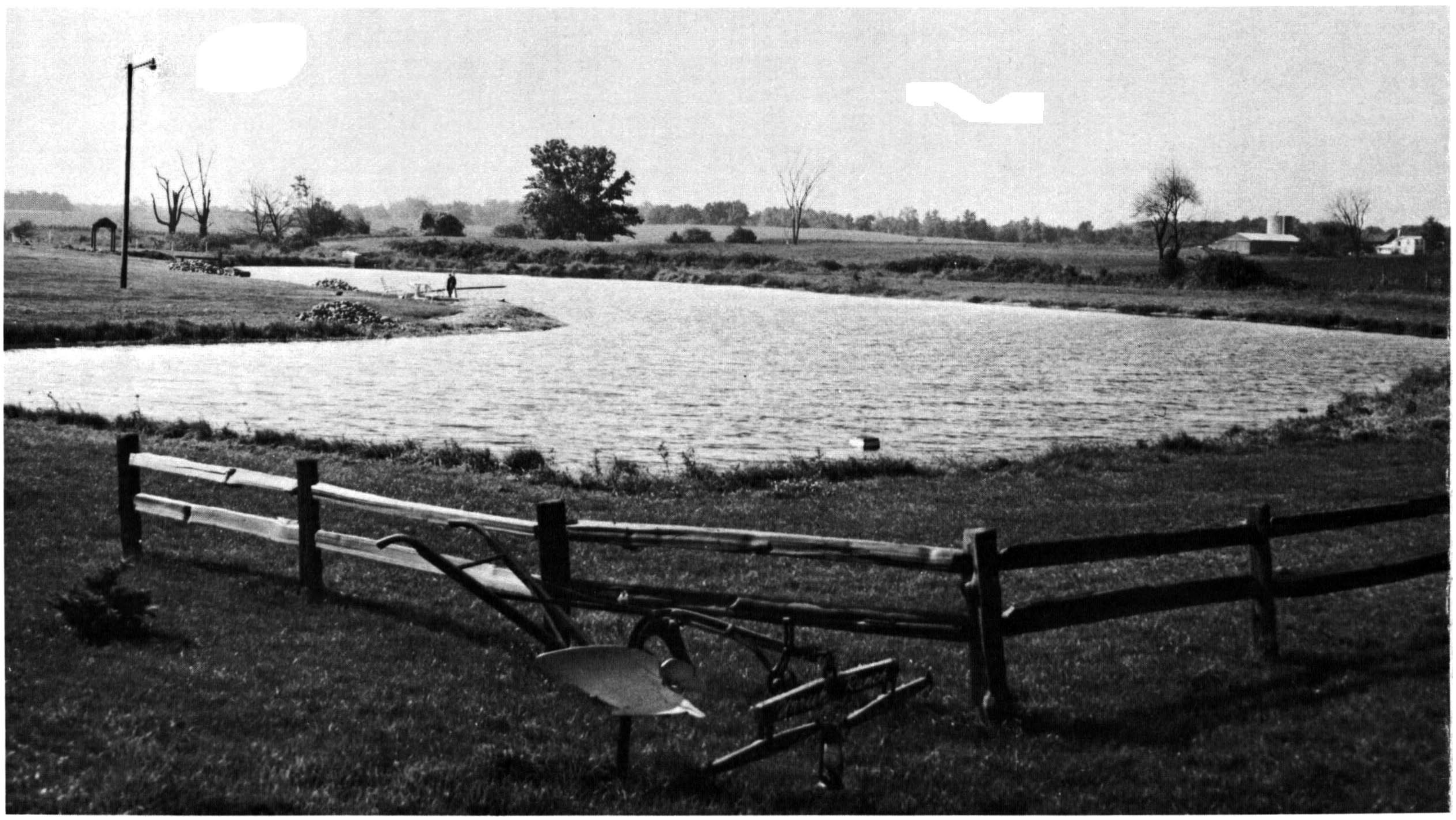
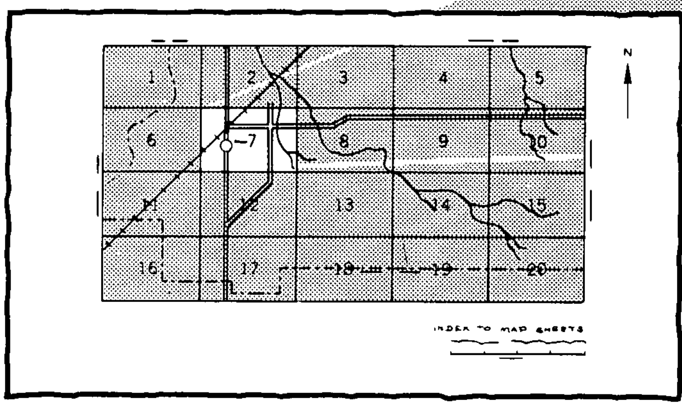
Soil Survey of
Ingham County, Michigan

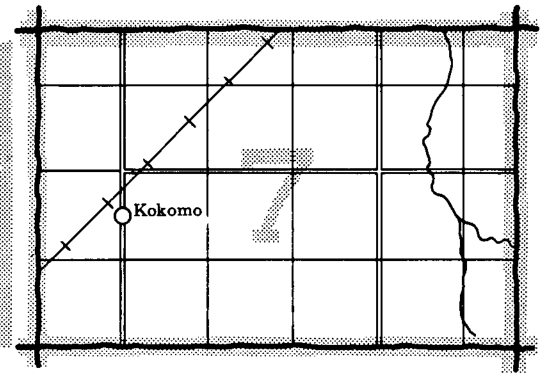


United States Department of Agriculture
Soil Conservation Service
in cooperation with
Michigan Agricultural Experiment Station

HOW TO USE

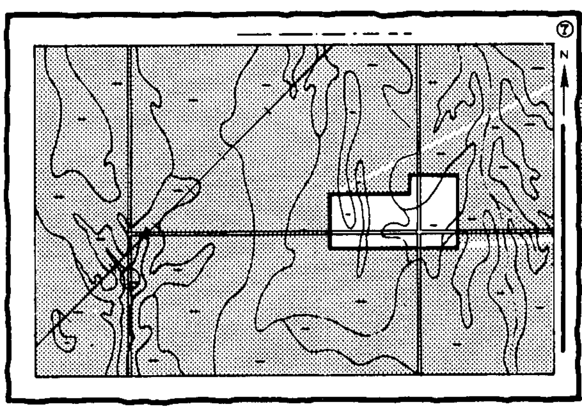
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

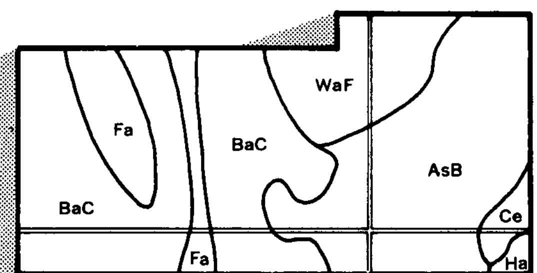




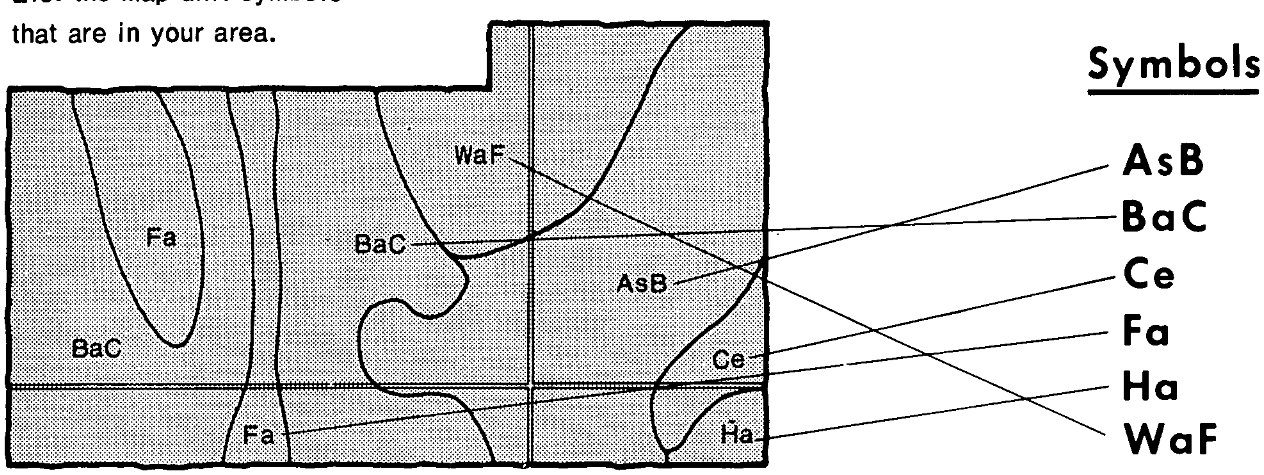
2. Note the number of the map sheet and turn to that sheet.

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



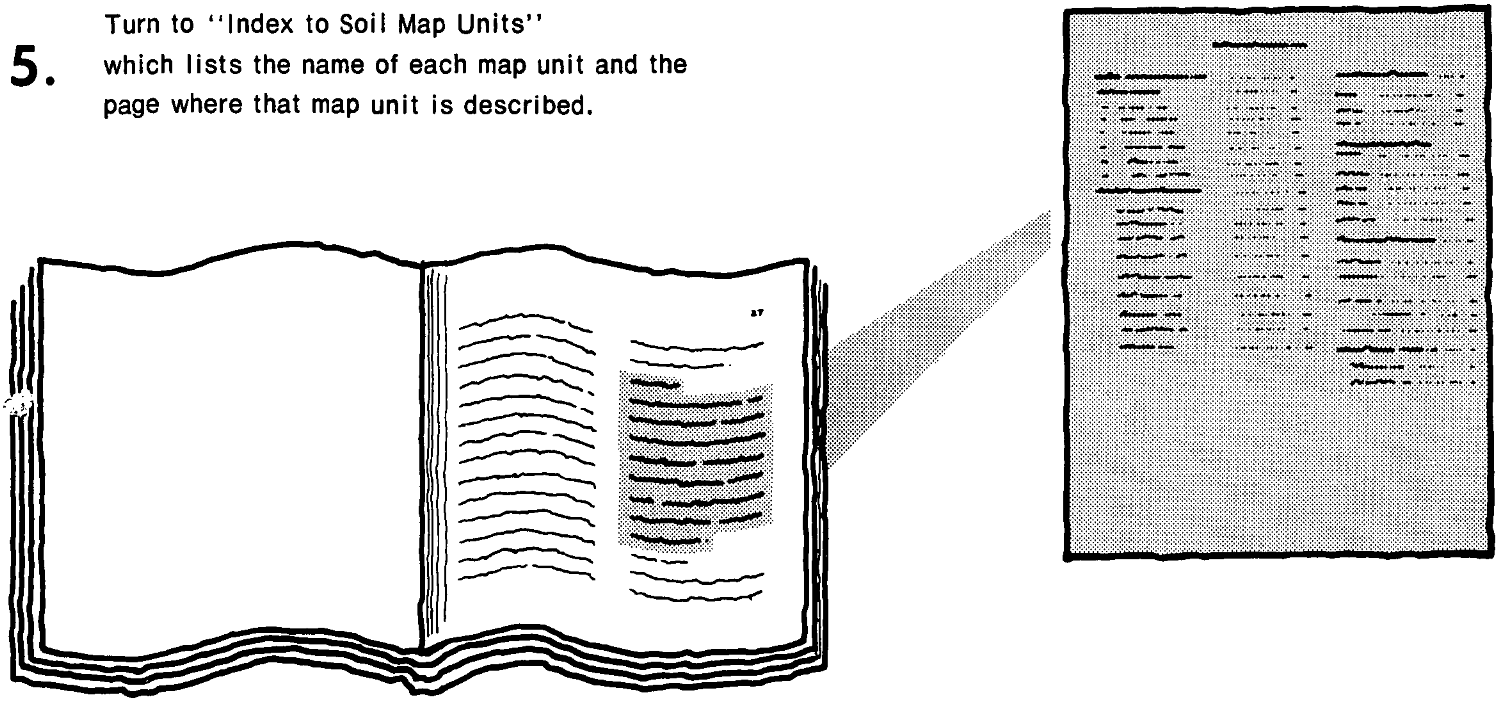


4. List the map unit symbols that are in your area.

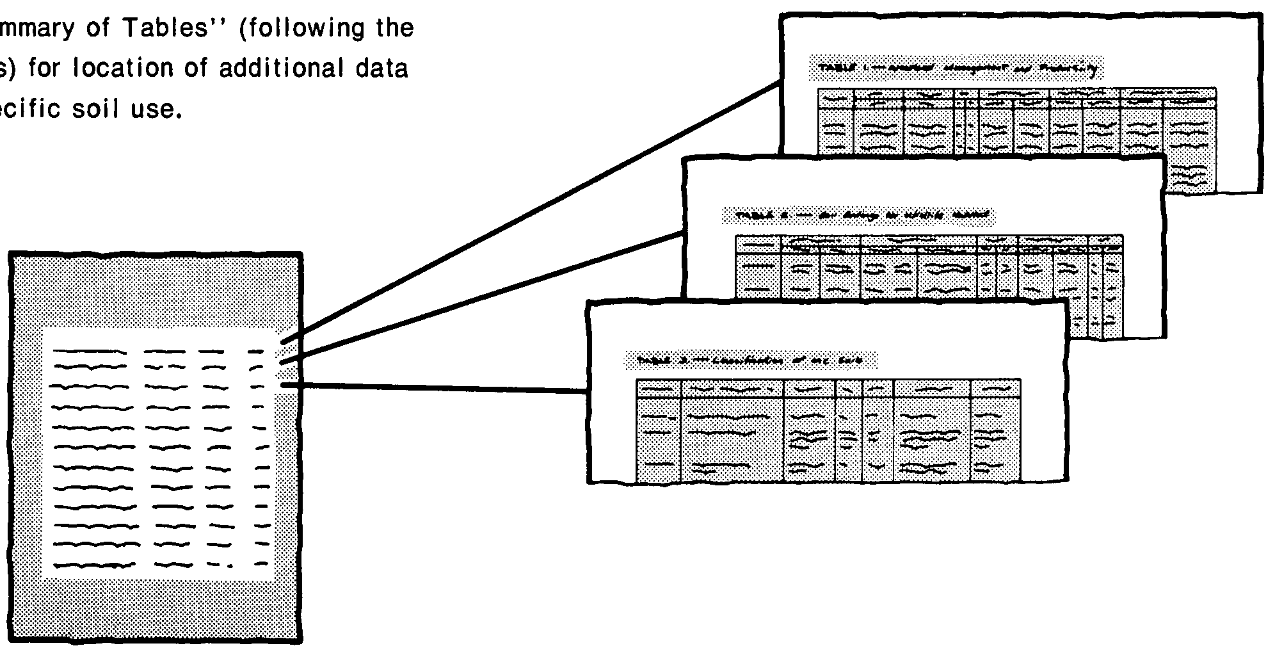


THIS SOIL SURVEY

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



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



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

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. 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 the period 1965 to 1976. Soil names and descriptions were approved in March 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1977.

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 Ingham County Soil Conservation District. Preparation of this soil survey was partly financed by the Ingham County Board of Commissioners under provisions of an agreement with the Soil Conservation Service and the Michigan Agricultural Experiment Station.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Recreation pond in area of Sebewa loam. The pond is stocked with large-mouth bass and bluegill.

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Issued August 1979

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Foreword

The Soil Survey of Ingham County, Michigan, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

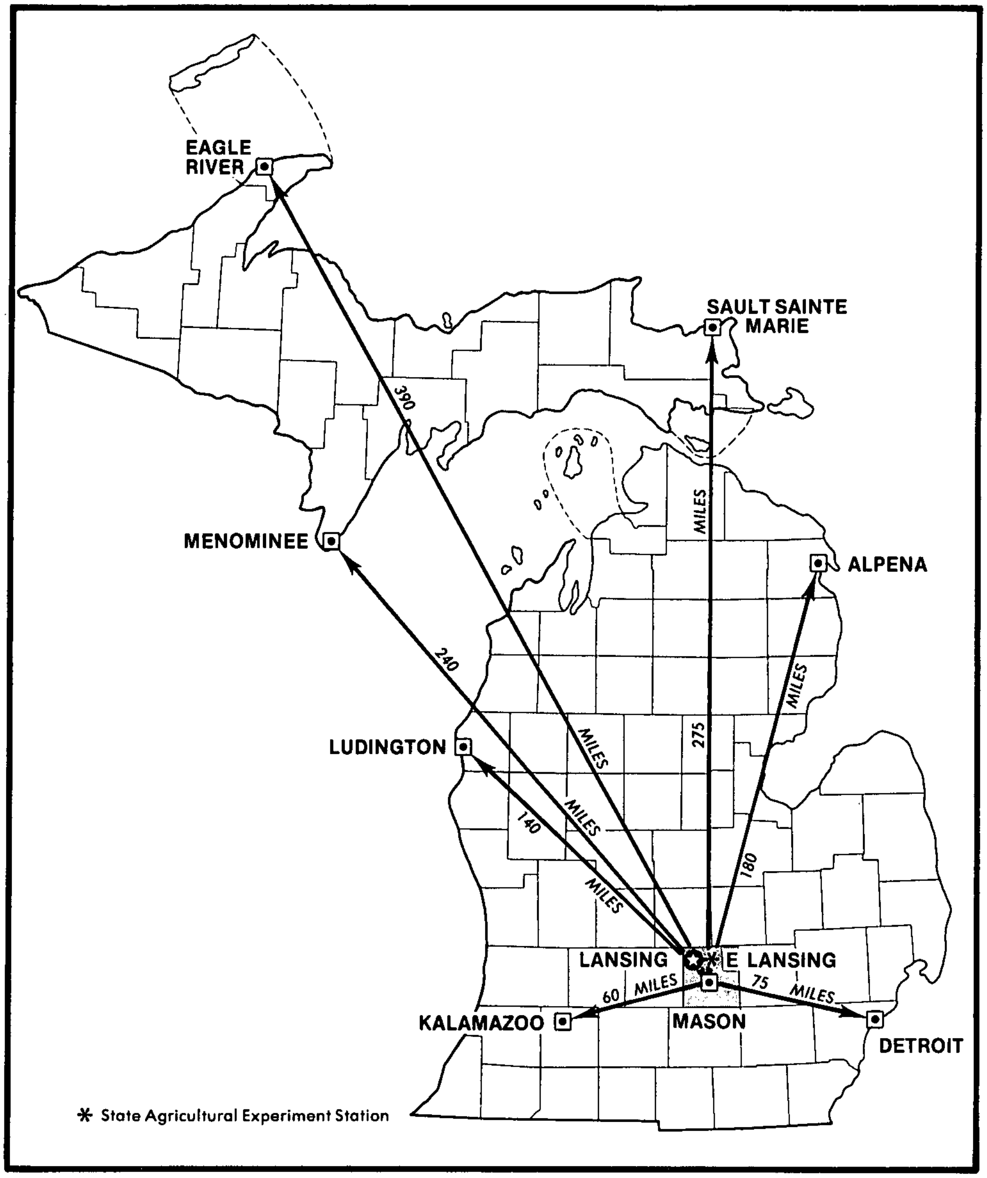
This soil survey has been prepared for many different users. Farmers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Arthur H. Cratty
State Conservationist
Soil Conservation Service



Location of Ingham County in Michigan.

