope----------	Wetness, soil blowing.	Favorable.
17C, 17D---------- Marlette	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Soil blowing, slope.	Slope.
19B---------- Perrinton	Moderate: slope.	Moderate: piping.	Severe: no water.	Deep to water	Rooting depth, slope.	Rooting depth.
19C, 19D, 19E----- Perrinton	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Rooting depth, slope.	Slope, rooting depth.
20*. Pits						
21B---------- Ithaca	Slight---------	Moderate: wetness.	Severe: no water.	Frost action---	Wetness--------	Wetness.
22---------- Ziegenfuss	Slight---------	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, rooting depth.	Wetness, 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
23---------- Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
24---------- Vestaburg	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Wetness, droughty.
25---------- Edmore	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Wetness, droughty.
26---------- Edwards	Severe: seepage.	Severe: ponding.	Severe: slow refill.	Frost action, ponding, subsides.	Ponding, soil blowing.	Wetness.
27---------- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Soil blowing, ponding.	Wetness.
28---------- Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding--------	Wetness.
29---------- Loxley	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing, too acid.	Wetness.
30---------- Adrian	Severe: seepage.	Severe: seepage, ponding, excess humus.	Severe: slow refill, cutbanks cave.	Ponding, frost action, subsides.	Ponding, soil blowing.	Wetness.
31A---------- Algansee	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, droughty.
32---------- Glendora	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, droughty.
33A---------- Wixom	Severe: seepage.	Severe: piping.	Severe: no water.	Favorable------	Wetness, droughty, fast intake.	Wetness, erodes easily, droughty.
34A---------- Pipestone	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, droughty.
35B---------- Capac	Slight---------	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness--------	Wetness.
37A---------- Locke	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness, soil blowing, rooting depth.	Wetness, rooting depth.
38A---------- Thetford	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, droughty.
39B---------- Riverdale	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, 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
40B---------- Aubbeenaubbee	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness, soil blowing.	Wetness.
41---------- Corunna	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Wetness, erodes easily.
42---------- Palms	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides.	Ponding, soil blowing.	Wetness.
43B---------- Arkona	Severe: seepage.	Severe: wetness.	Severe: slow refill, cutbanks cave.	Percs slowly---	Wetness, droughty, fast intake.	Wetness, droughty, percs slowly.
44---------- Wauseon	Severe: seepage.	Severe: hard to pack, ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, droughty, soil blowing.	Wetness, droughty, rooting depth.
45B---------- Coloma	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty.
46B---------- Tustin	Severe: seepage.	Severe: hard to pack.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Droughty, rooting depth.
46C---------- Tustin	Severe: seepage, slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty, rooting depth.
47B---------- Mecosta	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Large stones, droughty.
47C, 47D, 47E----- Mecosta	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Large stones, slope, droughty.
48. Psammaquents						
49A---------- Covert	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Droughty.
50C*:						
Metea----------	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
Coloma----------	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, droughty.
51B---------- Leoni	Severe: seepage.	Moderate: large stones.	Severe: no water.	Deep to water	Droughty, slope.	Large stones, droughty.
51C, 51D---------- Leoni	Severe: seepage, slope.	Moderate: large stones.	Severe: no water.	Deep to water	Droughty, slope.	Large stones, slope, droughty.

* 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	
10B, 10C, 10E---- Plainfield	0-3	Sand----------	SP-SM, SM, SP	A-3, A-2, A-1	0	75-100	75-100	40-80	3-35	---	NP
	3-22	Sand----------	SP	A-3, A-1, A-2	0	75-100	75-100	40-70	1-4	---	NP
	22-60	Sand, fine sand	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
11B, 11C, 11E---- Coloma	0-39	Sand----------	SP, SM, SP-SM	A-2, A-3	0-10	85-100	85-100	50-70	2-15	---	NP
	39-60	Stratified sand to loamy sand.	SP, SM, SP-SM	A-2, A-3	0-10	75-100	75-100	50-85	2-30	---	NP
12B, 12C, 12D---- Spinks	0-9	Loamy sand-------	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	9-31	Loamy sand-------	SM	A-2-4	0	100	80-100	50-90	15-25	---	NP
	31-60	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
13B, 13C, 13D---- Metea	0-10	Loamy sand-------	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	10-21	Loamy sand, loamy fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	21-33	Clay loam, sandy clay loam, silty clay loam.	CL, SC	A-6	0	90-100	90-95	75-95	40-75	30-40	10-15
	33-60	Loam, sandy clay loam, clay loam.	CL, CL-ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-35	5-15
14A---------- Covert	0-4	Sand----------	SP-SM, SM	A-3, A-2-4	0	95-100	90-100	50-75	5-15	---	NP
	4-35	Sand----------	SP-SM, SM	A-3, A-2-4	0	95-100	90-100	50-70	5-15	---	NP
	35-60	Sand, fine sand	SP-SM, SM	A-3, A-2-4	0	95-100	90-100	50-70	5-15	---	NP
16B, 16C, 16D, 16E---------- Remus	0-6	Sandy loam-------	SM, SM-SC	A-2, A-4	0-10	85-100	85-95	55-80	25-45	<25	NP-7
	6-9	Sandy loam, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4, A-1-B	0-10	85-100	85-95	45-75	15-45	<25	NP-7
	9-23	Sandy loam, sandy clay loam.	SC	A-2, A-6	0-10	85-100	85-95	45-85	10-45	20-30	10-15
	23-60	Sandy loam, sandy clay loam.	SC	A-2, A-6	0-10	85-100	85-95	55-85	25-45	25-40	10-20
17B, 17C, 17D---- Marlette	0-11	Sandy loam-------	SM, SM-SC	A-4, A-2	0-5	95-100	85-95	60-70	30-40	<25	NP-7
	11-38	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	80-95	55-90	20-40	5-25
	38-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
19B, 19C, 19D, 19E---------- Perrinton	0-8	Loam----------	ML, CL, CL-ML	A-4, A-6	0-5	95-100	95-100	80-100	55-80	18-35	2-15
	8-30	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0-5	95-100	95-100	80-100	65-90	25-55	11-30
	30-60	Clay loam, silty clay loam, silty clay.	CL	A-6	0-5	95-100	95-100	90-100	65-90	25-36	11-18
20*. Pits											
21B---------- Ithaca	0-9	Loam----------	CL	A-4, A-6	0-3	95-100	95-100	80-100	55-85	25-35	7-15
	9-28	Clay loam, silty clay loam, clay.	CL, CH	A-7	0-3	95-100	90-100	85-100	60-90	40-55	20-30
	28-60	Clay loam, silty clay loam, clay.	CL, CH	A-7	0-3	95-100	90-100	85-100	60-90	40-55	20-30

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
22---------- Ziegenfuss	0-6	Silty clay loam	CL	A-6, A-7	0-5	95-100	90-100	85-90	65-85	35-45	15-20
	6-21	Clay loam, silty clay loam, clay.	CL, CH	A-7	0-5	95-100	90-100	90-95	65-85	40-55	20-32
	21-60	Clay loam, silty clay loam, clay.	CL, CH	A-7	0-5	95-100	90-100	90-95	70-85	40-55	20-32
23---------- Roscommon	0-7	Loamy sand-------	SM, SP-SM	A-2, A-3	0	100	95-100	50-70	5-25	---	NP
	7-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	0-15	---	NP
24---------- Vestaburg	0-14	Sandy loam-------	SM, SP-SM	A-2, A-4	0-5	85-95	75-95	55-75	20-40	<20	NP
	14-35	Sand, gravelly sand, gravelly loamy sand.	SM, SP-SM	A-2, A-1	0-5	85-95	75-90	40-60	10-20	---	NP
	35-60	Gravelly sand, gravelly loamy sand, very gravelly sand.	GW, SW, GP, SP	A-1	5-10	50-85	40-75	25-45	0-5	---	NP
25---------- Edmore	0-8	Sandy loam-------	SM, SM-SC	A-2, A-4	0-5	95-100	90-100	60-70	25-40	<20	NP-7
	8-34	Sandy loam, loamy sand, sand.	SM, SC, SM-SC	A-2, A-4	0-5	95-100	90-100	60-75	20-40	<20	NP-10
	34-60	Loamy sand, sand	SM, SM-SC	A-2	0-5	95-100	90-100	55-70	15-30	<20	NP-7
26---------- Edwards	0-28	Sapric material	PT	A-8	0	---	---	---	---	---	---
	28-60	Marl----------	---	---	0	100	95-100	80-90	60-80	---	---
27, 28---------- Houghton	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
29---------- Loxley	0-2	Hemic material---	PT	A-8	---	---	---	---	---	---	---
	2-60	Sapric material	PT	A-8	---	---	---	---	---	---	---
30---------- Adrian	0-31	Sapric material	PT	A-8	---	---	---	---	---	---	---
	31-60	Sand, loamy sand, gravelly sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
31A---------- Algansee	0-10	Loamy sand-------	SM	A-2-4	0	100	100	50-75	15-30	---	NP
	10-60	Sand----------	SM, SP-SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
32---------- Glendora	0-6	Loamy sand-------	SP-SM, SM	A-3, A-2, A-4, A-1	0-5	95-100	90-100	45-95	5-40	<20	NP-4
	6-60	Stratified sand to loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-B	0-5	95-100	90-100	45-85	0-35	---	NP
33A---------- Wixom	0-10	Loamy sand-------	SM	A-2-4	0	95-100	95-100	50-70	15-30	---	NP
	10-22	Loamy sand, sand, loamy fine sand.	SM, SP-SM	A-2-4, A-3	0	95-100	95-100	50-75	5-30	<20	NP-4
	22-60	Clay loam, sandy clay loam, loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	51-95	20-40	5-25
34A---------- Pipestone	0-9	Loamy sand-------	SP, SM, SP-SM	A-2-4, A-3	0	95-100	90-100	60-80	0-20	---	NP
	9-24	Sand, loamy sand, fine sand.	SP-SM, SP, SM	A-2-4, A-3	0	95-100	90-100	60-80	0-15	---	NP
	24-30	Sand, fine sand	SP-SM, SP	A-3, A-2-4	0	95-100	90-100	50-80	0-10	---	NP
35B---------- Capac	0-11	Loam----------	CL, ML, CL-ML	A-4	0-5	95-100	90-100	80-95	60-75	<25	3-10
	11-40	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	50-80	25-40	5-20
	40-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-75	15-35	5-15

See footnote at end of table.