SOIL SURVEY OF INGHAM COUNTY, MICHIGAN

Fieldwork by James R. Barnes, William L. Bowman, Guy H. Earle, Jr., Robert J. Engel, Donald F. Gibbs, Sheldon G. Holcomb, and George Threlkeld, Soil Conservation Service; and Dan F. Amos, Raymond Laurin, Dave A. Lietzke, Ramez Mahjoory, Saiid Mahjoory, Bruce Rae, Patrick Sutton, and Ted M. Zobeck
Michigan Agricultural Experiment Station

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

Ingham County is in the south-central part of the lower peninsula of Michigan. Mason is the county seat, and Lansing the state capital. Lansing and East Lansing are the main commercial, industrial, and educational centers. The total area of the county is about 357,000 acres, or about 558 square miles.

The climate in Ingham County is favorable for most crops. About 48 percent of the acreage is used for crops, chiefly corn, wheat, soybeans, oats, and grass-legume hay.

General nature of the county

On the pages that follow is general information on the climate of the county, the settlement and development, the industry and transportation, and the lakes and streams.

Climate

Table 1 gives data on temperature and precipitation for the survey area, as recorded at East Lansing for the period 1947 to 1976. 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 24.9 degrees F, and the average daily minimum temperature is 17.5 degrees. The lowest temperature on record, which occurred at East Lansing on February 9, 1875, is -33 degrees. In summer the average temperature is 68.9 degrees, and the average daily maximum temperature is 80.2 degrees. The highest recorded temperature, which occurred on July 24, 1934, is 102 degrees.

Growing degree days, shown in table 1, 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.

Of the total annual precipitation, 18.1 inches, or 61 percent, usually falls in April through September, which includes the growing season for most crops. 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 5.47 inches at East Lansing on June 6, 1905. Thunderstorms occur on about 34 days each year, and most occur in June.

Average seasonal snowfall is 39.4 inches. The greatest snow depth at any one time during the period of record was 27 inches. On the average, 65 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 62 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The percentage of possible sunshine is 68 in summer and 36 in winter. The prevailing wind is from the southwest. Average windspeed is highest, 10.3 miles per hour, in January.

Climatic data in this section were specially prepared for the Soil Conservation Service by the Michigan Department of Agriculture, Michigan Weather Service.

Settlement and development

Ingham County, organized on April 5, 1838, was named for Samuel D. Ingham, Secretary of the Treasury in President Jackson's cabinet from 1829 to 1831. The county consisted only of the Village of Mason and six townships—Alaiedon, Aurelius, Ingham, Onondaga, Stockbridge, and Vevay. The first county seat, the "City of Ingham," was in Vevay Township. In 1840, the seat was moved to the Village of Mason.

The county was heavily timbered. Logging was the initial industry. Agriculture was a major part of the economy. By 1850, the county had 8 flour mills and 24 saw mills. Another early industry was coal mining. Deposits were found in Aurelius Township in the 1870's, in the Village of Mason in 1873, in Williamston Village in 1918, and in Webberville in 1919.

In 1847, the seat of the State Government was moved from Detroit to Lansing. Shortly thereafter, in 1855, the Michigan Legislature established the Nation's first land grant college, the Michigan Agricultural College, in East Lansing.

The population of the county increased from fewer than 100 in 1838 to 8,643 in 1850 and to more than 17,000 in 1860. The population in 1970 was 261,039.

Industry and transportation

Manufacturing and agricultural enterprises are important in Ingham County.

An airport just north of the Ingham-Clinton county line provides the county with passenger and freight transportation. Three railroads provide freight service to Ingham County. One provides passenger service to the Lansing area. All pass through the Lansing area.

Two major regional highways serve Ingham County. U.S. 127 extends from the south-central county line to Lansing and the north county line where it joins U.S. 27. Highway I-96 extends from the east county line to the west county line. Two-lane state highways—M-36, M-43, M-52, and M-99—serve other parts of the county.

Lakes and streams

Ingham County has one large natural lake, Lake Lansing, in the north-central part of the county. A county park is on the west shore of this lake. Several smaller private lakes are in the southeastern part of the county. Most are surrounded by muck soils. Thus, recreation is limited on the shores of those lakes.

There are two major streams in the county. The Grand River flows northward along the west side of the county. The Red Cedar River, in the northern part of the county, flows westward. These two rivers join at Lansing and flow out of the county at the northwest corner.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land-use planning

The general soil map at the back of this publication shows, in color, associations that have a distinct pattern of soils and of relief and drainage. Each association is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils in an association can occur in other associations, but in different patterns.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soil in any one association differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Association descriptions

1. Urban land-Marlette-Capac association

Urban land and nearly level to hilly, well drained to somewhat poorly drained loamy soils

This association consists of Urban land and nearly level to hilly soils. It makes up about 10 percent of the county. It is about 45 percent Urban land, 20 percent Marlette or similar soils, 15 percent Capac or similar soils, and 20 percent soils of minor extent.

Urban land consists of areas of structures and pavements. The soil material around building foundations and the fill material that supports structures consist mainly of Marlette or Capac soils that have been cut or graded. Urban land generally is in less sloping areas. Drainage varies.

Marlette soils are on ridgetops, low knolls, and side slopes and in higher broad areas. They are well drained and moderately well drained. Capac soils are in low broad areas and along minor drainageways. They are somewhat poorly drained.

Marlette soils are undulating to hilly. Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is brown loam with fine sandy loam coatings, and the lower part is dark yellowish brown and brown, firm clay loam. The substratum to a depth of 60 inches is brown loam.

Capac soils are nearly level and undulating. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is mottled and is about 23 inches thick. The upper part is light olive brown, friable loam, and the lower part is brown and grayish brown, firm loam and clay loam. The substratum to a depth of 60 inches is grayish brown, mottled loam.

Minor in this association are the well drained Boyer and Spinks soils and the very poorly drained Brookston and Colwood soils. Boyer and Spinks soils are on uplands. Brookston and Colwood soils are in low areas and along streams. Scattered areas of other minor soils occur throughout the association.

About half of this association is covered with structures and pavements. Areas that have not been urbanized include parks, playgrounds, vacant lots, isolated tracts of wooded land, yards, and open space around and between buildings. Septic tank filter fields do not function properly on Capac soils because of the high water table.

The Marlette soils in this association have good potential for most recreational uses. Capac soils have fair to poor potential for most kinds of recreation and for sanitary facilities and building sites because of excess water. Marlette soils have good potential for building sites. Marlette and Capac soils have good potential for vegetable gardens.

2. Marlette-Capac-Owosso association

Nearly level to rolling, well drained to somewhat poorly drained loamy soils

This association is on till plains and moraines. It makes up about 21 percent of the county. It is about 35 percent Marlette or similar soils, 30 percent Capac or similar soils, 10 percent Owosso or similar soils, and 25 percent soils of minor extent.

Marlette soils commonly are in positions similar to those of Owosso soils but are higher than Capac soils. They are on the higher broad plains, knolls, and ridges. Capac soils are in low areas and in drainageways.

Marlette soils are well drained and moderately well drained. Capac soils are somewhat poorly drained. Owosso soils are well drained. The available water capacity is high for Marlette and Capac soils and moderate for Owosso soils. Capac soils and the more gently sloping parts of Marlette soils have a seasonal high water table.

Marlette soils are undulating to rolling. Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is brown loam with fine sandy loam coatings, and the lower part is dark yellowish brown and brown clay loam. The substratum to a depth of 60 inches is brown loam.

Capac soils are nearly level and undulating. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is mottled and is about 23 inches thick. The upper part is light olive brown, friable loam, and the lower part is brown and grayish brown, firm loam and clay loam. The substratum to a depth of 60 inches is grayish brown, mottled loam.

Owosso soils are undulating to rolling. Typically, the surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 8 inches thick. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, very friable and friable sandy loam, and the lower part is dark brown, firm clay loam. The substratum to a depth of 60 inches is brown clay loam.

Minor in this association are the well drained Hillsdale and Riddles soils and the poorly drained and very poorly drained Colwood and Brookston soils. Hillsdale and Riddles soils are in positions similar to those of Marlette and Owosso soils. Colwood and Brookston soils are in low flat areas and in drainageways.

This association is used mainly as cropland. Some areas are pasture. An erosion hazard on Marlette and Owosso soils and excess water in Capac soils are the major limitations.

The potential is good for cropland, pasture, and woodland except in the rolling areas where it is only fair for cropland. Marlette and Owosso soils have good potential for most recreational uses and for sanitary facilities and building sites, except in the rolling areas where the potential is fair. Capac soils have fair to poor potential for most kinds of recreation and for sanitary facilities and building sites because of excess water.

3. Houghton-Palms-Edwards association

Nearly level, very poorly drained muck soils

This association (fig. 1) is in depressional areas, in areas surrounding lakes, and in drainageways. It makes up about 5 percent of the county. It is about 39 percent Houghton or similar soils, 30 percent Palms or similar soils, 16 percent Edwards or similar soils, and 15 percent soils of minor extent.

Houghton and Edwards soils occur throughout the association but are more commonly near the center of large areas. Palms soils occur throughout also but are more commonly near the edges of large areas. All of these soils have moderately slow to moderately rapid permeability. All are subject to flooding.

Houghton soils are nearly level. Typically, the surface layer is black muck about 8 inches thick. The underlying layers to a depth of 60 inches are dark reddish brown and black muck.

Palms soils are nearly level. Typically, the upper layer is black muck about 36 inches thick. The substratum to a depth of 60 inches is gray sandy loam.

Edwards soils are nearly level. Typically, the upper layer is black muck about 29 inches thick. The substratum to a depth of 60 inches is light gray and gray marl.

Minor in this association are the very poorly drained and poorly drained Adrian, Sebewa, Aurelius, Boots, Gilford, and Colwood soils. Adrian soils are in positions similar to those of Palms soils. Boots soils are in positions similar to those of Houghton soils. Aurelius soils are in positions similar to those of Edwards soils. Sebewa, Gilford, and Colwood soils are at the edges of the muck units.

This association is used mainly as cropland, woodland, and wildlife habitat. Wetness, flooding, and unstable soil material are the main limitations to the use of these soils for farming and for most other purposes. Most of the soils have poor drainage outlets.

This association has fair to poor potential for field crops but is suited to truck and specialty crops (fig. 2). It has good potential for pasture but poor potential for most types of recreation and for sanitary facilities and building sites.

4. Oshtemo-Houghton-Riddles association

Nearly level to hilly, well drained and very poorly drained, sandy, loamy, and muck soils

This association (fig. 3) is on outwash plains and till plains. It makes up about 18 percent of the county. It is about 25 percent Oshtemo or similar soils, 25 percent Houghton or similar soils, 15 percent Riddles or similar soils, and 35 percent soils of minor extent.

Oshtemo soils in most places are higher than Houghton and Riddles soils. They are on ridgetops and side slopes and in broad nearly level areas. Houghton soils are in depressional areas, in drainageways, and in areas surrounding lakes. Riddles soils commonly are in positions similar to those of Oshtemo soils but are slightly lower.

Oshtemo and Riddles soils are well drained. Houghton soils are very poorly drained. Houghton soils are subject to frequent flooding.

Oshtemo soils are nearly level to rolling. Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is dark yellowish brown and yellowish brown sandy loam about 7 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable sandy loam, and the lower part is yellowish brown, loose and very friable loamy sand and sand. The substratum to a depth of 60 inches is brown gravelly sand.

Houghton soils are nearly level. Typically, the surface layer is black muck about 8 inches thick. The underlying layers to a depth of 60 inches are dark reddish brown and black muck.

Riddles soils are undulating to hilly. Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 14 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown and brown, firm sandy clay loam and clay loam, and the lower part is dark yellowish brown, friable sandy loam.

The substratum to a depth of about 66 inches is yellowish brown sandy loam.

Minor in this association are the well drained Spinks, Boyers, and Hillsdale soils, the somewhat poorly drained Aubbeenaubbee soils, and the very poorly drained Gilford and Palms soils. Spinks and Boyer soils are in positions similar to those of Oshtemo soils. Hillsdale soils are in positions similar to those of Riddles soils. Aubbeenaubbee soils are along drainageways and in shallow depressions. Gilford and Palms soils are in drainageways, in low areas, and in depressions.

This association is mainly cropland and woodland. Some areas are pasture. The main limitations are droughtiness and erosion on Oshtemo soils, wetness in Houghton soils, and an erosion hazard on Riddles soils. Ponding is common on Houghton soils. Most of the hilly areas of this association are woodland and pasture. Large areas of Houghton soils are wooded. If adequately drained, Houghton soils are productive. Oshtemo soils are suited to irrigation.

This association has fair potential for cropland except in the undulating areas of Riddles soils where the potential is good. The potential is good for pasture. It is good for woodland except in areas of Houghton soils, where it is only fair. The nearly level and undulating areas of Oshtemo and Riddles soils have good potential for recreation and for sanitary facilities and building sites. The rolling areas have only fair potential. Houghton soils have poor potential. Houghton soils have good potential for truck and specialty crops. Oshtemo soils are a good source of sand and gravel.

5. Capac-Marlette-Colwood association

Nearly level and undulating, well drained to very poorly drained loamy soils

This association (fig. 4) is on till plains. It makes up about 21 percent of the county. It is about 35 percent Capac or similar soils, 15 percent Marlette or similar soils, 15 percent Colwood or similar soils, and 35 percent soils of minor extent.

Capac soils are in low broad areas and along minor drainageways. Marlette soils are on low knolls, in higher broad areas, and on low ridges. Colwood soils are in depressional areas and in drainageways.

Capac soils are somewhat poorly drained. Marlette soils are well drained and moderately well drained. Colwood soils are poorly drained and very poorly drained. Capac soils have moderate to moderately slow permeability. Marlette and Colwood soils have moderate permeabilty. All have high available water capacity. Capac soils and the more gently sloping parts of Marlette soils have a seasonal high water table. Colwood soils have a high water table and are frequently flooded.

Capac soils are nearly level and undulating. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is mottled and is about 23 inches thick. The upper part is light olive brown, friable loam, and the lower part is brown and grayish brown, firm loam and clay loam. The substratum to a depth of 60 inches is grayish brown, mottled loam.

Marlette soils are undulating. Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is brown loam with fine sandy loam coatings, and the lower part is dark yellowish brown and brown, firm clay loam. The substratum to a depth of 60 inches is brown loam.

Colwood soils are nearly level. Typically, the surface and subsurface layers are black loam and silty clay loam about 15 inches thick. The subsoil is about 11 inches thick. It is dark gray, firm silty clay loam. The substratum to a depth of 60 inches is multicolored, stratified fine sandy loam, loam, silty clay loam, and clay loam.

Minor in this association are the poorly drained and very poorly drained Brookston soils, the well drained Oshtemo soils, and the somewhat poorly drained Aubbeenaubbee soils. Brookston soils occupy positions similar to those of Colwood soils. Oshtemo soils are in positions similar to those of Marlette soils or are slightly higher. Aubbeenaubbee soils occupy positions similar to those of Capac soils.

This association is used mainly as cropland. It contains some of the best agricultural land in the county. Some areas are wooded. Excess water is the main limitation. Unless adequately drained, Colwood soils are too wet for most uses.

This association has good potential for cropland, pasture, and woodland. Capac soils have fair potential for recreation and fair to poor potential for most engineering uses. Colwood soils have poor potential for recreation and for most engineering uses. Marlette soils have good potential for recreation, sanitary facilities, and building sites.

6. Marlette-Oshtemo-Capac association

Nearly level to steep, well drained to somewhat poorly drained loamy and sandy soils

This association is on till plains, outwash plains, and moraines. It makes up about 21 percent of the county. It is about 25 percent Marlette or similar soils, 15 percent Oshtemo or similar soils, 15 percent Capac or similar soils, and 45 percent soils of minor extent.

Marlette soils are on hills and higher broad plains with slight knolls and ridges. Oshtemo soils are in positions similar to those of Marlette soils and in some lower areas. Capac soils are in low broad areas and along minor drainageways.

Marlette soils are well drained and moderately well drained. Oshtemo soils are well drained. Capac soils are somewhat poorly drained. Marlette and Capac soils have moderate and moderately slow permeability and a high available water capacity. Oshtemo soils have moderately rapid permeability and a low available water capacity.

Marlette soils are undulating to steep. Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is brown loam with fine sandy loam coatings, and the lower part is dark yellowish brown and brown, firm clay loam. The substratum to a depth of 60 inches is brown loam.

Oshtemo soils are undulating to rolling. Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is dark yellowish brown and yellowish brown sandy loam about 7 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable sandy loam and the lower part is yellowish brown, loose and very friable loamy sand and sand. The substratum to a depth of 60 inches is brown gravelly sand.

Capac soils are nearly level and undulating. Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is mottled and is about 23 inches thick. The upper part is light olive brown, friable loam, and the lower part is brown and grayish brown, firm loam and clay loam. The substratum to a depth of 60 inches is grayish brown, mottled loam.

Minor in this association are the somewhat poorly drained Brady soils, the poorly drained Houghton soils, and the poorly drained and very poorly drained Colwood and Brookston soils. Brady soils are in low areas, in slight depressions, and along minor drainageways. Houghton, Colwood, and Brookston soils are in depressional areas and in drainageways.

This association is mainly cropland. Some areas are pasture and woodland. The main limitations are an erosion hazard on Marlette soils, droughtiness and erosion on Oshtemo soils, and excess water on Capac soils. Most of the rolling and steep areas are woodland and pasture. Oshtemo soils are suited to irrigation.

The nearly level and undulating areas have good potential for cropland. Oshtemo soils have fair potential. This association has good potential for pasture and woodland. The nearly level and undulating areas of Marlette and Oshtemo soils have good potential for most kinds of recreation and for most engineering uses. The sloping to steep areas of this association have good potential for woodland and pasture and fair or poor potential for all other uses. Capac soils have fair potential for most kinds of recreation and fair to poor potential for sanitary facilities and building sites. Oshtemo soils are a good source of sand and gravel.

7. Riddles-Hillsdale-Aubbeenaubbee association

Nearly level to hilly, well drained and somewhat poorly drained loamy soils

This association (fig. 5) is on till plains and moraines. It makes up about 4 percent of the county. It is about 25 percent Riddles or similar soils, 20 percent Hillsdale or similar soils, 20 percent Aubbeenaubbee soils, and 35 percent soils of minor extent.

Riddles and Hillsdale soils are on knolls, in higher broad areas, and on ridges. Aubbeenaubbee soils are in broad low areas, along drainageways, and in shallow depressions.

Riddles and Hillsdale soils are well drained. Aubbeenaubbee soils are somewhat poorly drained. Riddles soils have moderate permeability and a high available water capacity. Hillsdale soils have moderate and moderately rapid permeability and a moderate available water capacity. Aubbeenaubbee soils have moderate permeability in the upper part of the solum and moderately slow permeability in the lower part. They have a high available water capacity.

Riddles soils are undulating to hilly. Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 14 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown and brown, firm sandy clay loam and clay loam, and the lower part is dark yellowish brown, friable sandy loam. The substratum to a depth of about 66 inches is yellowish brown sandy loam.

Hillsdale soils are undulating to hilly. Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 2 inches thick. The subsoil is yellowish brown and dark yellowish brown, dominantly friable sandy loam. It is about 56 inches thick.