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	
37A---------- Locke	0-15	Sandy loam-------	SM, SM-SC, ML, CL-ML	A-2-4, A-4	0-7	95-100	80-95	60-90	25-60	<30	3-9
	15-32	Sandy clay loam, sandy loam, loam.	SC, CL	A-6	0-7	95-100	80-95	65-85	35-55	20-30	10-15
	32-60	Sandy loam-------	SM, SM-SC, ML, CL-ML	A-2-4, A-4	0-7	95-100	75-95	60-85	30-55	<30	NP-10
38A---------- Thetford	0-30	Loamy sand, sand	SM	A-2, A-4	0	95-100	90-100	70-85	20-45	<20	NP-4
	30-60	Loamy sand, sandy loam, sand.	SM	A-2, A-4	0	95-100	90-100	60-80	20-40	<20	NP-4
39B---------- Riverdale	0-9	Loamy sand-------	SM, SP-SM	A-1, A-2, A-3	0-5	80-100	65-95	45-70	5-30	<20	NP-4
	9-38	Sand, loamy sand, gravelly sand.	SM, SP-SM	A-1, A-2, A-3	0-5	80-100	65-95	45-70	5-30	<20	NP-4
	38-42	Gravelly sandy loam, sandy loam, gravelly sandy clay loam.	SM, SC, SM-SC	A-2	0-5	85-100	65-90	55-75	15-35	12-35	NP-16
	42-60	Gravelly sand, very gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	0-10	40-80	35-70	20-45	0-10	---	NP
40B---------- Aubbeenaubbee	0-9	Fine sandy loam	SM, SM-SC	A-2-4, A-4	0	100	90-100	50-80	30-50	<25	NP-6
	9-17	Sandy loam, loam, fine sandy loam.	SM, ML	A-2-4, A-4	0	100	90-100	55-90	30-70	<20	NP
	17-33	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	95-100	75-95	35-70	25-35	11-16
	33-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6	0-3	85-100	80-100	70-95	50-70	20-35	2-14
41---------- Corunna	0-11	Fine sandy loam	SM, ML, SC, CL	A-2, A-4	0-5	95-100	95-100	65-85	25-70	<30	NP-10
	11-35	Sandy loam, loamy sand.	SM, SC, SM-SC	A-4, A-2	0-5	95-100	95-100	50-75	15-40	<30	NP-10
	35-60	Sandy clay loam, clay loam, loam.	CL	A-6, A-7	0	100	95-100	90-100	70-90	25-50	11-25
42---------- Palms	0-34	Sapric material	PT	---	---	---	---	---	---	---	---
	34-60	Clay loam, sandy clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
43B---------- Arkona	0-9	Loamy sand-------	SM	A-2-4	0	100	95-100	55-80	20-35	---	NP
	9-35	Sand, loamy sand, loamy fine sand.	SP, SM, SP-SM	A-2-4, A-3	0	100	95-100	50-75	0-35	---	NP
	35-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	90-100	90-100	75-95	51-70	25-40
44---------- Wauseon	0-11	Sandy loam-------	SM, ML	A-4, A-2	0	100	95-100	60-85	30-55	---	NP
	11-24	Sandy loam, loamy fine sand, very fine sand.	SM	A-2, A-4	0	100	95-100	65-95	20-45	---	NP
	24-60	Clay, silty clay, silty clay loam.	CH, CL, MH, ML	A-7	0	90-100	85-100	80-100	75-95	42-70	18-36
45B---------- Coloma	0-42	Loamy sand-------	SM	A-2	0-5	95-100	90-100	50-75	15-35	---	NP
	42-50	Stratified sand to loamy sand.	SP, SM, SP-SM	A-2, A-3, A-4	0-5	95-100	90-100	50-100	2-40	---	NP
	50-60	Clay loam, silty clay loam, loam.	CL, CL-ML, ML	A-4, A-6	0-5	95-100	95-100	85-95	60-90	20-35	3-15
46B, 46C---------- Tustin	0-30	Loamy sand, sand	SM	A-2	0	100	100	60-100	15-25	---	NP
	30-60	Silty clay, silty clay loam, clay.	CL, CH	A-7, A-6	0-5	90-100	90-100	85-100	65-100	30-80	15-50

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
47B, 47C, 47D, 47E---------- Mecosta	0-10	Sand----------	SM, SP-SM	A-3, A-2-4	0-5	90-100	90-100	50-95	5-15	---	NP
	10-20	Sand, gravelly sand, loamy sand.	SM, SP-SM	A-1, A-3, A-2-4	0-15	75-100	65-95	45-75	5-30	<20	NP-5
	20-22	Gravelly loamy sand, gravelly sandy loam.	SM-SC, SM, SP-SM	A-2-4	0-15	40-70	40-70	35-65	10-30	<20	NP-5
	22-60	Gravelly sand, extremely gravelly coarse sand, very gravelly coarse sand.	SP, SM, SP-SM	A-2-4, A-3	0-25	20-50	20-50	25-50	0-10	---	NP
48. Psammaquents											
49A---------- Covert	0-8	Loamy sand-------	SM, SP-SM	A-2-4	0	100	100	50-75	15-30	<20	NP-4
	8-38	Sand, loamy sand	SP-SM, SM	A-3, A-2-4	0	95-100	90-100	50-70	5-15	---	NP
	38-60	Gravelly sand----	SP-SM, SP	A-1, A-3	0-25	75-95	65-95	45-75	0-10	---	NP
50C*:											
Metea----------	0-10	Loamy sand-------	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	10-25	Loamy sand, loamy fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	25-33	Clay loam, sandy clay loam, silty clay loam.	CL, SC	A-6	0	90-100	90-95	75-95	40-75	30-40	10-15
	33-60	Loam, silty clay loam, clay loam.	CL, CL-ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-35	5-15
Coloma----------	0-39	Loamy sand-------	SM	A-2	0-10	85-100	85-100	50-75	15-30	---	NP
	39-60	Stratified sand to loamy sand.	SP, SM, SP-SM	A-2, A-3	0-10	75-100	75-100	50-85	2-30	---	NP
51B, 51C, 51D---- Leoni	0-14	Gravelly sandy loam, extremely gravelly sandy loam.	SM	A-2, A-4	1-20	85-95	75-90	60-80	30-50	30	NP-7
	14-30	Extremely gravelly sandy loam, gravelly sandy clay loam, extremely gravelly clay loam.	SM, SC, SM-SC, SP-SM	A-2, A-1	5-30	70-85	60-85	40-50	10-25	<25	NP-8
	30-60	Extremely gravelly sand, very gravelly loamy sand, cobbly sandy loam.	SM, SP-SM, SC, SM-SC	A-1, A-2, A-4	5-35	65-85	40-80	35-50	5-40	<22	NP-8

* 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
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
10B, 10C, 10E---- Plainfield	0-3	2-9	1.35-1.65	6.0-20	0.04-0.09	4.5-7.3	Low----------	0.15	5	1	<1
	3-22	1-4	1.50-1.65	6.0-20	0.04-0.07	4.5-6.5	Low----------	0.17			
	22-60	1-4	1.50-1.75	6.0-20	0.04-0.07	4.5-6.5	Low----------	0.17			
11B, 11C, 11E---- Coloma	0-39	1-9	1.35-1.65	6.0-20	0.06-0.09	5.1-6.0	Low----------	0.15	5	1	<1
	39-60	1-4	1.50-1.65	6.0-20	0.03-0.06	5.1-6.5	Low----------	0.15			
12B, 12C, 12D---- Spinks	0-9	2-15	1.20-1.60	6.0-20	0.08-0.10	5.1-7.3	Low----------	0.17	5	2	2-4
	9-31	3-15	1.20-1.60	2.0-6.0	0.08-0.10	5.6-7.3	Low----------	0.17			
	31-60	0-15	1.20-1.50	2.0-6.0	0.04-0.08	5.6-7.8	Low----------	0.17			
13B, 13C, 13D---- Metea	0-10	3-8	1.45-1.60	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	.5-2
	10-21	2-10	1.50-1.70	6.0-20	0.06-0.11	5.1-6.5	Low----------	0.17			
	21-33	25-35	1.50-1.70	0.6-2.0	0.15-0.19	5.6-7.3	Low----------	0.32			
	33-60	20-30	1.40-1.65	0.6-2.0	0.05-0.19	7.4-8.4	Low----------	0.32			
14A---------- Covert	0-4	2-10	1.25-1.55	6.0-20	0.06-0.09	4.5-7.3	Low----------	0.15	5	1	1-2
	4-35	2-10	1.25-1.60	6.0-20	0.05-0.08	4.5-7.3	Low----------	0.15			
	35-60	0-10	1.45-1.65	6.0-20	0.04-0.07	5.6-7.3	Low----------	0.15			