Aubbeenaubbee soils are nearly level and undulating. Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mottled brown sandy loam about 9 inches thick. The subsoil is mottled and is about 18 inches thick. It is brown, friable sandy loam in the upper part and brown, firm clay loam in the lower part. The substratum to a depth of 60 inches is mottled brown loam.

Minor in this association are the well drained Spinks soils, the well drained and moderately well drained Marlette soils, the somewhat poorly drained Capac soils, and the poorly drained and very poorly drained Colwood soils. Marlette and Spinks soils are in positions similar to those of Riddles soils. Capac soils are in positions similar to those of Aubbeenaubbee soils. Colwood soils are in depressional areas and drainageways.

This association is mainly cropland. Some areas are woodland and pasture. The main limitations are an erosion hazard on Riddles and Hillsdale soils, droughtiness on Hillsdale soils, and a seasonal high water table in Aubbeenaubbee soils. Many of the rolling and hilly areas are pasture and woodland. Many of the undulating areas are suited to irrigation.

This association has good to fair potential for cropland and good potential for pasture and woodland. Aubbeenaubbee soils have fair potential for most kinds of recreation and for sanitary facilities and building sites. Riddles and Hillsdale soils generally have good potential for most kinds of recreation. In the rolling and hilly areas, the potential is fair or poor because of the slope. Excess water is a limitation to most uses of Aubbeenaubbee soils.

Broad land use considerations

Deciding what land should be used for residential development is an important issue in the survey area. Each year a considerable acreage throughout the county is developed for residential use. The general soil map can help in planning the general outline for future residential areas, but it cannot be used in selecting sites for specific residential or other urban type structures. Data on specific soils in this survey also can help in planning future land use patterns.

Areas where the soils are severely limited for residential and other urban development are extensive. Large parts of the Houghton-Palms-Edwards association and the Capac-Marlette-Colwood association and some of the less sloping parts of the Marlette-Capac-Owosso association have a seasonal high water table, which severely limits urban development. The steeper parts of the Oshtemo-Houghton-Riddles association, the Marlette-Oshtemo-Capac association, and the Riddles-Hillsdale-Aubbeenaubbee association are severely limited because of the slope.

Large areas of the county have soils that are less severely limited than the soils previously mentioned and can be developed for urban uses at lower cost. These areas are the less sloping, well drained parts of the Oshtemo-Houghton-Riddles association, the Marlette-Oshtemo-Capac association, and the Riddles-Hillsdale-Aubbeenaubbee association. The Marlette-Capac-Owosso and the Capac-Marlette-Colwood associations have the best potential as farmland and should not be overlooked when broad land uses are considered.

In many areas the soils have good potential for farming but poor potential for nonfarm uses. These areas are identified as soil associations 2, 5, 6, and 7 on the general soil map. In these associations are the Capac, Colwood, and Aubbeenaubbee soils, which have good potential for farming and are some of the best cropland in Ingham County. Wetness is a limitation to farm and nonfarm uses of these soils, but with proper drainage and shaping of the surface, much of this limitation can be overcome.

Specialty crops, especially lettuce, mint, onions, and potatoes, are suited to the soils of the Houghton-Palms-Edwards association.

Most of the soils in the county have good or fair potential for woodland.

The hilly parts of the Oshtemo-Houghton-Riddles association, the Marlette-Oshtemo-Capac association, and the Riddles-Hillsdale-Aubbeenaubbee association have good potential as sites for parks and extensive recreation areas. Hardwood forests enhance the beauty of much of these associations. Undrained marshes and swamps in the Houghton-Palms-Edward and Oshtemo-Houghton-Riddles associations are good as nature study areas. All provide habitat for many species of wildlife.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Capac series, for example, was named for the town of Capac in St. Clair County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Marlette loam, 12 to 18 percent slopes, eroded, is one of several phases within the Marlette series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes and undifferentiated groups.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Marlette-Boyer complex, 18 to 25 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the dominant (named) soils or may have all of them. Udorthents and Udipsamments is an undifferentiated group in this survey area.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Ad—Adrian muck. This very poorly drained, nearly level soil is in depressional areas, in drainageways, and in broad flat areas. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to more than 150 acres.

Typically, the surface layer and subsoil are black muck about 29 inches thick. The substratum to a depth of 60 inches is dark grayish brown and grayish brown sand and gravelly loamy sand. In some small areas, it is marl or moderately coarse to moderately fine textured material.

Included with this soil in mapping are small areas of Houghton soils and small areas of poorly drained and very poorly drained mineral soils. Houghton soils do not have a mineral substratum. They occur as scattered areas throughout the unit and make up about 10 percent of the acreage. The poorly drained and very poorly drained mineral soils are more stable. They are on low knolls and ridges and near the edge of the unit. They make up about 5 percent of the unit.

This Adrian soil has a high water table that rises to within 6 inches of the surface in winter and spring. Permeability is moderately rapid to moderately slow. The available water capacity is high. Surface runoff is very slow or ponded.

Most of the acreage is cropland, woodland, and wildlife habitat. Small areas are permanent pasture. The potential is poor for cropland, recreational uses, and most engineering uses. It is good for pasture and fair for woodland. It is fair for truck and specialty crops.

The major limitations in cropland are excess water, flooding, poor drainage outlets, and unstable soil material. Unless drained, this soil is too wet for crops. If it is drained, soil blowing and subsidence are problems. Windbreaks, crop residue management, and cover crops help to control soil blowing. Controlled drainage reduces subsidence. Tile drainage and deep ditches are needed to remove excess water and improve stability. If placed in the sand substratum, the tile needs blinding. Where drainage outlets are poor, pumping is needed to remove excess water.

Excess water and flooding limits the use of the soil as pasture. Pasturing when the soil is wet causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are the major limitations in woodland. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, the stand should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table and flooding are difficult to overcome.

Capability subclass IVw; Michigan soil management group M/4c.

AnA—Aubbeenaubbee-Capac sandy loams, 0 to 3 percent slopes. These somewhat poorly drained, nearly level and undulating soils are in broad low areas, on low ridges and knolls, along drainageways, and in shallow depressions. Areas are irregular in shape and range from 3 to more than 100 acres. Aubbeenaubbee soils make up 55 percent of this map unit and Capac soils 25 percent. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Aubbeenaubbee soil has a dark grayish brown sandy loam surface layer about 8 inches thick. The subsurface layer is mottled brown sandy loam about 9 inches thick. The subsoil is mottled and about 18 inches thick. It is brown, friable sandy loam in the upper part and brown, firm clay loam in the lower part. The substratum to a depth of 60 inches is mottled brown loam. In some small areas the substratum is coarse textured. In others it is stratified with coarse to moderately fine textured sediments.

Typically, the Capac soil has a dark grayish brown sandy loam surface layer about 8 inches thick. The subsoil is about 23 inches thick and mottled. The upper part is light olive brown, friable loam, and the lower part is brown and grayish brown, firm loam and clay loam. The substratum to a depth of 60 inches is mottled grayish brown loam. In some places this soil has a darker colored surface layer than is typical and lacks the coatings in the upper part of the subsoil. In some small areas depth to the substratum is less than 26 inches.

Included with these soils in mapping are small areas of Owosso, Marlette, and Brookston soils. Owosso and Marlette soils, at the tops of knolls and ridges, are better drained. They make up about 5 to 10 percent of the unit. Brookston soils, in drainageways and depressional areas, are more poorly drained. They make up about 8 percent of the unit.

The seasonal high water table rises to within 1 foot to 3 feet of the surface in the Aubbeenaubbee soil and within 1 foot to 2 feet of the surface in the Capac soil in winter and spring. Permeability in the Aubbeenaubbee soil is moderately rapid in the moderately coarse textured upper layers and moderate in the medium and moderately fine textured lower layers. Permeability in the Capac soil is moderate or moderately slow. For both soils, the available water capacity is high and surface runoff is slow.

Most areas are cropland. Some small areas are woodland and permanent pasture. These soils have good potential as cropland, pasture, and woodland, fair potential for recreational uses, and fair to poor potential for most engineering uses.

The major limitation in cropland is excess water, which delays planting and harvesting in many years. Tile drainage is needed.

The major limitation in pasture is the excess water. Pasturing when the soil is wet causes compaction and poor tilth. Tile drainage is needed.

The major hazard in woodland is plant competition. Herbicides and tillage are needed to control plant competition in new plantations.

The major limitation for recreational use is excess water. These soils are wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitation in using these soils as a building site is the excess water. Septic tank filter fields generally do not function properly because of the high water table. Permeability is an additional limitation if the Capac soil is used as a septic tank absorption field. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. Because the water table is high, dwellings and small buildings should be constructed without basements.

Capability subclass IIIw; Michigan soil management group 3/2b-2.5b.

Au—Aurelius muck. This very poorly drained, nearly level soil is in depressional areas and drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 100 acres.

Typically, the upper layer is black muck about 9 inches thick. Below this is about 4 inches of black sedimentary peat and 17 inches of grayish brown marl. The substratum to a depth of 60 inches is dark gray stratified fine sandy loam, silt loam, and loamy fine sand. In places the muck is less than 8 inches or more than 16 inches thick. In places it is underlain by marl or loamy material.

Included with this soil in mapping are small areas of Houghton and Keowns soils. Houghton soils, near the center of this map unit, are less stable. They make up about 5 percent of the unit. Keowns soils are more permeable. They occur as scattered areas throughout the unit and make up about 5 percent of the acreage.

This Aurelius soil has a high water table that rises to within 6 inches of the surface in winter and spring. Permeability is moderately rapid to moderately slow in the organic material and slow in the marl and sedimentary peat. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland. Small areas are permanent pasture, woodland, and wildlife habitat. The potential is poor for cropland, woodland, recreational uses, and most engineering uses. It is good for pasture.

The major limitations in cropland are the excess water, flooding, poor drainage outlets, and unstable soil material. Unless drained, this soil is too wet for crops. If it is drained, soil blowing, subsidence, and plant nutrient deficiency are problems. Windbreaks, crop residue management, and cover crops help to control soil blowing. Controlled drainage reduces subsidence. Tile drainage and deep ditches are needed to remove excess water and improve stability. If placed in the substratum, the tile requires blinding. Where drainage outlets are poor, pumping is needed to remove excess water. Placing fertilizer in bands increases the supply of nutrients.

Excess water and flooding limit the use of the soil as pasture. Pasturing causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are the major limitations in woodland. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, the stand should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table, flooding, and the instability of the soil are difficult to overcome.

Capability subclass IVw; Michigan soil management group M/MC.

Bo—Boots muck. This very poorly drained, nearly level soil is in depressional areas. It is subject to frequent flooding. Areas are irregular in shape and range from about 10 to 500 acres.

Typically, the surface layer is black muck about 10 inches thick. The underlying layers to a depth of 60 inches are dark brown and dark reddish brown mucky peat. In places this soil is muck throughout.

Included with this soil in mapping are many small areas of Adrian, Edwards, and Palms soils, mostly near the edges of this map unit. Adrian, Edwards, and Palms soils have layers within 51 inches that make drainage more difficult. These included soils make up 5 to 10 percent of the unit.

This Boots soil has a high water table that rises to within 6 inches of the surface in winter and spring. Permeability is moderate or moderately rapid. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland, woodland, and wildlife habitat. Small areas are permanent pasture. The potential is fair for cropland and woodland, good for pasture, and poor for recreational uses and most engineering uses. It is fair for truck and specialty crops.

The major limitations in cropland are the excess water, flooding (fig. 7), poor drainage outlets, and unstable soil material. Unless drained, this soil is too wet for crops. If it is drained, soil blowing and subsidence are hazards. Tile drainage and deep ditches are needed to remove excess water and improve stability. Where drainage outlets are poor, pumping is needed to remove excess water. Windbreaks and crop residue management reduce subsidence.

Excess water and flooding limit the use of the soil as pasture. Pasturing when the soil is wet causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are the major limitations in woodland. Equipment limitations, seedling mortality, windthrow hazard, and plant competition are severe. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, the stand should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table, the flooding, and the instability of the soil are difficult to overcome.

Capability subclass IVw; Michigan soil management group Mc.

BrB—Boyer sandy loam, 0 to 6 percent slopes. This well drained, nearly level and undulating soil is on broad complex slopes, on low ridges, and on knolls. Areas are irregular in shape and range from 3 to more than 120 acres.

Typically, the surface layer is dark brown sandy loam about 8 inches thick. The subsurface layer is brown loamy sand about 6 inches thick. The friable, strong brown subsoil is about 14 inches thick. The upper part is sandy loam, and the lower part is gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown gravelly sand. Depth to the substratum is extremely variable within short distances. In some small areas it is less than 22 inches or more than 40 inches. Some areas have more clay in the subsoil.

Included with this soil in mapping are small areas of Brady and Matherton soils. Brady and Matherton soils, on foot slopes and in shallow depressions and in drainageways, are less well drained than this Boyer soil. They make up 5 to 10 percent of this map unit.

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

Most areas are cropland. Small areas are woodland. The potential is fair for cropland and good for pasture, woodland, recreational uses, and most engineering uses.

The major limitation in cropland is drought. Cover crops, green manure crops, crop residue management, manure, and no till cropping systems conserve moisture. The soil is suited to irrigation.

This soil is suitable for pasture. Rotational grazing or strip grazing is needed during dry periods.

The major hazard in woodland is plant competition. Cultivation and herbicides are needed to control plant competition in new plantations.

This soil is suitable as a building site. Seepage is a problem in sewage lagoons because of the very permeable substratum. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water. Septic tank absorption fields may pollute the ground water as a result of the moderately rapid permeability of the soil.

Capability subclass IIIs; Michigan soil management group 4a.

BsD—Boyer-Spinks loamy sands, 12 to 18 percent slopes. These well drained, hilly soils are in pitted areas and along streams and drainageways. Areas are irregular in shape and range from 3 to 30 acres. Boyer soils are at the tops of ridges and knolls, on upper side slopes, and at mid slope. They make up about 40 percent of this map unit. Spinks soils are at mid slope, on lower side slopes, and on broader ridgetops. They make up about

30 percent of the unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Boyer soil has a very dark grayish brown loamy sand surface layer about 5 inches thick. The subsurface layer is yellowish brown loamy sand about 6 inches thick. The friable subsoil is about 12 inches thick. The upper part is dark brown sandy loam, and the lower part is yellowish brown, loose loamy sand. The substratum to a depth of 60 inches is brown stratified sand and gravelly sand. Depth to the substratum is extremely variable within short distances. In many small areas it is less than 22 inches. In some small areas it is more than 40 inches.

Typically, the Spinks soil has a very dark grayish brown loamy sand surface layer about 5 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, loose loamy sand, and the lower part is light yellowish brown, loose sand with bands of yellowish brown, friable loamy sand and light sandy loam. The substratum to a depth of 60 inches is light yellowish brown sand. In some small areas the total thickness of bands in the subsoil is less than 6 inches. In many small areas depth to the substratum is less than 36 inches.

Included with these soils in mapping are small areas of soils that have more clay in the subsoil. These included soils are on ridgetops, on the tops of knolls, and on upper side slopes. They make up 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. In the Spinks soil it is moderately rapid or rapid. For both soils, the available water capacity is low and surface runoff is medium.

Most areas are woodland and permanent pasture. Some small areas are cropland. These soils have poor potential for cropland and most engineering uses, good potential for pasture and woodland, and fair to poor potential for recreational uses.

The major hazards in cropland are erosion, drought, and soil blowing. Contour farming, stripcropping, close growing crops, no till cropping systems, cover crops, crop residue management, and manure help to control erosion and soil blowing and conserve soil moisture.

These soils are suitable for pasture. Rotational grazing or strip grazing is needed during dry periods.

The major limitations in woodland are erosion, equipment limitations, seedling mortality, and plant competition. Logging trails and plantation rows on the contour reduce the risk of erosion and help to overcome the equipment limitation. Herbicides are needed to control plant competition and increase seedling survival.

The major limitation for most recreational uses is slope. Paving the paths and trails with wood chips improves trafficability and reduces erosion. Constructing trails on the contour helps to control erosion.

The major limitations in using these soils as sites for buildings and sanitary facilities are the slope, the possible pollution of ground water from septic tank absorption fields, and the instability of the soil. The slope limitation can be reduced by land shaping and constructing roads and streets on the contour. Shoring walls helps to prevent cave ins.

Capability subclass IVe; Michigan soil management group 4a.

BsE—Boyer-Spinks loamy sands, 18 to 30 percent slopes. These well drained, steep and very steep soils are in pitted areas and along streams and drainageways. Areas are generally irregular in shape. Some are long and narrow. They range from 3 to 25 acres. Boyer soils are on ridgetops on the tops of knolls, on upper side slopes, and at mid slope. They make up 35 percent of this map unit. Spinks soils are at mid slope, on lower side slopes, and on broader ridgetops. They make up 25 percent of the unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Boyer soil has a very dark grayish brown loamy sand surface layer about 5 inches thick. The subsurface layer is yellowish brown loamy sand about 6 inches thick. The subsoil is about 12 inches thick. The upper part is dark brown, friable sandy loam, and the lower part is yellowish brown, loose loamy sand. The substratum to a depth of 60 inches is brown stratified sand and gravelly sand. Depth to the substratum is extremely variable within short distances. In many small areas it is less than 22 inches. In some small areas it is more than 40 inches.

Typically, the Spinks soil has a very dark grayish brown loamy sand surface layer about 5 inches thick. The subsoil is about 33 inches thick. The upper part is yellowish brown, loose loamy sand, and the lower part is light yellowish brown, loose sand with bands of yellowish brown, friable loamy sand and sandy loam. The substratum to a depth of 60 inches is light yellowish brown sand. In some small areas the total thickness of the loamy sand and sandy loam bands in the subsoil is less than 6 inches. In many small areas depth to the substratum is less than 36 inches.

Included with these soils in mapping are small areas of Marlette, Metea, and Owosso soils. These included soils are less droughty than the Boyer and Spinks soils. They occur as scattered areas throughout the unit. They make up 15 to 20 percent of the unit.

Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. In the Spinks soil it is moderately rapid or rapid. For both soils, the available water capacity is low and surface runoff is medium or rapid.

Most areas are woodland and wildlife habitat. Small areas are permanent pasture. These soils have poor potential for cropland, most engineering uses, and most recreational uses. They have fair potential for pasture and good potential for woodland.

The major hazards in cropland are erosion, drought, and soil blowing. Cropping these soils is generally impractical because of the steep slopes.

The major limitations in pasture are the droughtiness and steep slopes. Rotational grazing or strip grazing is needed during dry periods.

The major limitations in woodland are erosion, equipment limitations, and plant competition. Constructing logging trails on the contour helps to control erosion and overcome the equipment limitation. Herbicides are needed to control plant competition on new plantings. Seedlings have to be planted by hand in most places.

The major limitation for recreational use is the slope. Paving the paths and trails improves trafficability and reduces erosion. Constructing trails on the contour helps to control erosion.

The major limitation in using these soils as sites for buildings and sanitary facilities is the slope. The chief hazards are the possible pollution of ground water from septic tank absorption fields and the cave in of walls cut in excavations. Shoring walls helps to prevent cave ins.

Capability subclass VIe; Michigan soil management group 4a.

ByA—Brady sandy loam, 0 to 3 percent slopes. This somewhat poorly drained, nearly level and undulating soil is in broad low areas, in depressional areas, and along drainageways. Areas are irregular in shape and range from 3 to about 100 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsurface layer is mottled grayish brown sandy loam about 5 inches thick. The subsoil is 48 inches thick. It also is mottled. The upper part is grayish brown, friable sandy loam, the next part is brown, very friable loamy sand, and the lower part is dark yellowish brown, loose sand. The substratum to a depth of about 68 inches is yellowish brown, loose gravelly sand. In some small areas the depth to the substratum is between 30 and 40 inches.

Included with this soil in mapping are small areas of Oshtemo and Gilford soils. Oshtemo soils, on slightly higher knolls, are better drained than this Brady soil. They make up about 5 percent of this map unit. Gilford soils, in the more depressional areas and in drainageways, are more poorly drained. They make up about 5 percent of the unit.

This Brady soil has a seasonal high water table within 1 foot to 3 feet of the surface in winter and spring. Permeability is moderately rapid in the upper part of the soil and very rapid in the lower part. The available water capacity is moderate. Surface runoff is slow.

Most areas are cropland. Small areas are woodland and permanent pasture. The potential is fair for cropland and recreational uses, good for pasture and woodland, and poor for most engineering uses.

The major limitation in cropland is the excess water, which delays planting and harvesting in many years. Tile drainage is needed. If drained, the soil is slightly droughty. Cover crops, green manure crops, crop residue management, manure, and no till cropping systems conserve moisture.

The major limitation in pasture is the excess water. Pasturing when the soil is wet causes compaction and poor tilth. Tile drainage is needed.

The major hazard in woodland is plant competition. Herbicides and tillage help to control plant competition in new plantations.

The major limitation for recreational uses is the excess water. This soil is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitations in using this soil as a building site are the excess water and the instability of the soil when excavated. Septic tank filter fields generally do not function properly because of the high water table. Seepage is a problem in sewage lagoons. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water. Because of the water table and the moderately rapid permeability of the soil, commercial sewers should be used if they are available. Septic tank absorption fields may pollute the ground water. Constructing buildings with basements should be avoided. Walls cut in excavations tend to cave. Shoring walls and pumping out excess water help to prevent cave ins.

Capability subclass IIw; Michigan soil management group 4b.

CaA—Capac loam, 0 to 3 percent slopes. This somewhat poorly drained, nearly level and undulating soil is in broad low areas and depressional areas and along minor drainageways. Areas are irregular in shape and range from 3 to 300 acres.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is mottled and is about 23 inches thick. The upper part is light olive brown, friable loam, and the lower part is brown and grayish brown, firm loam and clay loam. The substratum to a depth of 60 inches is mottled grayish brown loam. In many small areas, the surface layer is slightly darker than is typical and the faces of peds in the upper part of the subsoil do not have brown coatings.

Included with this soil in mapping are small areas of Colwood, Marlette, and Owosso soils. Colwood soils, in depressional areas and in drainageways, are more poorly drained than this Capac soil. Marlette and Owosso soils, on knolls and ridges, are better drained. Included soils make up 10 to 15 percent of this map unit.

This Capac soil has a seasonal high water table within 1 foot to 2 feet of the surface in winter and spring. Permeability is moderate or moderately slow. The available water capacity is high. Surface runoff is slow.

Most areas are cropland. Some small areas are woodland and permanent pasture. The potential is good for cropland, pasture, and woodland, fair for recreational uses, and fair to poor for most engineering uses.

The major limitation in cropland is the excess water, which delays planting and harvesting in many years. Tile and surface drains are needed.

The major limitation in pasture is the excess water. Pasturing when the soil is wet causes compaction and poor tilth. Tile drainage is needed.

The major hazard in woodland is plant competition. Herbicides and tillage help to control plant competition in new plantations.

The major limitation for recreational uses is the excess water. The soil is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitation in using this soil as a building site is the excess water. Septic tank filter fields do not function properly because of the high water table. Permeability also is a limitation. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available.

Capability subclass IIw; Michigan soil management group 2.5b.

Ce—Ceresco fine sandy loam. This somewhat poorly drained, nearly level soil is on flood plains along streams and rivers. It is subject to frequent flooding. Areas are long or irregular in shape. They range from 3 to 100 acres.

Typically, the surface layer is very dark gray fine sandy loam about 15 inches thick. The mottled, friable subsoil is about 33 inches thick. The upper part is stratified dark brown and very dark grayish brown very fine sandy loam. The next part is dark yellowish brown very fine sandy loam. The lower part is grayish brown fine sandy loam. The substratum to a depth of 60 inches is mottled stratified very dark gray and dark grayish brown loamy fine sand. In some small areas this soil has more clay in the profile. In some small areas the upper part of the subsoil has no mottles, and in other small areas the subsoil is grayer.

Included with this soil in mapping are small areas of Gilford soils. Gilford soils, in drainageways and depressional areas, are more poorly drained. They make up about 5 percent of this map unit.

This Ceresco soil has a seasonal high water table within 1 foot to 2 feet of the surface in winter and spring. Permeability is moderate or moderately rapid. The available water capacity is moderate. Surface runoff is very slow or ponded.

Most areas are woodland, permanent pasture, and wildlife habitat. Some small areas are cropland. The potential is fair for cropland and recreational uses, good for pasture and woodland, and poor for most engineering uses.

The major limitations in cropland are the excess water and the flooding. Dikes, levees, deep ditches, and tile drains are needed. Many areas have poor drainage outlets. Many are so small that installing drainage and flood protection would be impractical.

The major limitations in pasture are the excess water and the flooding. Pasturing when this soil is wet causes compaction and damages the sod. Rotating pastures and deferred grazing are needed.

The major hazard in woodland is plant competition. Herbicides and tillage help to control plant competition in new plantations.

The major limitations for recreational uses are the excess water and the flooding. This soil is frequently flooded and is wet and muddy during wet periods and after heavy rains. Surface and tile drains are needed. Picnic areas, playgrounds, paths, and trails are generally not damaged by floodwater, but they cannot be used while flooded. Camp areas, however, should not be located on this soil unless they are protected from flooding.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table and flooding are difficult to overcome.

Capability subclass Vw; Michigan soil management group L-2c.

Ch—Cohoctah silt loam. This poorly drained and very poorly drained, nearly level soil is in low areas along streams and rivers. It is subject to frequent flooding. Areas are long and range from about 3 to 100 acres.

Typically, the surface and subsurface layers are very dark grayish brown silt loam 19 inches thick. The substratum is dark grayish brown loam in the upper part, dark grayish brown and dark brown sandy loam in the next part, and olive gray loamy sand in the lower part. In some small areas there is a muck surface layer 6 to 16 inches thick.

Included with this soil in mapping are small areas of Palms soils. Palms soils, in depressional areas throughout this map unit, have a muck layer more than 16 inches thick. They make up about 5 to 10 percent of the unit.

This Cohoctah soil has a high water table within 1 foot of the surface in winter and spring. Permeability is moderately rapid. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are woodland and wildlife habitat. A few small areas are cropped. The potential is poor for cropland, recreational uses, and most engineering uses. It is fair for pasture and woodland.

The major limitations in cropland are the excess water and the flooding. Dikes, levees, deep ditches, and tile drains are needed. Many areas have poor drainage outlets. Many are so small that installing drainage and flood protection would be impractical.

The major limitations in pasture are the excess water and the flooding. Pasturing when this soil is wet causes compaction and damages the sod. Rotating pastures and deferred grazing should be considered.

The major limitations in woodland are the equipment limitations, seedling mortality, plant competition, and windthrow hazard. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, the stand should be only slightly thinned by cutting. Mature stands can be clear cut.

The major limitations for recreational uses are wetness and flooding. The soil is frequently flooded and is wet during wet periods and after rains. Surface and tile drains are needed. Picnic areas, playgrounds, paths, and trails are generally not damaged by floodwater, but they cannot be used while flooded. Camp areas, however, should not be located on this soil unless they are protected from flooding.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table and flooding are difficult to overcome.

Capability subclass Vw; Michigan soil management group L-2c.

Co—Colwood-Brookston loams. These poorly drained and very poorly drained, nearly level soils are in depressional areas and in drainageways. They are subject to frequent flooding. Areas are long or irregular in shape and range from 3 to 500 acres. Colwood and Brookston soils occur throughout this map unit. They make up about 45 and 35 percent of the unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Colwood soil has a black loam surface layer and a silty clay loam subsurface layer about 15 inches thick. The subsoil is dark gray, firm silty clay loam about 11 inches thick. The substratum to a depth of 60 inches is multicolored, stratified fine sandy loam, loam, silty clay loam, and clay loam. In places it is sand or gravelly sand.

Typically, the Brookston soil has a black surface layer and a very dark gray loam subsurface layer about 13 inches thick. The subsoil is about 29 inches thick. The upper part is dark gray, friable clay loam. The next part is dark gray, firm clay loam. The lower part is gray, firm clay loam. The substratum to a depth of 60 inches is yellowish brown loam. In places the surface layer is less than 10 inches thick. In some small areas it is muck. In places depth to effervescent material is less than 24 inches.

Included with these soils in mapping are small areas of Capac, Kibbie, and Aubbeenaubbee soils. These included soils, on low ridges and knolls, are better drained than Colwood and Brookston soils. They make up about 15 percent of the unit.

These Colwood and Brookston soils have a high water table within 1 foot of the surface in winter and spring. Permeability is moderate. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland. Small areas are woodland, permanent pasture, and wildlife habitat. The soils have good potential for cropland, pasture, and woodland. They have poor potential for recreational uses and most engineering uses.

The major limitations in cropland are the excess water and the flooding. Unless drained, these soils are too wet for crops. Tile and surface drains are needed.

The major limitations in pasture are the excess water and the flooding. Pasturing when these soils are wet causes compaction and damages the sod. Tile and surface drains are needed.

The major limitations in woodland are the equipment limitations, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, the stand should be only slightly thinned. Mature stands can be clear cut.

The major limitations for recreational uses are the excess water and the flooding. These soils are frequently flooded and are wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitations in using these soils as sites for buildings and sanitary facilities are the excess water and the flooding. Septic tank filter fields generally do not function properly because of the high water table and the flooding. These limitations are difficult to overcome.

Capability subclass IIw; Michigan soil management groups 2.5c-s, 2.5c.

Ed—Edwards muck. This very poorly drained, nearly level soil is in depressional areas and drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 175 acres.

Typically, the upper layer is black muck about 29 inches thick. The substratum to a depth of 60 inches is light gray and gray marl. In small areas it is moderately coarse to moderately fine textured.

Included with this soil in mapping are small areas of Houghton soils. Houghton soils are more permeable than this Edwards soil. They occur as scattered areas throughout this map unit and make up about 5 percent of the acreage.

This Edwards soil has a high water table that rises to within 6 inches of the surface in winter and spring. Permeability is moderately slow to moderately rapid in the organic material and is variable in the marl. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland, woodland, and wildlife habitat. Small areas are permanent pasture. The potential is poor for cropland, recreational uses, and most engineering uses. It is fair for woodland and good for pasture. The soil has potential for truck and specialty crops.

The major limitations in cropland are the excess water, flooding, and unstable soil material. Drainage outlets are poor in many places. If the soil is drained, soil blowing and subsidence are hazards. Windbreaks, crop residue management, and cover crops help to control soil blowing. Controlled drainage reduces subsidence. Tile drainage and deep ditches are needed to remove excess water and improve stability. Where drainage outlets are poor, pumping is needed to remove excess water. Permeability can be a problem in places where tile is placed in the marl substratum.

Excess water and flooding limit the use of the soil as pasture. Pasturing when the soil is wet causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are limitations in woodland. The equipment limitation, seedling mortality, windthrow hazard, and plant competition are severe. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, the stand should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table, flooding, and the instability of the soil are difficult to overcome.

Capability subclass IVw; Michigan soil management group M/mc.

EvB—Eleva Variant channery sandy loam, 2 to 6 percent slopes. This well drained and moderately well drained, gently sloping soil is on broad terraces along major drainageways. Areas are irregular in shape and range from 3 to 100 acres.

Typically, the surface layer is dark grayish brown channery sandy loam about 8 inches thick. The subsurface layer is yellowish brown channery sandy loam about 6 inches thick. The subsoil is dark yellowish brown, friable channery sandy loam about 14 inches thick. Bedrock at 28 inches is dark reddish gray and yellowish brown sandstone. In places the depth to the substratum is less than 20 inches. In some areas the subsoil does not have sandstone fragments. In some small areas the soil is somewhat poorly drained.

Included with this soil in mapping are small areas of Brady, Kibbie, Hillsdale, and Oshtemo soils. Hillsdale and Oshtemo soils do not have bedrock within 60 inches of the surface. They occur as scattered areas throughout this map unit and make up about 10 percent of the acreage. Brady and Kibbie soils, on concave slopes and along drainageways, are less well drained. They make up 10 percent of the unit.

This Eleva variant soil has a seasonal high water table that is more than 2 1/2 feet below the surface in winter and spring. Permeability is moderately rapid. The available water capacity is low. Surface runoff is slow.

Most areas are cropland. Small areas are permanent pasture. The potential is fair for cropland, good for pasture, woodland, and recreational uses, and poor for most engineering uses.

The major hazard in cropland is drought. Rock fragments hinder tillage in some places. Cover crops, green manure crops, crop residue management, and no till cropping systems help to conserve soil moisture.

This soil is suitable for pasture. Rotation grazing or strip grazing is needed during dry periods.

This soil is suitable for woodland. To minimize windthrow damage, stands should be only slightly thinned.

The major limitation for most recreational uses is the small stones on the surface. Leveling is difficult because of the small stones throughout the soil.

The depth to rock limits this soil as a site for buildings and septic tank absorption fields. Seepage is a problem in sewage lagoons. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water.

Capability subclass IIIs; Michigan soil management group 3/Ra.

Gf—Gilford sandy loam. This very poorly drained, nearly level soil is in depressional areas, in broad low areas, and in drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 300 acres.

Typically, the surface layer is black sandy loam about 10 inches thick. The mottled subsoil is about 29 inches thick. The upper part is dark gray, very friable sandy loam. The next part is dark gray, firm sandy loam. The lower part is dark grayish brown, friable, stratified sandy loam and loamy sand. The substratum to a depth of 60 inches is mottled grayish brown fine sand and light olive brown gravelly loamy sand. In many areas the substratum is medium textured or moderately fine textured. In some small areas the soil has more clay in the subsoil.

Included with this soil in mapping are small areas of Brady and Palms soils. Brady soils, on low knolls and ridges, are better drained than this Gilford soil. They make up 5 to 10 percent of this map unit. Palms soils, in the more concave areas of this unit, are less stable. They make up about 5 percent of the unit.

This Gilford soil has a high water table within 1 foot of the surface in winter and spring. Permeability is moderately rapid. The available water capacity is moderate. Surface runoff is very slow or ponded.

Most areas are cropland. Small areas are woodland, permanent pasture, and wildlife habitat. The potential is good for cropland, pasture, and woodland. It is poor for recreational uses and most engineering uses.

The major limitations in cropland are the excess water and the flooding. Unless drained, this soil is too wet for crops. If drained, it is slightly droughty. Tile and surface drains are needed. Cover crops, green manure crops, crop residue management, and no till cropping systems conserve soil moisture.

The major limitations in pasture are the excess water and the flooding. Pasturing when this soil is wet causes compaction and damages the sod. Tile and surface drains are needed.

The major limitations in woodland are the equipment limitation, seedling mortality, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned. Mature stands can be clear cut.

The major limitations for most recreational uses are the excess water and the flooding. The soil is frequently flooded and is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitations in using the soil as a site for buildings and sanitary facilities are the excess water and the flooding. Septic tank filter fields do not function properly because of the high water table and the flooding. Seepage is a problem in sewage lagoons. Deep ditches and tile drains are needed to lower the water table.

Capability subclass IIw; Michigan soil management group 4c.

Gr—Granby loamy fine sand. This poorly drained and very poorly drained, nearly level soil is in depressional areas, in broad low areas, and in drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 15 acres.

Typically, the surface layer is black loamy fine sand about 10 inches thick. The subsoil is mottled, very friable loamy fine sand about 38 inches thick. The upper part is dark gray, and the lower part is grayish brown. The substratum to a depth of 60 inches is mottled grayish brown gravelly sand. In some small areas the surface layer is less than 10 inches thick.

Included with this soil in mapping are small areas of Adrian, Colwood, Keowns, Sebewa, and Thetford soils. Adrian soils, in the more concave areas of this map unit, are less stable than this Granby soil. They make up about 5 percent of the unit. Colwood, Keowns, and Sebewa soils are less droughty and less subject to soil blowing when drained. They occur as scattered areas throughout the unit and make up 10 percent of the acreage. Thetford soils, on low knolls and ridges, are better drained. They make up about 2 to 5 percent of the unit.

This Granby soil has a high water table within 1 foot of the surface in winter and spring. Permeability is rapid. The available water capacity is low. Surface runoff is very slow or ponded.

Most areas are cropland. Small areas are woodland, permanent pasture, and wildlife habitat. The potential is fair for cropland and woodland, good for pasture, and poor for recreational uses and most engineering uses.

The major limitations in cropland are the excess water and the flooding. Unless drained, this soil is too wet for crops. If drained, it is droughty and subject to soil blowing. Tile and surface drains are needed. Cover crops, green manure crops, crop residue management, and no till cropping systems help to conserve moisture and control soil blowing.

The major limitations in pasture are the excess water and the flooding. Pasturing when this soil is wet causes compaction and damages the sod. Tile and surface drains are needed.

The major limitations in woodland are the equipment limitation, seedling mortality, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned. Mature stands can be clear cut.

The major limitations for most recreational uses are the excess water and the flooding. This soil is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table. If drained, the sandy surface layer is loose.

The major limitations in using this soil as a site for buildings and sanitary facilities are the excess water and the flooding. Seepage and excess water are problems in sewage lagoons. Septic tank filter fields do not function properly because of the high water table and the flooding.

Capability subclass IIIw; Michigan soil management group 5c.

Ha—Histosols and Aquents, ponded. These are nearly level, very poorly drained organic soils and mineral soils of coarse to moderately fine textured material. They are on bottom lands, along the edges of lakes, and in depressional areas. They are flooded most of the time. Areas range from 3 to about 100 acres.

The natural vegetation is mostly marsh grass, sedge, cattail, pond lily, and reed. Shrubs that tolerate wetness grow in some places.

Included with these soils in mapping are small scattered areas of open water. These areas occur throughout this map unit and make up 5 to 10 percent of the acreage.

The water table is at or above the surface of these soils most of the year. Permeability and available water capacity are variable. Surface runoff is ponded.

Most areas provide habitat for wildlife. The potential is poor for cropland, pasture, woodland, recreational uses, and most engineering uses.

The major limitations are the flooding and the high water table. Drainage is generally not feasible. The soils are too wet for most crops, pasture grasses, and trees.

Because of the high water table and the unstable organic soils, building site development is generally not feasible.

Not assigned to capability or management groups.

Hn—Houghton muck. This very poorly drained, nearly level soil is in depressional areas, in areas surrounding lakes, and in drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 300 acres.

Typically, the surface layer is black muck about 8 inches thick. The underlying layers to a depth of 60 inches are dark reddish brown and black muck. In places more than 2 inches of sedimentary peat is within 51 inches of the surface.

Included with this soil in mapping are small areas of Palms, Adrian, Edwards, and Napoleon soils. Palms, Adrian, and Edwards soils have layers within 51 inches that make drainage more difficult. They occur as scattered areas throughout this map unit and make up 10 percent of the acreage. Napoleon soils, in areas away from moving water, are more acid than this Houghton soil. They make up about 5 percent of the unit.