16B, 16C, 16D, 16E---------- Remus	0-6	8-18	1.10-1.60	2.0-6.0	0.10-0.18	5.1-7.3	Low----------	0.28	3	3	1-2
	6-9	5-18	1.30-1.75	2.0-6.0	0.08-0.17	5.1-7.3	Low----------	0.28			
	9-23	10-30	1.75-1.90	0.6-2.0	0.08-0.16	5.1-7.3	Low----------	0.28			
	23-60	15-30	1.30-1.80	0.6-2.0	0.08-0.16	5.1-7.3	Low----------	0.28			
17B, 17C, 17D---- Marlette	0-11	10-18	1.30-1.65	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.32	5	3	1-3
	11-38	18-30	1.30-1.70	0.2-0.6	0.18-0.20	5.6-7.8	Low----------	0.32			
	38-60	15-25	1.30-1.70	0.2-0.6	0.12-0.19	7.9-8.4	Low----------	0.32			
19B, 19C, 19D, 19E---------- Perrinton	0-8	10-22	1.50-1.85	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.32	4	6	1-3
	8-30	35-50	1.50-1.80	0.2-0.6	0.10-0.20	5.1-6.5	Moderate-----	0.32			
	30-60	35-50	1.65-1.95	0.2-0.6	0.14-0.20	7.9-8.4	Moderate-----	0.32			
20*. Pits											
21B---------- Ithaca	0-9	8-27	1.40-1.70	0.6-2.0	0.20-0.24	5.1-7.3	Low----------	0.32	5	6	1-4
	9-28	35-50	1.40-1.65	0.2-0.6	0.10-0.20	5.1-7.8	Moderate-----	0.32			
	28-60	30-50	1.50-1.65	0.2-0.6	0.13-0.20	7.9-8.4	Moderate-----	0.32			
22---------- Ziegenfuss	0-6	27-35	1.35-1.55	0.2-0.6	0.16-0.19	5.6-7.8	Moderate-----	0.32	5	6	1-4
	6-21	35-50	1.40-1.70	0.2-0.6	0.14-0.20	5.6-7.8	Moderate-----	0.32			
	21-60	35-50	1.50-1.75	0.2-0.6	0.13-0.20	7.4-8.4	Moderate-----	0.32			
23---------- Roscommon	0-7	0-12	0.90-1.60	6.0-20	0.07-0.20	5.6-7.8	Low----------	0.17	5	2	4-15
	7-60	0-10	1.45-1.75	6.0-20	0.05-0.07	5.6-8.4	Low----------	0.17			
24---------- Vestaburg	0-14	2-12	0.90-1.60	2.0-6.0	0.10-0.12	6.6-7.8	Low----------	0.17	4	2	5-6
	14-35	2-12	1.45-1.65	6.0-20	0.06-0.08	6.6-7.8	Low----------	0.17			
	35-60	0-12	1.55-1.65	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
25---------- Edmore	0-8	2-15	1.35-1.50	2.0-6.0	0.12-0.15	6.1-7.3	Low----------	0.20	5	3	4-6
	8-34	2-15	1.40-1.55	0.6-6.0	0.08-0.14	5.6-7.8	Low----------	0.20			
	34-60	0-12	1.40-1.65	2.0-6.0	0.05-0.10	7.4-8.4	Low----------	0.20			
26---------- Edwards	0-28	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	---	3	55-75
	28-60	---	---	---	---	7.4-8.4	----------	----			
27---------- Houghton	0-60	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	----------	----	---	3	>70

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/cm³	In/hr	In/in	pH					Pct
28----------	0-60	---	0.08-0.30	0.2-6.0	0.35-0.45	6.6-7.3	----------	----	---	8	>70
Houghton											
29----------	0-2	---	0.30-0.40	0.6-6.0	0.45-0.55	<4.5	----------	----	2	3	70-90
Loxley	2-60	---	0.10-0.35	0.2-6.0	0.35-0.45	<4.5	----------	----			
30----------	0-31	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	---	3	55-75
Adrian	31-60	2-10	1.40-1.75	6.0-20	0.03-0.08	5.6-8.4	Low----------	----			
31A----------	0-10	0-15	1.35-1.50	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	1-4
Algansee	10-60	0-18	1.40-1.65	6.0-20	0.05-0.07	5.6-7.8	Low----------	0.17			
32----------	0-6	0-15	1.35-1.50	2.0-20	0.07-0.15	5.6-7.8	Low----------	0.17	5	2	---
Glendora	6-60	0-10	1.40-1.65	6.0-20	0.05-0.11	5.6-7.8	Low----------	0.17			