This Houghton soil has a high water table that rises to within 1 foot of the surface in winter and spring. Permeability is moderately slow to moderately rapid. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland, woodland, and wildlife habitat. Small areas are permanent pasture. The potential is fair for cropland and woodland, good for pasture, and poor for recreational uses and most engineering uses. It is good for truck and specialty crops.

The major limitations in cropland are the excess water, flooding, poor drainage outlets, and unstable soil material. If the soil is drained, soil blowing and subsidence are hazards. Tile drainage and deep ditches are needed. Where drainage outlets are poor, pumping is needed. Windbreaks, crop residue management, and cover crops help to control soil blowing. Controlled drainage reduces subsidence.

Excess water and flooding limit the use of the soil as pasture. Pasturing causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are the major limitations in woodland. The equipment limitation, seedling mortality, windthrow hazard, and plant competition are severe. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival.

To minimize windthrow damage, stands should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table, flooding, and the instability of the soil are difficult to overcome.

Capability subclass IIIw; Michigan soil management group Mc.

Ka—Keowns very fine sandy loam. This poorly drained, nearly level soil is in depressional areas and drainageways. It is subject to frequent flooding. Areas are long or irregular in shape and range from 3 to 500 acres.

Typically, the surface layer is very fine sandy loam about 10 inches thick. The subsoil is about 19 inches thick, and it is mottled. The upper part is dark grayish brown, friable fine sandy loam. The next part is grayish brown, friable fine sandy loam. The lower part is light yellowish brown, very friable, stratified very fine sandy loam and loamy very fine sand. The substratum to a depth of 60 inches is mottled brownish gray, stratified fine sand, loamy very fine sand, and very fine sandy loam. In places this soil contains strata of sand, coarse sand, or gravelly sand. In places the surface layer is less than 10 inches thick.

Included with this soil in mapping are small areas of Brady, Kibbie, and Palms soils. Kibbie and Brady soils, on low ridges and knolls, are less poorly drained than this Keowns soil. They make up about 10 to 15 percent of this map unit. Palms soils, in slightly more depressional areas, are less stable. They make up 5 percent of the unit.

This Keowns soil has a high water table within 1 foot of the surface in winter and spring. Permeability is moderate. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland. Small areas are permanent pasture, wildlife habitat, and woodland. The potential is fair for cropland, good for pasture and woodland, and poor for recreational uses and most engineering uses.

The major limitations in cropland are the excess water and the flooding. Unless drained, this soil is too wet for crops. Tile and surface drains are needed. This soil tends to plug tile drains unless they are blinded.

The major limitations in pasture are the excess water and the flooding. Pasturing when this soil is wet causes compaction and damages the sod. Tile and surface drains are needed.

The major limitations in woodland are the equipment limitation, seedling mortality, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned. Mature stands can be clear cut.

The major limitations in using this soil as a site for buildings, sanitary facilities, and sewage lagoons are the excess water and the flooding. Septic tank filter fields do not function properly because of the high water table and flooding. Seepage is a problem in sewage lagoons unless the bottom of the lagoons is sealed with impermeable material.

Capability subclass IIIw; Michigan soil management group 3c-s.

KbA—Kibbie loam, 0 to 3 percent slopes. This somewhat poorly drained, nearly level and undulating soil is in broad low areas, on low ridges and knolls, along drainageways, and in shallow depressions. Areas are irregular in shape and range from 3 to 100 acres.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 17 inches thick, and it is mottled. The upper part is dark brown, friable clay loam. The next part is dark brown, firm silty clay loam. The lower part is yellowish brown, friable sandy clay loam. The substratum to a depth of 60 inches is mottled grayish brown, stratified silt loam, loam, and sandy loam. In some small areas the surface layer is lighter colored. In some the substratum is nonstratified, medium to moderately fine textured material. In others the subsoil contains less clay.

Included with this soil in mapping are small areas of Colwood, Keowns, and Sisson soils. Colwood and Keowns soils, in drainageways and depressional areas, are more poorly drained than this Kibbie soil. Sisson soils, on tops of knolls and ridges, are better drained. These included soils make up 10 to 15 percent of this map unit.

This Kibbie soil has a seasonal high water table within 1 foot to 2 feet of the surface in winter and spring. Permeability is moderate. The available water capacity is high. Surface runoff is slow.

Most areas are cropland. Small areas are woodland and permanent pasture. The potential is good for cropland, pasture, and woodland. It is fair for recreational uses and poor for most engineering uses.

The major limitation in cropland is the excess water, which delays planting and harvesting in many years. Tile drainage is needed.

The major limitation in pasture is the excess water. Pasturing when this soil is wet causes compaction and poor tilth. Tile drainage is needed.

The major hazard for newly planted trees is plant competition. Control through the use of herbicides and cultivation is needed.

The major limitation for recreational uses is the excess water. The soil is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitation in using this soil as a site for buildings and sanitary facilities is the excess water. Septic tank filter fields do not function properly because of the seasonal high water table. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. Seepage is a problem in sewage lagoons unless the bottom of the lagoons is sealed with impermeable material.

Capability subclass IIw; Michigan soil management group 2.5b-s.

Ln—Lenawee silty clay loam. This poorly and very poorly drained soil is in depressional areas and in drainageways. It is subject to frequent flooding. Areas range from 5 to about 40 acres.

Typically, the surface layer is black silty clay loam about 8 inches thick. The mottled dark gray subsoil is about 22 inches thick. The upper part is very firm silty clay, and the lower part is firm silty clay loam. The substratum to a depth of 60 inches is stratified olive brown silt loam and clay loam and grayish brown sand. In small areas the subsoil contains less clay. In small areas the surface layer is lighter colored, and the subsoil is less gray.

This Lenawee soil has a high water table within 1 foot of the surface in winter and spring. Permeability is moderately slow. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland. Small areas are woodland, permanent pasture, and wildlife habitat. The potential is good for cropland, pasture, and woodland. It is poor for recreational uses and most engineering uses.

The major limitations in cropland are the excess water and the flooding. Unless drained, this soil is too wet for crops. Good tilth is difficult to maintain. Tile and surface drains are needed. Cover crops, green manure crops, crop residue management, and no till cropping systems or tilling under proper moisture conditions help to maintain good tilth.

The major limitations in pasture are the excess water and the flooding. Pasturing when this soil is wet causes compaction and damages the sod. Tile and surface drains are needed.

The major limitations in woodland are the equipment limitation, seedling mortality, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned. Mature stands can be clear cut.

The major limitations in using this soil as a building site are the excess water and the flooding. Septic tank filter fields do not function properly because of the high water table, the flooding, and the slow permeability. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available.

Capability subclass IIw; Michigan soil management group 1.5c.

MaB—Marlette fine sandy loam, 2 to 6 percent slopes. This moderately well drained, undulating soil is on broad complex slopes, on ridgetops and low knolls, and on side slopes. Areas are irregular in shape and range from 3 to 500 acres.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil is about 22 inches thick. The upper part is brown loam with fine sandy loam coatings. The lower part is dark yellowish brown and brown, firm clay loam. The substratum to a depth of 60 inches is brown loam. In many areas there are no coatings in the upper part of the subsoil. In some small areas there is less clay and more sand in the upper part of the subsoil. In small areas depth to the substratum is less than 25 inches or more than 40 inches.

Included with this soil in mapping are small areas of Capac and Aubbeenaubbee soils. These soils, on foot slopes, in shallow depressions, and in drainageways, are less well drained than this Marlette soil. They make up 10 to 15 percent of this map unit.

This Marlette soil has a seasonal high water table 2 1/2 feet to 6 feet below the surface in winter and spring. Permeability is moderate or moderately slow. The available water capacity is high. Surface runoff is medium.

Most areas are cropland. Small areas are woodland and pasture. The potential is good for cropland, pasture, woodland, recreational uses, and most engineering uses.

The major limitations in cropland are the erosion hazard and poor tilth. Diversions, cover crops, grass waterways, and no till cropping systems help to control erosion. Tilling only when the soil is dry and adding organic matter—manure, green manure crops, and crop residue—improve tilth.

This soil is suitable for woodland. Herbicides and tillage are needed to control plant competition in new plantations.

This soil has few limitations for recreational uses. Slope is a moderate limitation to playgrounds. Slopes can be shaped and leveled to provide playground sites.

The major limitation in using this soil as a building site is wetness. The water table is as shallow as 30 inches during wet periods. Frost action is a problem on local roads and streets. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. Frost action on local roads and streets can be controlled by replacing or covering the upper layer of the soil with suitable base material.

Capability subclass IIe; Michigan soil management group 2.5a.

MaC—Marlette fine sandy loam, 6 to 12 percent slopes. This well drained, rolling soil is on ridges, on knolls, and along streams and drainageways. Areas are irregular in shape and range from 3 to 60 acres.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The firm subsoil is about 20 inches thick. The upper part is loam with fine sandy loam coatings. The next part is dark yellowish brown clay loam. The lower part is brown clay loam. The substratum to a depth of 60 inches is brown loam. In many areas there are no coatings in the upper part of the subsoil. In some small areas there is less clay and more sand in the upper part of the subsoil. In some small areas depth to the substratum is less than 25 inches.

Included with this soil in mapping are small areas of Boyer and Oshtemo soils. Boyer and Oshtemo soils, on knolls, ridges, and lower side slopes, are droughty. They make up 5 to 10 percent of the map unit.

Permeability is moderate or moderately slow in this Marlette soil. The available water capacity is high. Surface runoff is medium.

Most areas are cropland. Small areas are woodland. The potential is fair for cropland, most recreational uses, and most engineering uses. It is good for pasture and woodland.

The major limitations in cropland are erosion and poor tilth. Diversions, crop rotations, cover crops, grass waterways, and no till cropping systems help to control erosion. Tilling only when the soil is dry and adding organic matter—manure, green manure crops, and crop residue—improve tilth.

This soil is suitable for woodland. Plant competition is a hazard. Control through the use of herbicides and tillage is needed in new plantations.

The major limitation for most recreational uses is slope. Paving paths and trails improves trafficability and reduces erosion.

The major limitation in using this soil as a building site is slope. Permeability is moderately slow in septic tank absorption fields. The slope makes the construction of sewage lagoons difficult. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available.

Capability subclass IIIe; Michigan soil management group 2.5a.

MeD2—Marlette loam, 12 to 18 percent slopes, eroded. This well drained, hilly soil is on ridges and knolls and along streams and drainageways. Areas are irregular in shape and range from 3 to about 40 acres.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is firm, dark brown clay loam about 19 inches thick. The substratum to a depth of 60 inches is dark brown loam. In some small areas there is less clay and more sand in the upper part of the subsoil. In many places the depth to the substratum is less than 25 inches.

Included with this soil in mapping are small areas of Boyer and Oshtemo soils. Boyer and Oshtemo soils, at mid slope, on lower side slopes, and on knolls and ridges, are droughty. They make up to 10 to 15 percent of the map unit.

Permeability is moderate or moderately slow in this Marlette soil. The available water capacity is high. Surface runoff is rapid.

Most areas are cropland and permanent pasture. Small areas are woodland. The potential is poor for cropland, most recreational uses, and most engineering uses. It is fair for pasture and good for woodland.

The major problems in cropland are erosion and poor tilth. This hilly soil is eroded and is difficult to keep in good tilth. It should be used only for hay and close growing crops.

The major limitations in pasture are erosion and the slope. Keeping an adequate cover of grass and contour or no till seeding help to control erosion. Spreading fertilizer is difficult because of the slope. It should be done on the contour.

The major hazard in woodland is plant competition. Control through the use of herbicides and tillage is needed in new plantations.

The major limitation for most recreational uses is slope. Paving paths and trails improves trafficability and reduces the risk of erosion.

The major limitation in using this soil as a building site is the slope. Local roads and streets can be constructed on the contour in some places. The moderate to moderately slow permeability limits the use of this soil as a septic tank absorption field. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available.

Capability subclass VIe; Michigan soil management group 2.5a.

MoE—Marlette-Boyer complex, 18 to 25 percent slopes. These well drained, steep soils are on hills and ridges. Areas are irregular in shape and range from 5 to more than 50 acres. Marlette soils make up about 35 percent of this map unit and Boyer soils about 30 percent. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Marlette soil has a very dark grayish brown sandy loam surface layer about 4 inches thick. The subsurface layer is brown loam about 5 inches thick. The firm subsoil is about 18 inches thick. The upper part is brown loam with fine sandy loam coatings. The next part is dark yellowish brown clay loam. The lower part is brown clay loam. The substratum to a depth of 60 inches is brown loam. In some areas there is more sand and less clay in the upper part of the subsoil. In some areas the depth to the substratum is less than 25 inches or more than 40 inches.

Typically, the Boyer soil has a very dark grayish brown loamy sand surface layer 4 inches thick. The subsurface layer is yellowish brown loamy sand about 5 inches thick. The subsoil is about 12 inches thick. The upper part is dark brown, friable sandy loam, and the lower part is yellowish brown, loose loamy sand. The substratum to a depth of 60 inches is brown, stratified sand and gravelly sand. Depth to the substratum is extremely variable within short distances. In many areas it is less than 22 inches. In some it is more than 40 inches. In places layers of loam and sandy loam substratum are below a depth of 40 inches.

Included with these soils in mapping are small areas of Spinks soils. Also included are areas where slopes are more than 25 percent. Spinks soils are more droughty. They make up 10 to 15 percent of this map unit.

Permeability is moderate or moderately slow in the Marlette soil. It is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. The available water capacity is high in the Marlette soil and low in the Boyer soil. Surface runoff is rapid in the Boyer soil and very rapid in the Marlette soil.

Most of this unit is permanent pasture, woodland, recreation land, or woodland wildlife habitat. Small areas are mined for sand and gravel. These soils have poor potential for cropland, most engineering uses, and most recreational uses. They have fair potential for pasture and good potential for woodland.

The major hazards in cropland are erosion, drought, and soil blowing. Because of the steep slopes, cropping these soils is generally impractical.

The major limitations in pasture are droughtiness and steep slopes. Rotational grazing or strip grazing is needed during dry periods. The slope makes seeding and fertilizing difficult.

The major limitations in woodland are erosion, equipment limitation, and plant competition. Logging trails should be constructed on the contour. Herbicides help to control plant competition in new plantations. Seedlings have to be hand planted in most places.

The major limitation for recreational use is the slope. Paving paths and trails improves trafficability and reduces the risk of erosion. Trails should be constructed on the contour.

The major limitation in using these soils as sites for buildings and sanitary facilities is the slope. Good sites for buildings, waste disposal, and sewage lagoons are limited on this unit because of slope.

Capability subclass VIc; Michigan soil management groups 2.5a, 4a.

MrA—Matherton sandy loam, 0 to 3 percent slopes. This somewhat poorly drained, nearly level and undulating soil is in broad low areas, on low ridges and knolls, and along minor drainageways. Areas are irregular in shape and range from 3 to about 100 acres.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The mottled dominantly brown subsoil is about 29 inches thick. The upper part is friable sandy loam. The next part is firm clay loam. The lower part is friable loam. The substratum to a depth of 60 inches is mottled yellowish brown gravelly sand. In some areas the surface layer is lighter colored. In some areas the depth to the substratum is more than 40 inches.

Included with this soil in mapping are small areas of Boyer and Sebewa soils. Boyer soils, in slightly higher positions on knolls and low ridges, are better drained than this Matherton soil. They make up about 5 percent of this map unit. Sebewa soils, in slightly depressional areas, are more poorly drained. They make up about 10 percent of the unit.

This Matherton soil has a seasonal high water table within 1 foot to 2 feet of the surface in winter and spring. Permeability is moderate in the solum and rapid in the substratum. The available water capacity is moderate. Surface runoff is slow.

Most areas are cropland. Small areas are woodland and permanent pasture. The potential is good for cropland, pasture, and woodland. It is fair for most recreational uses and poor for most engineering uses.

The major limitation in cropland is the excess water, which delays planting and harvesting in many years. Tile drainage is needed. If drained, the soil is slightly droughty. Cover crops, green manure crops, crop residue management, manure, and no till cropping systems help to conserve soil moisture.

The major limitation in pasture is the excess water. Pasturing when the soil is wet causes compaction and poor tilth. Tile drainage is needed.

This soil is suitable for woodland. The major hazard is severe plant competition. Herbicides and tillage help to control plant competition in new plantations.

The major limitation for recreational uses is the excess water. This soil is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table.

The major limitation in using this soil as a building site is the excess water. Septic tank filter fields do not function properly because of the seasonal high water table. Seepage is a problem in sewage lagoons. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water.

Capability subclass IIw; Michigan soil management group 3b.

MtB—Metea loamy sand, 2 to 6 percent slopes. This well drained, undulating soil is on the sides of low ridges and on broad slopes. Areas are irregular in shape and range from 3 to 25 acres.

Typically, the surface layer is very dark gray loamy sand about 4 inches thick. The subsoil is about 34 inches thick. The upper part is yellowish brown and dark yellowish brown, very friable loamy sand. The next part is yellowish brown, loose sand. The lower part is dark yellowish brown, firm clay loam. The substratum to a depth of 60 inches is mottled yellowish brown loam. In places the depth to the moderately fine textured material is 40 to 60 inches.

Included with this soil in mapping are small areas of Marlette soils. These included soils occur as scattered areas throughout this unit and make up about 15 percent of the acreage.

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

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland, most recreational uses, and most engineering uses. It is good for pasture and woodland.

The major hazards in cropland are water erosion and soil blowing. The soil is also slightly droughty. Windbreaks, cover crops, contour stripcropping, and crop residue help to control soil blowing. Cover crops, green manure crops, contour farming, crop residue management, manure, and no till cropping systems help to control erosion and conserve moisture.

This soil is suitable for pasture. Rotational grazing or strip grazing is needed during dry periods.

The major hazard in woodland is seedling mortality. Planting more seedlings per unit of area and keeping new plantations free of weeds improve seedling survival.

The major limitation for most recreational use is the sandy surface layer. A layer of medium textured topsoil is needed.

The major limitation in septic tank absorption fields is the moderately slow or moderate permeability. In most areas sanitary facilities should be connected to commercial sewers and treatment facilities if they are available.

Capability subclass IIIe; Michigan soil management group 4/2a.

MtC—Metea loamy sand, 6 to 12 percent slopes. This well drained, rolling soil is on side slopes of ridges. Areas are irregular in shape and range from 3 to 15 acres.

Typically, the surface layer is very dark gray loamy sand about 6 inches thick. The subsoil is about 32 inches thick. The upper part is yellowish brown and dark yellowish brown, very friable sand, and the lower part is dark yellowish brown, firm clay loam. The substratum to a depth of 60 inches is yellowish brown loam. Moderately eroded areas make up about 10 percent of this map unit. They are yellowish brown on the surface. In places the depth to the moderately fine textured material is 40 to 60 inches.

Included with this soil in mapping are small areas of Marlette soils. Marlette soils, at the tops of knolls and ridges, are less droughty than this Metea soil. They make up about 10 percent of the unit.

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

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland, most recreational uses, and most engineering uses. It is good for pasture and woodland.

The major hazards in cropland are erosion and soil blowing. The soil is also slightly droughty. Windbreaks, cover crops, contour stripcropping, and crop residue help to control soil blowing. Cover crops, green manure crops, contour farming, crop rotations, crop residue management, manure, and no till cropping systems help to control erosion and conserve soil moisture.

This soil is suitable for pasture. Rotational grazing or strip grazing is needed during dry periods.

The major hazard in woodland is seedling mortality. Planting more seedlings per unit of area and keeping new plantations free of weeds improve seedling survival.

The major limitations for most recreational uses are the sandy surface layer and slope. A layer of medium textured topsoil is needed. The slope makes it difficult to shape and level areas for playgrounds.

The major limitation in septic tank absorption fields is the moderately slow or moderate permeability. Slope is a major limitation in constructing sewage lagoons. In most areas sanitary facilities should be connected to commercial sewers and treatment facilities if they are available.

Capability subclass IIIe; Michigan soil management group 4/2a.

Na—Napoleon muck. This very poorly drained, nearly level soil is in depressional areas and broad low areas. It is subject to frequent flooding. Areas range from about 5 to 100 acres.

Typically, the surface layer is dark reddish brown mucky peat and muck about 6 inches thick. The underlying layers to a depth of 60 inches are dark reddish brown mucky peat. In places the organic layers are less than 51 inches thick.

Included with this soil in mapping are small areas of Boots and Houghton soils and small areas of Histosols and Aquents, ponded. Boots and Houghton soils, mostly at the edge of this map unit, are less acid than this Napoleon muck. They make up 10 percent and 5 percent of the unit.

This Napoleon muck has a high water table that rises to within 1 foot of the surface in winter and spring. Permeability is moderate or moderately rapid. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are woodland wildlife habitat. The potential is poor for cropland, most recreational uses, and most engineering uses. It is fair for pasture and woodland.

The major limitations in cropland are excess water, flooding, poor drainage outlets, and unstable soil material. Unless drained, this soil is too wet for crops. If it is drained, soil blowing and subsidence are problems. This soil is too acid for some crops.

Excess water and flooding limit the use of this soil as pasture. Pasturing when the soil is wet causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are the major limitations in woodland. The equipment limitation, seedling mortality, windthrow hazard, and plant competition are problems. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table, flooding, and the instability of the soil are difficult to overcome.

Capability subclass VIw; Michigan soil management group Mc-a.

OsB—Oshtemo sandy loam, 0 to 6 percent slopes. This well drained, nearly level and undulating soil is on broad complex slopes and on low ridges and knolls. Areas are irregular in shape and range from 3 to about 600 acres.

Typically, the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is dark yellowish brown sandy loam about 7 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable sandy loam, and the lower part is yellowish brown, loose and very friable sand and loamy sand. The substratum to a depth of 60 inches is brown gravelly sand. In small areas the depth to the substratum is less than 40 inches. In places it is more than 60 inches.

Included with this soil in mapping are small areas of Brady soils. Brady soils, in shallow depressions, in drainageways, and on foot slopes, are not so well drained as the Oshtemo soil. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in this Oshtemo soil. The available water capacity is moderate. Surface runoff is slow or very slow.

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland and good for pasture, woodland, recreational uses, and most engineering uses.

The major hazard in cropland is drought. Cover crops, green manure crops, crop residue management, manure, and no till cropping systems help to conserve moisture. The soil is suited to irrigation.

This soil is suitable for pasture. Rotational grazing or strip grazing is needed during dry periods.

This soil is suitable for woodland. Plant competition is a moderate hazard. Herbicides and tillage help to control plant competition in new plantations.

This soil is suitable for most recreational uses. Leveling and shaping are needed in the more sloping areas if they are to be used as playground sites.

This soil is suitable as a building site. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water.

Capability subclass IIIs; Michigan soil management group 3a.

OsC—Oshtemo sandy loam, 6 to 12 percent slopes. This well drained, rolling soil is in broad pitted areas, on ridges, and on knolls. Areas are irregular in shape and range from 3 to about 70 acres.

Typically, the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsurface layer is dark yellowish brown sandy loam about 5 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable sandy loam, and the lower part is yellowish brown, loose and very friable sandy and loamy sand. The substratum to a depth of 60 inches is gravelly sand. In many areas the depth to the substratum is less than 40 inches. In places it is more than 60 inches.

Permeability is moderately rapid in this Oshtemo soil. The available water capacity is moderate. Surface runoff is medium.

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland, most recreational uses, and most engineering uses and good for pasture and woodland.

The major hazards in cropland are erosion and drought. Cover crops, green manure crops, crop residue, manure, contour farming, and no till cropping systems help to control erosion and conserve soil moisture.

This soil is suitable for pasture and woodland. Plant competition is a moderate hazard in woodland. Herbicides and tillage help to control plant competition in new plantations. Rotational grazing or strip grazing is needed during dry periods.

The major limitation for most recreational uses is the slope. The slope is a problem in camp areas and picnic areas and on playgrounds. It makes shaping and leveling for playgrounds difficult. Paving paths and trails improves trafficability and reduces the risk of erosion.

The major limitation in using this soil as a site for buildings and sewage lagoons is the slope. Seepage is a hazard in sewage lagoons. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water. Engineering projects should be designed to fit the slope.

Capability subclass IIIe; Michigan soil management group 3a.

OtB—Oshtemo-Spinks loamy sands, 0 to 6 percent slopes. These well drained, nearly level and undulating soils are on broad complex slopes and on low ridges and knolls. Areas are irregular in shape and range from 3 to more than 500 acres. Oshtemo and Spinks soils make up 45 and 35 percent of this map unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Oshtemo soil has a dark brown loamy sand surface layer about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 10 inches thick. The subsoil is about 31 inches thick. The upper part is brown, friable sandy loam, and the lower part is strong brown, very friable loamy sand. The substratum to a depth of 60 inches is pale brown sand. In some places the depth to carbonates is more than 60 inches. In some small areas the depth to the substratum is less than 40 inches.

Typically, the Spinks soil has a dark grayish brown loamy sand surface layer about 8 inches thick. The subsurface layer is yellowish brown sand about 12 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown, loose loamy sand, and the lower part is yellowish brown, loose sand with lamellae of strong brown, very friable loamy sand. The substratum to a depth of 60 inches is yellowish brown sand. In some small areas total thickness of the loamy sand lamellae in the subsoil is less than 6 inches.

Included with these soils in mapping are small areas of Brady and Metea soils. Brady soils, in shallow depressions and drainageways and on foot slopes, are less well drained than Oshtemo and Spinks soils. They make up about 5 percent of the unit. Metea soils, on ridgetops and side slopes, are less droughty. They make up about 5 percent of the unit.

Permeability is moderately rapid in the Oshtemo soil and moderately rapid or rapid in the Spinks soil. For both soils, the available water capacity is low and surface runoff is slow or very slow.

Most areas are cropland. Some small areas are woodland and pasture. The potential is fair for cropland and most recreational uses and good for pasture, woodland, and most engineering uses.

The major hazards in cropland are drought and soil blowing. Windbreaks, cover crops, green manure crops, crop residue management, manure, and no till cropping systems conserve soil moisture and reduce the risk of soil blowing. The soils are suited to irrigation.

The major hazards in woodland are seedling mortality and plant competition. Herbicides and the cultivation of new plantations reduce plant competition and improve seedling survival.

The major limitation for most recreational uses of these soils is the sandy surface layer. A layer of medium textured topsoil is needed.

These soils are suitable for building sites. Seepage is a problem in sewage lagoons. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water.

Capability subclass IIIs; Michigan soil management groups 3a-5, 4a.

OtC—Oshtemo-Spinks loamy sands, 6 to 12 percent slopes. These well drained, rolling soils are in broad pitted areas and on ridges and knolls. Areas are irregular in shape and range from 3 to 140 acres. Oshtemo soils are on ridgetops, the tops of knolls, and the upper side slopes. They make up about 45 percent of the unit. Spinks soils are at mid slope, on lower side slopes, and on broad ridgetops. They make up about 34 percent of the unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Oshtemo soil has a dark brown loamy sand surface layer about 8 inches thick. The subsurface layer is yellowish brown loamy sand about 8 inches thick. The subsoil is about 30 inches thick. The upper part is brown, friable sandy loam, and the lower part is strong brown, very friable loamy sand. The substratum to a depth of 60 inches is pale brown sand. In some areas the depth to the substratum is less than 40 inches.

Typically, the Spinks soil has a dark grayish brown loamy sand surface layer 8 inches thick. The subsurface layer is yellowish brown sand about 12 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown, loose loamy sand, and the lower part is yellowish brown, loose sand with lamellae of strong brown, very friable loamy sand. In small areas the total thickness of the loamy sand lamellae is less than 6 inches.

Included with these soils in mapping are small areas of Hillsdale and Metea soils. Hillsdale and Metea soils are at the tops of ridges and knolls and on upper side slopes. These included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Oshtemo soil and moderately rapid and rapid in the Spinks soil. For both soils, the available water capacity is low and surface runoff is slow.

Most areas are cropland. Small areas are woodland or pasture. These soils have fair potential for cropland, most recreational uses, and most engineering uses. They have good potential for pasture and woodland.

The major hazards in cropland are erosion, drought, and soil blowing. Diversions, grass waterways, and no till cropping systems help to control erosion. Windbreaks, cover crops, green manure crops, crop residue, manure, and no till cropping systems help to conserve soil moisture and reduce the risk of soil blowing.

The major hazard in pasture is drought. Rotational grazing or strip grazing is needed during dry periods.

The major hazards in woodland are seedling mortality and plant competition. Herbicides and cultivation of new plantations help to control plant competition and improve seedling survival.

The major limitations for most recreational uses are the sandy surface layer and the slope. A layer of medium textured topsoil is needed. Slope makes the shaping and leveling of playgrounds difficult.

The major limitation in using these soils as building sites is the slope. Seepage is a hazard in sewage lagoons. Sealing the bottoms of lagoons with impermeable material helps to prevent contamination of ground water. Engineering projects should be designed to fit the slope of the soil.

Capability subclass IIIe; Michigan soil management groups 3a, 4a.

OwB—Owosso-Marlette sandy loams, 2 to 6 percent slopes. These well drained and moderately well drained, undulating soils occur as broad areas on low ridges and knolls. Slopes are complex. Areas are irregular in shape and range from 3 to about 130 acres. Owosso and Marlette soils make up 30 to 45 percent of this map unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Owosso soil has a dark brown sandy loam surface layer about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 8 inches thick. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, friable and very friable sandy loam, and the lower part is dark brown, firm clay loam. The substratum to a depth of 60 inches is brown clay loam. In small areas the entire subsoil is sandy loam. In places the substratum is sandy loam.

Typically, the Marlette soil has a brown sandy loam surface layer about 9 inches thick. The firm subsoil is about 22 inches thick. The upper part is brown loam with brown fine sandy loam coatings, and the lower part is brown clay loam. The substratum to a depth of 60 inches is brown loam. In many areas there are no coatings in the upper part of the subsoil. In small areas the depth to the substratum is less than 25 inches.

Included with these soils in mapping are small areas of Boyer, Capac, and Oshtemo soils. Capac soils, in shallow depressions, in drainageways, and on foot slopes, are less well drained than Owosso and Marlette soils. They make up about 5 percent of the unit. Boyer and Oshtemo soils, on knolls, ridges, and lower side slopes, are more droughty and more subject to soil blowing. They make up about 10 percent of the unit.

Permeability is moderately rapid in the moderately coarse textured upper layers of the Owosso soil and moderately slow in the medium and moderately fine textured lower layers. Permeability is moderately slow in the

Marlette soil. The available water capacity is moderate in the Owosso soil and high in the Marlette soil. Surface runoff is slow in the Owosso soil and medium in the Marlette soil. The Marlette soil has a seasonal high water table that fluctuates between 2 1/2 and 6 feet in winter and spring.

Most areas are cropland. Small areas are woodland and pasture. These soils have good potential for cropland, pasture, woodland, recreational uses, and most engineering uses.

The major limitations in cropland are the hazard of erosion and poor tilth. The Owosso soil is slightly droughty. Diversions, cover crops, grass waterways, and no till cropping systems help to control erosion and conserve soil moisture. Tilling only when the soil is dry and adding organic matter—manure, green manure crops, and crop residue—help to keep the soils in good tilth.

These soils are suitable for pasture and woodland. Plant competition is a hazard. Herbicides and tillage are needed in new plantations.

These soils are suitable for recreational uses, but shaping and leveling are needed if they are to be used as sites for playgrounds.

The major limitations in using these soils as building sites are the low strength and the shrink-swell potential. The water table is within 30 inches of the surface during wet periods in some areas of the Marlette soil. The moderately slow permeability is a limitation in septic tank absorption fields. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. The shrink-swell potential can be controlled by constructing dwellings and small buildings without basements, backfilling around foundations with suitable material, and providing drainage around foundations. On local roads and streets, the upper layer of the soil should be replaced or covered with suitable base material because of the shrink-swell potential and the low strength. Sewage lagoons are generally suited. Some land shaping may be needed.

Capability subclass IIe; Michigan soil management groups 3/2a, 2.5a.

OwC—Owosso-Marlette sandy loams, 6 to 12 percent slopes. These well drained, rolling soils are on ridges, on knolls, and along streams and drainageways. Areas are irregular in shape and range from 3 to about 40 acres. Owosso soils are typically at mid slope, on lower side slopes, and on the broader ridgetops. They make up about 40 percent of this map unit. Marlette soils are on ridgetops and the tops of knolls and on upper side slopes. They make up about 25 percent of the unit. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Owosso soil has a dark brown sandy loam surface layer about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 8 inches thick. The subsoil is about 23 inches thick. The upper part is dark yellowish brown, friable and very friable sandy loam, and the lower part is dark brown, firm clay loam. The substratum to a depth of 60 inches is brown clay loam. In some small areas the entire subsoil is a sandy loam. In places the substratum is sandy loam.

Typically, the Marlette soil has a brown sandy loam surface layer about 9 inches thick. The subsoil is firm and is about 20 inches thick. The upper part is brown loam with brown fine sandy loam coatings. The next part is dark yellowish brown clay loam. The lower part is brown clay loam. The substratum to a depth of 60 inches is brown loam. In many areas there are no coatings in the upper part of the subsoil. In small areas the depth to the substratum is less than 25 inches.

Included with these soils in mapping are small areas of Boyer and Oshtemo soils. Boyer and Oshtemo soils, on knolls, ridges, and lower side slopes, are more droughty and more subject to soil blowing than Owosso and Marlette soils. They make up about 10 percent of the unit.

Permeability is moderately rapid in the moderately coarse textured upper layers of the Owosso soil and moderately slow in the medium and moderately fine textured lower layers. Permeability is moderate or moderately slow in the Marlette soil. The available water capacity is moderate in the Owosso soil and high in the Marlette soil. For both soils, surface runoff is medium.

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland, recreational uses, and most engineering uses. It is good for most pasture and woodland.

The major hazard in cropland is erosion. Additional problems are poor tilth and droughtiness. Diversions, crop rotation, cover crops, grass waterways, and no till cropping systems help to control erosion and conserve soil moisture. Tilling only when the soil is dry and adding organic matter—manure, green manure crops, and crop residue—help to keep the soil in good tilth.

These soils are suitable for woodland, but plant competition is severe. Herbicides and tillage are needed in new plantations.

Slope is the major limitation for most recreational uses. The slopes make it difficult to shape and level areas for playgrounds. Paving paths and trails improves trafficability and reduces erosion.

The major limitations in using these soils as building sites are the low strength, the slope, and the shrink-swell potential. The moderately slow permeability is a limitation in septic tank absorption fields. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. The shrink-swell potential can be controlled by constructing dwellings and small buildings without basements, backfilling around foundations with suitable material, and providing drainage around foundations. The upper layer of the soil should be replaced or covered with suitable base material so that local roads and streets function properly. Roads and streets should be on the contour. Land shaping is needed to overcome the slope limitation. Constructing sewage lagoons is difficult because of the slope.

Capability subclass IIIe; Michigan soil management groups 3/2a, 2.5a.

Pa—Palms muck. This very poorly drained, nearly level soil is in depressional areas, low areas, and drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 160 acres.

Typically, the upper layer is black muck about 36 inches thick. The substratum to a depth of 60 inches is gray sandy loam. In places the muck layer is less than 16 inches thick. In some small areas the substratum is coarse textured.

Included with this soil in mapping are small areas of Aurelius, Colwood, Gilford, and Sebewa soils. Aurelius soils are less permeable than Palms muck. They occur throughout this map unit and make up about 10 percent of the acreage. Colwood, Gilford, and Sebewa soils, on low knolls and ridges and near the edge of the unit, are more stable. They make up about 5 percent of the unit.

This Palms soil has a high water table that rises to within 1 foot of the surface in winter and spring. Permeability is moderately slow to moderately rapid. The available water capacity is high. Surface runoff is very slow or ponded.

Most areas are cropland, woodland, permanent pasture, and wildlife habitat. The potential is good for cropland and pasture, fair for woodland, and poor for recreational uses and most engineering uses. It is good for truck and specialty crops.

The major limitations in cropland are excess water, flooding, and unstable soil material. Unless drained, this soil is too wet for crops. If the soil is drained, soil blowing and subsidence are hazards. This soil has poor drainage outlets in many places. Windbreaks, crop residue, and cover crops help to control soil blowing. Controlled drainage reduces subsidence. Tile drainage and deep ditches are needed to remove excess water and improve stability. If placed in the substratum, the tile needs blinding. Pumps are needed to remove water at the outlet in many places.

Excess water and flooding limit the use of the soil as pasture. Pasturing when the soil is wet causes compaction and damages the sod. Tile drainage and ditches are needed.

Excess water and unstable soil material are limitations in woodland. They can result in equipment limitations, seedling mortality, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned by cutting. Mature stands can be clear cut.

Building site development and sanitary facilities are not practical on this soil. The limitations caused by the high water table, the flooding, and the instability of the soil are difficult to overcome.

Capability subclass IIw; Michigan soil management group M/3c.

Pt—Pits. This map unit consists of areas that have been excavated for sand and gravel. Areas range from 3 to 100 acres.

Included in mapping are small areas of soils that have not been excavated and some ponds where material has been excavated below the water table.

Depth to the water table ranges from the surface to more than 5 feet. Permeability and available water capacity are variable. Surface runoff ranges from very rapid to ponded. The organic matter content is very low. Some plant nutrients are not available because of the alkalinity of the unit.

Most areas are used as wildlife habitat or are still being mined. Some are in recreational use. The potential is poor for cropland, pasture, and woodland. Areas are too variable to be rated according to their potential for recreational and engineering uses. Onsite evaluation is needed.

Not assigned to interpretive groupings.

RdB—Riddles-Hillsdale sandy loams, 2 to 6 percent slopes. These well drained, undulating soils are on broad complex slopes and on knolls. Areas are irregular in shape and range from 5 to about 160 acres. Riddles soils make up about 50 percent of this map unit, and Hillsdale soils about 30 percent. Areas of these soils are so intricately associated that mapping them separately is not practical.

Typically, the Riddles soil has a dark brown sandy loam surface layer about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 14 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown and brown, firm sandy clay loam and clay loam, and the lower part is dark yellowish brown, friable sandy loam. The substratum to a depth of about 66 inches is yellowish brown sandy loam. In places a loam or clay loam substratum is at a depth of 30 to 40 inches.

Typically, the Hillsdale soil has a dark brown sandy loam surface layer about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 4 inches thick. The subsoil is yellowish brown and dark yellowish brown, dominantly friable sandy loam about 56 inches thick.

Included with these soils in mapping are small areas of Spinks soils. Spinks soils are more droughty than the Riddles and Hillsdale soils. They occur as scattered areas throughout the unit and make up about 10 percent of the acreage.