33A----------	0-10	2-12	1.20-1.60	6.0-20	0.10-0.12	5.1-6.5	Low----------	0.15	5	2	2-4
Wixom	10-22	2-14	1.40-1.70	6.0-20	0.06-0.11	5.1-6.5	Low----------	0.15			
	22-60	18-35	1.30-1.70	0.2-0.6	0.14-0.20	6.1-7.8	Moderate-----	0.43			
34A----------	0-9	2-12	1.20-1.60	6.0-20	0.07-0.10	4.5-7.3	Low----------	0.17	5	2	3-4
Pipestone	9-24	2-12	1.20-1.60	6.0-20	0.06-0.09	4.5-7.3	Low----------	0.17			
	24-30	2-12	1.20-1.60	6.0-20	0.05-0.07	5.1-7.3	Low----------	0.17			
35B----------	0-11	10-18	1.40-1.70	0.6-2.0	0.18-0.20	5.6-7.3	Low----------	0.32	5	5	1-3
Capac	11-40	18-35	1.45-1.70	0.2-0.6	0.14-0.18	5.6-7.3	Low----------	0.32			
	40-60	10-35	1.50-1.70	0.2-0.6	0.14-0.16	7.4-8.4	Low----------	0.32			
37A----------	0-15	10-20	1.35-1.65	0.6-6.0	0.16-0.20	5.1-7.3	Low----------	0.20	5	3	2-4
Locke	15-32	18-25	1.40-1.70	0.6-2.0	0.14-0.18	5.6-7.3	Low----------	0.32			
	32-60	8-18	1.65-1.80	0.6-2.0	0.12-0.15	7.4-8.4	Low----------	0.32			
38A----------	0-30	2-15	1.25-1.41	2.0-6.0	0.10-0.13	5.6-7.3	Low----------	0.17	5	2	1-4
Thetford	30-60	8-18	1.35-1.45	2.0-6.0	0.08-0.13	5.6-7.8	Low----------	0.17			
39B----------	0-9	2-10	1.25-1.40	6.0-20	0.06-0.12	6.1-7.8	Low----------	0.17	4	2	1-4
Riverdale	9-38	2-12	1.35-1.45	6.0-20	0.05-0.11	6.1-7.8	Low----------	0.17			
	38-42	5-15	1.35-1.45	2.0-6.0	0.05-0.13	6.1-7.8	Low----------	0.17			
	42-60	0-5	1.25-1.50	>20	0.02-0.04	7.9-8.4	Low----------	0.10			
40B----------	0-9	8-15	1.30-1.45	0.6-6.0	0.16-0.18	5.6-7.3	Low----------	0.24	5	3	1-2
Aubbeenaubbee	9-17	7-15	1.40-1.60	0.6-6.0	0.09-0.14	5.1-6.5	Low----------	0.24			
	17-33	22-30	1.40-1.55	0.2-2.0	0.16-0.18	5.6-7.3	Low----------	0.32			
	33-60	8-30	1.40-1.55	0.2-2.0	0.10-0.19	7.4-8.4	Low----------	0.32			
41----------	0-11	5-15	1.60-1.70	0.6-6.0	0.14-0.22	6.1-7.8	Low----------	0.20	4	3	1-2
Corunna	11-35	10-18	1.30-1.60	0.6-6.0	0.08-0.14	6.1-7.8	Low----------	0.20			
	35-60	18-35	1.45-1.70	0.2-0.6	0.16-0.20	7.4-8.4	Moderate-----	0.43			
42----------	0-34	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	2	3	>75
Palms	34-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	----			
43B----------	0-9	1-12	1.25-1.40	2.0-20	0.10-0.12	5.1-7.3	Low----------	0.17	4	2	1-3
Arkona	9-35	3-15	1.35-1.45	6.0-20	0.06-0.11	5.1-7.3	Low----------	0.17			
	35-60	35-50	1.25-1.60	0.06-0.2	0.08-0.12	6.1-8.4	High----------	0.28			
44----------	0-11	7-18	1.40-1.60	2.0-6.0	0.13-0.18	6.1-7.3	Low----------	0.20	4	3	4-8
Wauseon	11-24	5-18	1.40-1.75	6.0-20	0.06-0.16	6.6-7.8	Low----------	0.20			
	24-60	35-55	1.50-1.85	<0.06	0.08-0.18	7.4-8.4	High----------	0.32			
45B----------	0-42	2-10	1.35-1.65	6.0-20	0.09-0.12	5.1-7.3	Low----------	0.15	5	2	<1
Coloma	42-50	1-10	1.50-1.65	6.0-20	0.03-0.08	5.1-7.8	Low----------	0.15			
	50-60	15-40	1.35-1.75	0.2-2.0	0.14-0.20	7.9-8.4	Moderate-----	0.32			
46B, 46C----------	0-30	4-10	1.55-1.70	6.0-20	0.09-0.13	5.1-7.3	Low----------	0.17	4	2	.5-2
Tustin	30-60	35-60	1.65-1.95	0.06-0.2	0.07-0.20	5.6-8.4	High----------	0.32			

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/cm^3	In/hr	In/in	pH					Pct
47B, 47C, 47D, 47E----------	0-10	2-10	1.25-1.55	6.0-20	0.06-0.09	5.1-7.3	Low----------	0.15	5	1	.5-1
Mecosta	10-20	2-12	1.25-1.60	6.0-20	0.03-0.10	5.1-7.3	Low----------	0.15			
	20-22	5-12	1.25-1.60	6.0-20	0.06-0.10	5.1-7.3	Low----------	0.10			
	22-60	0-10	1.50-1.65	>20	0.02-0.06	6.6-8.4	Low----------	0.10			
48. Psammaquents											
49A----------	0-8	2-15	1.25-1.55	6.0-20	0.09-0.12	4.5-7.3	Low----------	0.15	5	2	1-2
Covert	8-38	2-10	1.25-1.55	6.0-20	0.05-0.08	4.5-7.3	Low----------	0.15			
	38-60	0-5	1.50-1.65	>20	0.02-0.04	5.6-8.4	Low----------	0.10			
50C*:											
Metea----------	0-10	3-8	1.45-1.60	6.0-20	0.10-0.12	5.6-7.3	Low----------	0.17	5	2	.5-2
	10-25	2-10	1.50-1.70	6.0-20	0.06-0.11	5.1-6.5	Low----------	0.17			
	25-33	25-35	1.50-1.70	0.6-2.0	0.15-0.19	5.6-7.3	Low----------	0.32			
	33-60	20-30	1.40-1.65	0.6-2.0	0.05-0.19	7.4-8.4	Low----------	0.32			
Coloma----------	0-39	2-12	1.35-1.65	6.0-20	0.09-0.12	5.1-6.0	Low----------	0.15	5	2	<1
	39-60	1-4	1.50-1.65	6.0-20	0.03-0.06	5.1-6.5	Low----------	0.15			
51B, 51C, 51D----	0-14	2-18	1.30-1.70	0.6-6.0	0.07-0.15	5.6-7.3	Low----------	0.10	3	8	1-3
Leoni	14-30	18-35	1.30-1.70	2.0-6.0	0.03-0.09	5.6-7.8	Low----------	0.10			
	30-60	0-18	1.20-1.50	2.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			

* 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 "rare," "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			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
10B, 10C, 10E----- Plainfield	A	None--------	---	---	>6.0	---	---	Low------	Low------	High.
11B, 11C, 11E----- Coloma	A	None--------	---	---	>6.0	---	---	Low------	Low------	Moderate.
12B, 12C, 12D----- Spinks	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
13B, 13C, 13D----- Metea	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
14A---------- Covert	A	None--------	---	---	2.0-3.5	Apparent	Nov-Apr	Low------	Low------	Moderate.
16B, 16C, 16D, 16E---------- Remus	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Moderate.
17B---------- Marlette	B	None--------	---	---	2.5-6.0	Apparent	Dec-Apr	Moderate	Low------	Moderate.
17C, 17D---------- Marlette	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Moderate.
19B, 19C, 19D, 19E---------- Perrinton	C	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
20*. Pits										
21B---------- Ithaca	C	None--------	---	---	1.0-2.0	Perched	Oct-May	High-----	High-----	Moderate.
22---------- Ziegenfuss	D	None--------	---	---	+1-1.0	Apparent	Nov-May	High-----	High-----	Low.
23---------- Roscommon	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	Moderate	High-----	Low.
24---------- Vestaburg	A/D	None--------	---	---	+1-1.0	Apparent	Oct-May	Moderate	High-----	Low.
25---------- Edmore	D	None--------	---	---	+1-1.0	Apparent	Nov-Jun	Moderate	High-----	Low.
26---------- Edwards	B/D	None--------	---	---	+1-0.5	Apparent	Sep-Jun	High-----	High-----	Low.
27---------- Houghton	A/D	None--------	---	---	+1-1.0	Apparent	Sep-Jun	High-----	High-----	Low.