Permeability is moderate in the Riddles soil and moderate or moderately rapid in the Hillsdale soil. The available water capacity is high in the Riddles soil and moderate in the Hillsdale soil. For both soils, surface runoff is slow.

Most areas are cropland. Small areas are woodland and pasture. The soils have good potential for cropland, pasture, woodland, recreational uses, and most engineering uses.

The major hazard in cropland is erosion. In addition, the Hillsdale soil is slightly droughty. Diversions, crop residue management, cover crops, grass waterways, and no till cropping systems help to control erosion and conserve soil moisture. The soils are suited to irrigation.

These soils are suitable for woodland. Plant competition is a hazard. Herbicides and tillage help to control the competition in new plantations.

The soils have no limitations for most recreational uses. Slopes are to be shaped and leveled if the soils are used as playground sites.

The major limitations in using the Riddles soil as a building site are the shrink-swell potential and the low strength. The shrink-swell potential can be controlled by constructing dwellings and small buildings without basements, backfilling around foundations with suitable material, and providing drainage around foundations. The upper layer of the soil should be replaced or covered with suitable base material so that local roads and streets function properly. Seepage and slope are limitations in using the soils as sites for sewage lagoons. Sealing the bottom of lagoons with impermeable material helps to prevent contamination of ground water.

Capability subclass IIe; Michigan soil management groups 2.5a, 3a.

RdC—Riddles-Hillsdale sandy loams, 6 to 12 percent slopes. These well drained, rolling soils are on low ridges, on knolls, and on side slopes. Areas are irregular in shape and range from 5 to about 100 acres. Riddles soils make up about 45 percent of this map unit, and Hillsdale soils 30 percent. Areas of these soils are so small and so intricately associated that mapping them separately is not practical.

Typically, the Riddles soil has a dark brown sandy loam surface layer about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown and brown sandy clay loam and firm clay loam, and the lower part is dark yellowish brown, friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown sandy loam. In places a clay loam substratum is at a depth of 30 to 40 inches.

Typically, the Hillsdale soil has a dark brown sandy loam surface layer about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 2 inches thick. The subsoil is yellowish brown and dark yellowish brown, dominantly friable sandy loam about 56 inches thick. In places sand and gravel occurs between 40 and 60 inches.

Included with these soils in mapping are small areas of Spinks soils. Spinks soils are more droughty than the Riddles and Hillsdale soils. They occur as scattered areas throughout the unit and make up about 10 percent of the acreage.

Permeability is moderate in the Riddles soil and moderate or moderately rapid in the Hillsdale soil. The available water capacity is high in the Riddles soil and moderate in the Hillsdale soil. For both soils, surface runoff is medium.

Most areas are cropland. Small areas are woodland and pasture. These soils have fair potential for cropland, most recreational uses, and most engineering uses and have good potential for pasture and woodland.

The major hazard in cropland is erosion. The Hillsdale soil is slightly droughty. Diversions, crop rotations, cover crops, grass waterways, crop residue management, and no till cropping systems help to control erosion and conserve soil moisture.

These soils are suitable for woodland. Plant competition is a hazard. Herbicides and tillage help to control the competition in new plantations.

The major limitation for most recreational uses is the slope. Paving paths and trails improves trafficability and reduces erosion.

Slope is a limitation in using the Riddles and Hillsdale soils as building sites. Low strength and shrink-swell potential are additional limitations on the Riddles soil. The shrink-swell potential of the Riddles soil can be controlled by constructing dwellings and small buildings without basements, backfilling around foundations with suitable material, and providing drainage around foundations. The upper layer of the Riddles soil should be replaced or covered with suitable base material so that local roads and streets function properly. Local roads and streets should be on the contour. Land shaping can correct some slope limitations.

Capability subclass IIIe; Michigan soil management groups 2.5a, 3a.

RdD—Riddles-Hillsdale sandy loams, 12 to 18 percent slopes. These well drained, hilly soils are on knolls and hills and in narrow valleys. Areas are irregular in shape and range from 5 to 40 acres. Riddles soils make up about 40 percent of this map unit, and Hillsdale soils 30 percent. Areas of these soils are so intricately mixed that mapping them separately is not practical.

Typically, the Riddles soil has a dark brown sandy loam surface layer about 6 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is about 38 inches thick. The upper part is dark yellowish brown and brown, firm sandy clay loam and clay loam, and the lower part is dark yellowish brown, friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown sandy loam. In places a clay loam substratum is at a depth of 30 to 40 inches.

Typically, the Hillsdale soil has a dark brown sandy loam surface layer about 6 inches thick. The subsoil is yellowish brown and dark yellowish brown, dominantly friable sandy loam about 56 inches thick. In places depth to the substratum is 30 to 40 inches. In places sand and gravel occurs between 40 and 60 inches.

Included with these soils in mapping are small areas of Spinks soils. Spinks soils, generally at the tops of knolls and hills, are more droughty than Riddles and Hillsdale soils. They make up about 15 percent of the unit.

Permeability is moderate in the Riddles soil and moderate or moderately rapid in the Hillsdale soil. The available water capacity is high in the Riddles soil and moderate in the Hillsdale soil. For both soils, surface runoff is rapid.

Most areas are cropland, pasture, and woodland. These soils have poor potential for cropland, most recreational uses, and most engineering uses. They have fair potential for pasture and good potential for woodland.

The major hazard in cropland is erosion. Poor tilth can be a problem. The Hillsdale soil is slightly droughty. Diversions, crop rotations, cover crops, grass waterways, crop residue management, and no till cropping systems help to control erosion and conserve soil moisture.

The major limitations in pasture are erosion and the slope. An adequate grass cover and contour or no till seeding help to control erosion. Spreading of fertilizer is difficult unless done on the contour.

These soils are suitable for woodland. Plant competition is a hazard. Herbicides and tillage help to control the competition in new plantations.

The major limitation for most recreational uses is the slope. Paving paths and trails improves trafficability and reduces erosion.

The major limitation in using these soils as building sites is the slope. Slope is a problem in constructing septic tank absorption fields and sewage lagoons. Local roads and streets should be on the contour.

Capability subclass IVe; Michigan soil management groups 2.5a, 3a.

Sb—Sebewa loam. This poorly drained and very poorly drained, nearly level soil is in broad low areas and along drainageways. It is subject to frequent flooding. Areas are irregular in shape and range from 3 to 500 acres.

Typically, the surface and subsurface layers are black loam about 12 inches thick. The mottled olive gray, firm loam subsoil is about 12 inches thick. The substratum to a depth of 60 inches is mottled grayish brown gravelly sand. In places the subsoil is stratified.

Included with this soil in mapping are small areas of Colwood, Matherton, and Palms soils. Colwood soils are likely to plug subsurface drains. They occur as scattered areas throughout this map unit and make up about 5 percent of the acreage. Matherton soils, on low ridges and knolls, are better drained than the Sebewa soil. They make up about 5 to 10 percent of the unit. Palms soils, in slight depressional areas, are less stable. They make up about 5 percent of the unit.

This Sebewa soil has a high water table within 1 foot of the surface in winter and spring. Permeability is moderate in the upper part of the soil and rapid in the lower part. The available water capacity is moderate. Surface runoff is very slow or ponded.

Most areas are cropland. Some are woodland, pasture, and wildlife habitat. The potential is good for cropland and pasture, fair for woodland, and poor for most recreational uses and most engineering uses.

The major hazards in cropland are the excess water and flooding. Unless drained, this soil is too wet for crops. If drained, it is slightly droughty. Tile and surface drains are needed. Cover crops, green manure crops, crop residue management, and no till cropping systems help to conserve moisture.

The major hazards in pasture are excess water and flooding. Pasturing when the soil is wet causes compaction and damages the sod. Tile and surface drains are needed.

The major limitations and hazards in woodland are equipment limitations, seedling mortality, windthrow hazard, and plant competition. Harvesting only during dry periods or when the soil is frozen helps to overcome the equipment limitation. Planting more seedlings per unit of area and controlling plant competition with herbicides or tillage improve seedling survival. To minimize windthrow damage, stands should be only slightly thinned. Mature stands can be clear cut.

The major limitations in using this soil as a building site are the excess water and flooding. Septic tank filter fields do not function properly because of the high water table and flooding. Seepage and excess water are problems in sewage lagoons.

Capability subclass IIw; Michigan soil management group 3/5c.

SnB—Sisson fine sandy loam, 2 to 6 percent slopes. This well drained, undulating soil is on broad complex slopes, at the tops of low ridges and low knolls, and on short uneven side slopes. Areas are irregular in shape and range from 3 to 50 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The yellowish brown and dark yellowish brown subsoil is about 30 inches thick. The upper part is friable fine sandy loam and silt loam. The next part is firm clay loam. The lower part is friable very fine sandy loam and silt loam. The substratum to a depth of 60 inches is yellowish brown, stratified very fine sandy loam, fine sandy loam, and silt loam. In some small areas the subsoil contains less clay. In places the depth to the substratum is more than 42 inches.

Included with this soil in mapping are small areas of Boyer, Kibbie, Oshtemo, and Spinks soils. Boyer, Oshtemo, and Spinks soils, on knolls, ridges, and lower side slopes, are more droughty than the Sisson soil. They make up 5 to 10 percent of this map unit. Kibbie soils, in shallow depressions, in drainageways, and on foot slopes, are less well drained. They make up about 5 percent of the unit.

Permeability is moderate in this Sisson soil. The available water capacity is high. Surface runoff is slow.

Most areas are cropland. Small areas are woodland and pasture. The potential is good for cropland, pasture, woodland, recreational uses, and most engineering uses.

The major hazard in cropland is erosion. Poor tilth can be a problem. Diversions, cover crops, grass waterways, and no till cropping systems help to control erosion. Tilling only when the soil is not wet and adding organic matter—manure, green manure crops, and crop residue—help to keep the soil in good tilth.

This soil is suitable for woodland. Plant competition is a hazard. Herbicides and tillage help to control the competition in new plantations.

This soil is suitable for most recreational uses. Shaping and leveling are needed if the soil is to be used as a site for playgrounds.

The major limitation in using this soil as a building site is the low strength. Because of the moderate permeability, seepage is a problem in sewage lagoons. Sealing the bottom of lagoons with impermeable material helps to prevent contamination of ground water.

Capability subclass IIe; Michigan soil management group 2.5a.

SnC—Sisson fine sandy loam, 6 to 12 percent slopes. This well drained, rolling soil is on ridges, on knolls, and along streams and drainageways. Areas are long and narrow or irregular in shape and range from 3 to about 55 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The yellowish brown and dark brown subsoil is about 21 inches thick. The upper part is friable silt loam, the next part is firm light clay loam, and the lower part is friable very fine sandy loam and silt loam. The substratum to a depth of 60 inches is yellowish brown stratified very fine sandy loam, fine sandy loam, and silt loam. In some small areas the subsoil contains less clay. In other small areas the lower part of the subsoil is mottled. In small areas depth to the substratum is less than 24 inches or more than 42 inches.

Included with this soil in mapping are small areas of Boyer, Oshtemo, and Spinks soils. Boyer, Oshtemo, and Spinks soils, on knolls, on ridges, and on lower side slopes, are more droughty than this Sisson soil. They make up 5 to 10 percent of this map unit.

Permeability is moderate in the Sisson soil. The available water capacity is high. Surface runoff is medium.

Most areas are cropland. Small areas are woodland. The potential is fair for cropland, most recreational uses, and most engineering uses. It is good for pasture and woodland.

The major hazard in cropland is erosion. Poor tilth can be a problem. Diversions, crop rotations, cover crops, grass waterways, and no till cropping systems help to control erosion. Tilling only when the soil is dry and adding organic matter—manure, green manure crops, and crop residue—help to keep the soil in good tilth.

This soil is suited to woodland. Plant competition is a severe hazard. Herbicides and tillage help to control the competition in new plantations.

The major limitation for most recreational uses is the slope. Paving paths and trails improves trafficability and reduces erosion.

The major limitations in using this soil as a building site are the slope and low strength. Slope severely limits the possible sites for sewage lagoons.

Capability subclass IIIe; Michigan soil management group 2.5a-s.

SpB—Spinks loamy sand, 0 to 6 percent slopes. This well drained, nearly level and undulating soil is in broad areas, on low ridges, and on knolls. Areas are irregular in shape and range from 3 to 200 acres.

Typically, the surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is yellowish brown loamy sand about 12 inches thick. The subsoil, about 38 inches thick, is yellowish brown, loose sand with bands of dark yellowish brown, very friable loamy sand. In small areas the total thickness of loamy sand bands is less than 6 inches. In some small areas the subsoil and substratum are gravelly.

Included with this soil in mapping are small areas of Hillsdale, Riddles, and Thetford soils. Hillsdale and Riddles soils, at the edge of this map unit on ridgetops and side slopes, are less droughty than this Spinks soil. They make up about 5 percent of the unit. Thetford soils, in shallow depressions, in drainageways, and on foot slopes, are less well drained. They make up 5 to 10 percent of the unit.

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

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland and most recreational uses. It is good for pasture, woodland, and most engineering uses.

The major hazards in cropland are drought and soil blowing. Windbreaks, cover crops, green manure crops, crop residue management, manure, and no till cropping systems help to conserve soil moisture and reduce soil blowing. The soil is suited to irrigation.

The major hazard in pasture is drought. Rotational grazing or strip grazing is needed during dry periods.

The major hazard in woodland is seedling mortality. Planting more seedlings per unit of area and tilling new plantations help in establishing adequate stands.

The major limitation for most recreational uses is the sandy surface layer. Adding a layer of medium textured topsoil helps to overcome this limitation.

This soil is suitable as a building site. Droughtiness, possible pollution of ground water from septic tank absorption fields, the instability of the soil when excavated, and seepage in sewage lagoons are problems. Sealing the bottom of lagoons with impermeable material helps to prevent contamination of ground water. Walls cut in excavations tend to cave. Shoring the walls helps to prevent cave ins.

Capability subclass IIIs; Michigan soil management group 4a.

SpC—Spinks loamy sand, 6 to 12 percent slopes. This well drained, rolling soil is in broad pitted areas, on ridges, and on knolls. Areas are irregular in shape and range from 3 to 100 acres.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsurface layer is yellowish brown loamy sand about 10 inches thick. The subsoil, about 37 inches thick, is yellowish brown, loose sand with bands of dark yellowish brown, friable loamy sand. The substratum to a depth of 60 inches is light yellowish brown sand. In small areas the total thickness of loamy sand bands in the subsoil is less than 6 inches. In some small areas the subsoil and substratum are gravelly.

Included with this soil in mapping are small areas of Hillsdale and Riddles soils. Hillsdale and Riddles soils, at the edges of this map unit on ridgetops and side slopes, are less droughty than the Spinks soil. They make up about 5 percent of the unit.

Permeability is moderately rapid or rapid in this Spinks soil. The available water capacity is low. Surface runoff is slow.

Most areas are cropland. Small areas are woodland and pasture. The potential is fair for cropland, most recreational uses, and most engineering uses. The potential is good for pasture and woodland.

The major hazards in cropland are erosion, drought, and soil blowing. Diversions, grass waterways, and no till cropping systems help to control erosion. Windbreaks, cover crops, green manure crops, crop residue management, manure, and no till cropping systems help to conserve soil moisture and reduce soil blowing.

The major hazard in pasture is drought. Rotational grazing or strip grazing is needed during dry periods.

The major hazard in woodland is seedling mortality. Planting slightly more seedlings per unit of area and tilling new plantations help in establishing adequate stands.

The major limitations for most recreational uses are the sandy surface layer and the slope. A layer of medium textured topsoil is needed.

The major limitations in using this soil as a building site are the slope, droughtiness, possible pollution of ground water from septic tank absorption fields, the instability of the soil when excavated, and seepage in sewage lagoons. Engineering projects should be designed to fit the slope of the soil. Walls cut in excavations tend to cave. Shoring the walls helps to prevent cave ins.

Capability subclass IIIe; Michigan soil management group 4a.

ThA—Thetford loamy sand, 0 to 3 percent slopes. This somewhat poorly drained, nearly level and undulating soil is in broad depressional areas and along drainageways. Areas are irregular in shape and range from 3 to 300 acres.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsurface layer is mottled brown sand about 5 inches thick. The mottled subsoil, about 45 inches thick, is brown, loose sand with dark grayish brown bands of friable loamy sand. The substratum to a depth of 60 inches is yellowish brown sand. In some profiles layers of silt and very fine sand occur below a depth of 40 inches.

Included with this soil in mapping are small areas of Gilford, Granby, Kibbie, and Spinks soils. Kibbie soils are less droughty than the Thetford soil and less subject to soil blowing. They occur as scattered areas throughout this map unit and make up about 5 percent of the acreage. Gilford and Granby soils, in slightly lower areas, are more poorly drained. They make up about 5 percent of the unit. Spinks soils, on slightly higher ridges and on knolls, are better drained. They make up about 5 percent of the unit.

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

Most areas are cropland. Some are woodland and pasture. The potential is fair for cropland and most recreational uses, good for pasture and woodland, and poor for most engineering uses.

The major limitation in cropland is excess water, which delays planting and harvesting in many years. If drained, this soil is droughty and is subject to soil blowing. Tile drainage is needed. Cover crops, green manure crops, windbreaks, stripcropping, crop residue management, manure, and no till cropping systems help to conserve soil moisture and reduce the hazard of soil blowing.

The major limitation in pasture is the excess water. Pasturing when this soil is wet causes compaction and damages the sod. Tile drainage is needed.

The major hazards in woodland are plant competition and seedling mortality. Planting slightly more seedlings per unit of area, using herbicides, and tilling improve seedling survival and control plant competition.

The major limitations for recreational uses are the excess water and the sandy surface layer. This soil is wet during wet periods and after rains. Surface and tile drains are needed to lower the water table. A layer of loamy topsoil is needed.

The major limitations in using this soil as a building site are the excess water, the moderately rapid permeability of the soil, and the instability of the soil when excavated. Septic tank filter fields do not function properly because of the seasonal high water table. Sanitary facilities should be connected to commercial sewers and treatment facilities if they are available. Constructing buildings with basements should be avoided because of the water table. Walls cut in excavations tend to cave. Shoring walls helps to prevent cave ins. Sewage lagoons are generally not suited to this soil unless a blanket of impervious material can be used to stop the seepage.

Capability subclass IIIw; Michigan soil management group 4b.

Ud—Udorthents and Udipsamments. These nearly level and gently sloping, somewhat poorly drained to well drained soils are on till plains, outwash plains, and moraines. Areas range from 5 to about 60 acres.

Some areas have been filled. Others have been excavated. The soil material is so altered that series identification is not feasible. The texture ranges from sand to silty clay loam.

Included with these soils in mapping are strongly sloping to very steep soils at the edge of the areas that are the more subject to erosion. They make up 5 to 10 percent of this map unit. Also included are some areas that are poorly drained. They make up 10 to 15 percent of the unit.

Depth to the high water table ranges from 2 feet to more than 5 feet. Permeability and available water capacity are variable. Surface runoff is medium to ponded. Reaction is mildly alkaline or moderately alkaline in most places. The soil material is very low in content of organic matter. Some plant nutrients are not available because of the alkalinity of the soil.

Most areas are used as wildlife habitat or are idle. Some are permanent pasture. Others are used for recreation. The potential is poor for cropland, pasture, and woodland. Onsite evaluation is needed to determine the potential for recreation and engineering uses.