28---------- Houghton	D	None--------	---	---	+2-0.5	Apparent	Sep-Jun	High-----	High-----	Low.
29---------- Loxley	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	High-----	High-----	High.
30---------- Adrian	A/D	None--------	---	---	+1-1.0	Apparent	Nov-May	High-----	High-----	Moderate.
31A---------- Algansee	B	Occasional	Long------	Nov-May	1.0-2.0	Apparent	Nov-May	Moderate	Low------	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			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
32--Glendora	A/D	Frequent	Long	Jan-Dec	0-1.0	Apparent	Nov-Jun	Moderate	High	Moderate.
33A--Wixom	B	None	---	---	1.0-2.0	Perched	Nov-Jun	Moderate	Moderate	High.
34A--Pipestone	A	None	---	---	1.0-2.0	Apparent	Oct-Jun	Moderate	Low	Moderate.
35B--Capac	B	None	---	---	1.0-2.0	Apparent	Nov-May	High	High	Low.
37A--Locke	B	None	---	---	1.0-2.0	Apparent	Nov-May	High	High	Moderate.
38A--Thetford	A	None	---	---	1.0-2.0	Apparent	Feb-May	Moderate	Low	Moderate.
39B--Riverdale	A	None	---	---	1.0-2.0	Apparent	Nov-May	Moderate	Low	Low.
40B--Aubbeenaubbee	B	None	---	---	1.0-3.0	Apparent	Jan-Apr	High	High	Moderate.
41--Corunna	B/D	None	---	---	+1-1.0	Apparent	Nov-May	High	High	Low.
42--Palms	A/D	None	---	---	+1-1.0	Apparent	Nov-May	High	High	Moderate.
43B--Arkona	B	None	---	---	1.0-2.0	Perched	Nov-May	Moderate	High	Moderate.
44--Wauseon	B/D	None	---	---	+1-1.0	Perched	Jan-Apr	High	High	Low.
45B--Coloma	A	None	---	---	>6.0	---	---	Low	Low	Moderate.
46B, 46C--Tustin	B	None	---	---	>6.0	---	---	Moderate	High	Low.
47B, 47C, 47D, 47E--Mecosta	A	None	---	---	>6.0	---	---	Low	Low	Moderate.
48. Psammaquents										
49A--Covert	A	None	---	---	2.0-3.5	Apparent	Nov-Apr	Low	Low	Moderate.
50C*:										
Metea	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Coloma	A	None	---	---	>6.0	---	---	Low	Low	Moderate.
51B, 51C, 51D--Leoni	B	None	---	---	>6.0	---	---	Low	Low	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Algansee	Mixed, mesic Aquic Udipsamments
Arkona	Sandy over clayey, mixed, mesic Alfic Haplaquods
Aubbeenaubbee	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Capac	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Coloma	Mixed, mesic Alfic Udipsamments
Corunna	Coarse-loamy, mixed, mesic Typic Haplaquolls
Covert	Sandy, mixed, mesic Entic Haplorthods
Edmore	Sandy, mixed, mesic Mollic Haplaquents
Edwards	Marly, euic, mesic Limnic Medisaprists
Glendora	Mixed, mesic Mollic Psammaquents
Houghton	Euic, mesic Typic Medisaprists
Ithaca	Fine, mixed, mesic Glossaquic Hapludalfs
Leoni	Loamy-skeletal, mixed, mesic Typic Hapludalfs
Locke	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Loxley	Dysic Typic Borosaprists
Marlette	Fine-loamy, mixed, mesic Glossoboric Hapludalfs
Mecosta	Sandy-skeletal, mixed, mesic Typic Udorthents
Metea	Loamy, mixed, mesic Arenic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Perrinton	Fine, mixed, mesic Glossoboric Hapludalfs
Pipestone	Sandy, mixed, mesic Entic Haplaquods
Plainfield	Mixed, mesic Typic Udipsamments
Psammaquents	Mixed, mesic Psammaquents
Remus	Fine-loamy, mixed, mesic Glossoboric Hapludalfs
Riverdale	Loamy, mixed, mesic Aquic Arenic Hapludalfs
Roscommon	Mixed, frigid Mollic Psammaquents
Spinks	Sandy, mixed, mesic Psammentic Hapludalfs
Thetford	Sandy, mixed, mesic Psammaquentic Hapludalfs
Tustin	Clayey, mixed, mesic Arenic Hapludalfs
*Vestaburg	Mixed, mesic Mollic Psammaquents
Wauseon	Coarse-loamy over clayey, mixed, mesic Typic Haplaquolls
Wixom	Sandy over loamy, mixed, mesic Alfic Haplaquods
Ziegenfuss	Fine, mixed, nonacid, mesic Mollic Haplaquepts

* The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

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