Not assigned to interpretive groupings.

UeB—Urban land-Boyer-Spinks complex, 0 to 10 percent slopes. This map unit consists of Urban land and undulating and rolling, well drained Boyer and Spinks soils in broad areas and on knolls. Areas are irregular in shape and range from 5 to 100 acres. Urban land makes up about 35 percent of this map unit, Boyer soils 25 percent, and Spinks soils 20 percent. Areas of Urban land and the Boyer and Spinks soils are so intricately associated that mapping them separately is not practical. Urban land is covered with buildings or pavements that so obscure or alter the soils that identification is not feasible.

Typically, the Boyer soil has a dark grayish brown sandy loam surface layer about 8 inches thick. The brown subsoil is about 18 inches thick. The upper part is sandy loam, and the lower part is gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown gravelly sand. In small areas the substratum begins between 40 and 60 inches. In some small areas there is more clay in the subsoil.

Typically, the Spinks soil has a dark brown loamy sand surface layer about 8 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown loamy sand, and the lower part is light yellowish brown sand with yellowish brown bands of loamy sand and light sandy loam. The substratum to depth of 60 inches is light yellowish brown sand. In small areas the total thickness of bands in the subsoil is less than 6 inches.

Included with this unit in mapping are small areas of Brady, Gilford, Metea, and Owosso soils. Brady and Gilford soils, along drainageways and in small depressions, have a seasonal high water table. They make up about 10 percent of the unit. Metea and Owosso soils, on small knolls and ridges, have more clay in the subsoil and the underlying material than Boyer and Spinks soils. They make up about 5 to 10 percent of the unit.

Permeability, available water capacity, and surface runoff in the Urban land are too variable to rate. Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. It is moderately rapid or rapid in the Spinks soil. For both soils, the available water capacity is low and surface runoff is medium to very slow.

Most areas are used for residential, commercial, and light industrial development. Some are used for school grounds and parks. This unit has good to fair potential for most recreational uses and good potential for most engineering uses.

The major limitation for most recreational uses is the sandy surface layer. A layer of medium textured topsoil is needed. Slope is a limitation in places.

These soils are suitable as sites for buildings and sanitary facilities. Onsite septic systems are likely to pollute the water supply.

Not assigned to interpretive groupings.

UpA—Urban land-Capac-Colwood complex, 0 to 4 percent slopes. This map unit consists of Urban land and nearly level and undulating Capac and Colwood soils in broad areas, on low ridges and knolls, along minor drainageways, and in shallow depressional areas. Low areas are subject to flooding. Areas are irregular in shape and range from 10 to 200 acres. Urban land makes up about 35 to 50 percent of this map unit, Capac soils 20 percent, and Colwood soils 20 percent. Areas of these soils and Urban land are so intricately associated that mapping them separately is not practical. Urban land is covered with streets, sidewalks, houses, and other buildings that so obscure or alter the soils that identification is not feasible.

Typically, the Capac soil has a very dark grayish brown loam surface layer about 9 inches thick. The mottled subsoil is about 23 inches thick. The upper part is light olive brown, friable loam, the next part is brown and grayish brown, firm loam and clay loam, and the lower part is brown, firm loam. The substratum to a depth of 60 inches is mottled grayish brown loam. In places the subsoil is less gray.

Typically, the Colwood soil has a black loam surface layer about 10 inches thick. The mottled subsoil is about 18 inches thick. The upper part is dark grayish brown, firm loam. The next part is light brownish gray, firm silty clay loam. The lower part is grayish brown, friable, stratified very fine sandy loam and loamy very fine sand. The substratum to a depth of 60 inches is multicolored, stratified very fine sand, silt, and silt loam. In some areas, the strata are gravelly. In places there is less clay in the subsoil.

Included with this unit in mapping are small areas of Brady, Gilford, Houghton, Kibbie, and Marlette soils and areas of Udorthents. Brady and Gilford soils are more permeable. They occur as scattered areas throughout the unit and make up about 10 percent of the acreage. Houghton soils, in depressional areas, are less stable. They make up about 5 percent of the unit. Udorthents are variable in characteristics. They occur as scattered areas throughout the unit and make up about 5 percent of the acreage.

In most areas of Urban land and Capac and Colwood soils, the seasonal high water table is within 2 feet of the surface in winter and spring. Permeability in Urban land is too variable to rate. It is moderate and moderately slow in the Capac soil and moderate in the Colwood soil. The available water capacity in Urban land is too variable to rate. It is high in the Capac and Colwood soils. Surface runoff is slow to ponded in Urban land and the Capac and Colwood soils.

Most areas are used for residential, commercial, and light industrial development. Some are used for school grounds and parks. This unit has fair to poor potential for most recreational uses and poor potential for most engineering uses.

The major limitation for most recreational uses is excess water. These soils are wet and muddy during wet periods and after heavy rains. Some areas are subject to flooding. Surface and tile drains are needed.

The major limitations in using this unit as sites for buildings and sanitary facilities are the high water table and the flooding. Septic tank filter fields do not function properly. All sanitary facilities should be connected to commercial sewers and treatment facilities.

Not assigned to interpretive groupings.

UtB—Urban land-Marlette complex, 2 to 12 percent slopes. These areas of Urban land and undulating and rolling, well drained and moderately well drained Marlette soils are on broad complex slopes, on ridges, on knolls, and on side slopes. Areas are irregular in shape and range from 10 to 500 acres. Urban land makes up about 35 to 50 percent of this map unit, and Marlette soils 30 percent. The Urban land and Marlette soils are so intricately associated that mapping them separately is not practical. Urban land is covered with buildings that so obscure or alter the soils that identification is not feasible.

Typically, the Marlette soil has a brown fine sandy loam surface layer about 9 inches thick. The firm subsoil is about 22 inches thick. The upper part is brown loam with brown fine sandy loam coatings, the next part is dark yellowish brown clay loam, and the lower part is brown clay loam. The substratum to a depth of 60 inches is brown loam. In places there are no coatings in the upper part of the subsoil. In places there is more sand and less clay in the upper part of the subsoil.

Included with this unit in mapping are small areas of Aubbeenaubbee, Boyer, Capac, Houghton, and Oshtemo soils. Aubbeenaubbee and Capac soils, along minor drainageways and in small depressional areas, are less well drained than the Marlette soil. They make up 5 to 10 percent of the unit. Houghton soils, in depressional areas, are less stable and have a high water table. They make up about 5 percent of the unit. Boyer and Oshtemo soils, on ridgetops and near major drainageways, are droughty. They make up about 10 percent of the unit.

Permeability, available water capacity, and surface runoff in the Urban land are too variable to rate. In the Marlette soil, permeability is moderate or moderately slow, the available water capacity is high, and surface runoff is medium. The Marlette soil has a seasonal high water table at a depth of 2 1/2 to 6 feet in winter and spring.

Most areas are used for residential, commercial, and light industrial development. Some are used for school grounds and parks. This unit has good potential for most recreational uses and good or fair potential for most engineering uses.

Limitations for recreational uses are generally slight. The slope is a moderate limitation for playgrounds. Leveling and shaping are needed to provide good sites for playgrounds.

The major limitations in using this unit as a site for buildings are the low strength of the soil and the wetness. The moderately slow permeability is a limitation in septic tank absorption fields. All sanitary facilities should be connected to commercial sewers and treatment facilities.

Not assigned to interpretive groupings.

Uu—Urban land-Fluvaquents complex. These areas of Urban land and nearly level Fluvaquents are on flood plains and in low positions on the landscape. Many areas are subject to flooding. Areas range from 10 to about 100 acres. Urban land makes up about 40 to 60 percent of this map unit, and Fluvaquents 30 percent. Areas of the Urban land and Fluvaquents are so intricately mixed that mapping them separately is not practical. Urban land is covered with streets, parking lots, and large buildings that so obscure or alter the soil that identification is not feasible.

Many areas of the Fluvaquents are filled with soil material that ranges from sandy loam to clay loam.

Included with this unit in mapping are some areas of nonsoil material, such as cinders, concrete, bricks, and asphalt. In many of these areas the water table is high.

Depth to the water table, the permeability, the available water capacity, and surface runoff in the Urban land are too variable to rate. Depth to the water table ranges from 2 to more than 5 feet in the Fluvaquents.

Most areas are used for commercial and industrial development. This unit has fair to poor potential for most recreational uses and poor potential for most engineering uses.

The major limitations for recreational uses are the flooding and the wetness. The soils are wet during wet periods and after heavy rains. Surface and tile drains are needed. Picnic areas, playgrounds, paths, and trails are generally not damaged by floodwater, but they cannot be used if flooded. Campgrounds, however, should not be located on this unit unless they are protected from flooding.

The major limitations in using this unit as building sites are the flooding and the excess water. Septic tank filter fields do not function properly because of the high water table and the flooding. Storm sewers are needed.

Not assigned to interpretive groupings.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

More than 171,000 acres was cropped in 1974 in Ingham County, according to the U.S. Census of Agriculture. Of this total more than 68,000 acres was used for row crops, mainly corn and soybeans; more than 17,000 acres for close growing crops, mainly wheat and oats; 25,000 acres for hay crops; 14,800 acres for pasture; and the rest for specialty crops and idle cropland.

Soil drainage is one of the major management needs on about two-thirds of the acreage used for crops and pasture in the survey area. Drainage of cropland improves the air-water relationship in the root zone. Spring planting, spraying, and harvesting are hampered where drainage is poor, and weed control is more difficult. Tile drains or surface drainageways, or both, can be used to remove excess water. They should be properly designed. Some soils are naturally so wet and so difficult to drain that the production of crops common to the area is generally not possible. Examples are the poorly drained and very poorly drained Cohoctah soils and Histosols and Aquents, ponded.

Unless artificially drained, the very poorly drained, poorly drained, and somewhat poorly drained soils are so wet that crops are damaged in most years. Examples are the Aubbeenaubbee, Capac, Edwards, Gilford, Houghton, and Palms soils.

Marlette soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Spots of wetter soils along drainageways and in swales are included in some areas, especially in areas where slopes are 2 to 6 percent. Artificial drainage is needed in some of these wetter areas.

Boyer, Spinks, and Oshtemo soils have good natural drainage most of the year. These soils dry out quickly and are deficient in moisture during dry months in summer. Crops that mature early can be grown if a large amount of organic material is added to the soils. Artificial drainage is needed in some of the wetter included areas.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the poorly drained or very poorly drained soils used for row crops. Drains have to be more closely spaced in the slowly permeable soils than in the more permeable soils. Permeability is slow or very slow in Lenawee soils. Finding outlets for tile drainage systems is difficult in many areas of Adrian, Aurelius, Boots, Cohoctah, Edwards, Houghton, and Palms soils. Diversions may be used in some areas to carry surface runoff away from wet areas. Good soil structure also benefits soil drainage. Low areas are subject to a shortened growing season because of frost late in spring and early in fall.

Organic soils oxidize and subside when the pore space is filled with air. Special drainage systems are needed, therefore, to control the depth and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of organic soils. Information on drainage design for each kind of soil is available in local offices of the Soil Conservation Service.

Soil erosion, including soil blowing, is a major hazard on more than half the cropland in Ingham County. If the slope is more than 2 percent, water erosion is a hazard. Marlette soils, for example, have slopes of 2 to 25 percent.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils with a clay loam subsoil, such as Marlette soils. Second, soil erosion results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface soil has been eroded away and the clay loam subsoil is exposed. Such spots are common in sloping areas of Marlette soils.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps a plant cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land and also provide nitrogen and improve tilth for the following crops.

Contouring and stripcropping are useful erosion control practices in the survey area. They are best suited to soils with smooth, uniform slopes, such as some areas of Marlette, Riddles, and Hillsdale soils.

Slopes are so short and irregular that contour tillage or terracing is not practical in many areas of Marlette, Riddles, Hillsdale, Oshtemo, and Spinks soils. On these soils, cropping systems that provide a substantial plant cover are needed to control erosion unless minimum tillage or no tillage is practiced. Minimizing tillage and leaving crop residue on the surface increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to Marlette, Riddles, Hillsdale, Oshtemo, and Spinks soils. No tillage for corn, which is common on an increasing acreage, is effective in reducing erosion on sloping land and can be adapted to some of the soils in the survey area. No tillage leaves the remains of the previous crops on the soil as a mulch that reduces the hazards of wind and water erosion. No tillage allows high yielding corn production on areas considered marginal because of erosion.

Good management is needed for satisfactory crop production with any tillage system. No tillage requires learning new skills in planting, as well as in insect and weed control. A correct planting date, selection of a herbicide system suited to the vegetation present, control of insect pests, adequate nutrients, and selection of tillage systems based on soil characteristics are all important.

Soil blowing (fig. 6) is a hazard on Boyer, Granby, Metea, Oshtemo, Spinks, and Thetford soils and on the muck soils—Adrian, Aurelius, Boots, Edwards, Houghton, Napoleon, and Palms soils. Soil blowing can damage these soils, especially the muck soils, in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. On the soils with a sandy surface layer, a plant cover, no tillage, surface mulch, buffer strips of grain 2 or 3 feet wide, or a rough surface through proper tillage minimize soil blowing. Overgrazing results in blowouts or other severe erosion.

On muck soils, windbreaks of adapted shrubs, such as Tatarian honeysuckle, are effective in reducing soil blowing. Sprinkler irrigation, controlling the water table, and buffer strips of grain 2 or 3 feet wide are also effective in minimizing soil blowing.

Information on the design of erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service.

Soil fertility is naturally medium to high in loamy soils and low in most sandy soils on the uplands in the survey area. The soils on flood plains, such as Cohoctah and Ceresco soils, are naturally higher in plant nutrients than most upland soils.

Many sandy soils are naturally medium acid to neutral. If these soils have never been limed, applications of ground limestone are needed to raise the pH level sufficiently for good growth of alfalfa and other crops that grow on nearly 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 be applied (*4*).

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Some of the soils used for crops in the survey area have a loamy surface layer that is light in color and low in content of organic matter. Generally, the surface of such soils is weak, and intense rainfall causes the formation of a crust on the surface. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material improve soil structure and reduce crust formation.

The dark colored Lenawee soils are clayey, and tilth is a problem because the soils are often wet until late in spring. If plowed when wet, they tend to be very cloddy when dry. They become compact in the subsoil, and a good seedbed is difficult to prepare. Fall plowing generally results in good tilth in spring.

Cover crops and green manure crops, proper use of crop residue, minimum tillage, and livestock manure maintain and improve the organic-matter content and soil tilth. Fall plowing on nearly level, poorly drained, or somewhat poorly drained soils at the right moisture content may reduce damage to soil structure and allow earlier tillage the following spring. Fall plowing should not be done on sloping land or on soils subject to blowing. Pasturing the loamy and clayey soils when they are wet should be avoided because it results in compaction and poor structure.

Field crops suited to the soils and climate of the survey include a few that are not now commonly grown. Corn and soybeans are the row crops commonly grown in the survey area. Grain sorghum, field beans, sunflowers, potatoes, and similar crops can be grown if economic conditions are favorable.

Wheat and oats are the common close growing crops. Rye, barley, buckwheat, and flax could be grown, and grass seed could be produced from bromegrass, fescue, red clover, redtop, and bluegrass.

Special crops grown commercially in the survey area are lettuce, onions, lawn sod, and potatoes. A small acreage throughout the county is used for mint, strawberries, sweet corn, tomatoes, cabbage, and other vegetables and small fruits. In addition, large areas could be adapted to other special crops, such as blueberries, grapes, tree fruits, and many vegetables.

Deep soils that have good natural drainage and that may warm up early in spring are especially well suited to many vegetables and small fruits. Examples are the Boyer, Oshtemo, and Spinks soils on slopes of less than 6 percent. Crops can generally be planted and harvested earlier on all of these soils than on other soils in the survey area.

If adequately drained and protected from soil blowing, the muck soils in the county are well suited to a wide range of vegetable crops. Adrian, Boots, Edwards, Houghton, and Palms muck soils are best suited.

Most of the well drained soils in the survey area are suited to orchards and nursery plants. Soils in low positions where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards.

Latest information and suggestions on growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. 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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. The capability class and subclass levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII (*7*). 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 landforms 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 too cold or too 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, though 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 indicated in table 6. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

Listed at the end of each unit description is the capability subclass and the Michigan soil management group. In the map units of soil complexes, the soil management groups are listed in the same order as the named series. The soils are grouped according to needs for lime and fertilizer, artificial drainage, and other practices. For an explanation of each group, refer to the Michigan State University Research Report 254 "Soil Management Units and Land Use Planning" (*5*).

Briefly, the soil management groups combine soils of similar profiles, texture, and natural drainage conditions. The groups are designated by numbers and letters that identify significant soil properties affecting various uses.

In mineral soils the number is based on the dominant texture: 0 indicates fine clay, more than 60 percent clay; 1 indicates clay, 40 to 60 percent clay; 1.5 indicates clay loam and silty clay loam; 2.5 indicates loam and silt loam; 3 indicates sandy loam; 4 indicates loamy sand; and 5 indicates sand. Soils that developed in uniform parent material are identified by a single number. Soils that developed from two different parent materials or that have contrasting textures in their profiles are identified by fractions. The numerator indicates the texture in the upper part of the profile, and the denominator the lower part of the profile, or the parent material. For example, 3/2 indicates soils that are 20 to 40 inches of sandy loam over loam to silty clay loam.

For alluvial soils in stratified materials, subject to flooding, the numbers are preceded by a capital "L." In soils having 20 to 40 inches of soil material over bedrock, the texture of the overlying material is the numerator of the fraction: 3/R, for example, means sandy loam over bedrock.

Organic soils, muck or peat, are identified by a capital "M." The thin 16- to 51-inch organic soils are identified according to the texture of the underlying mineral material: M/3, for example, means muck over sandy loam to clay loam; M/4, muck over loamy sand or sand; M/m, muck over marl. Organic soils more than 51 inches thick are identified only by the letter "M."

Lowercase letters after the capital letters or the numbers indicate natural drainage conditions: "a" indicates well drained and moderately well drained; "b" indicates somewhat poorly drained; and "c" indicates poorly drained and very poorly drained.

Other soil profile characteristics important to land use planning are indicated by adding a dash and a second lowercase letter to the symbol. For example, "a" after a dash identifies soils that have a very strongly acid (pH less than 4.5) subsoil. An "s" indicates stratification with fine sands and silts.

Woodland management and productivity

Table 7 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Map unit symbols for soils suitable for wood crops are listed.

In table 7 the soils are rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

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 some 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 equipment; *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 that the soil affects expected mortality of planted tree seedlings. Plant competition is not considered in the ratings. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Considered in the ratings of *windthrow hazard* are characteristics of the soil that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate*, that some trees are 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.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The *potential productivity* of merchantable or *important 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. Important 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 suitable for commercial wood production and that are suited to the soils.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species 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 depending on erodibility of the soil. They 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. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 8 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 8, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 9 shows, for each kind of soil, the degree and kind of limitations for building site development; table 10, for sanitary facilities; and table 12, for water management. Table 11 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

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 are indicated in table 9. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, and open ditches. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 9 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 9 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Lawns and landscaping require soils that are suitable for the establishment and maintenance of turf for lawns and ornamental trees and shrubs for landscaping. The best soils are firm after rains, are not dusty when dry, and absorb water readily and hold sufficient moisture for plant growth. The surface layer should be free of stones. If shaping is required, the soils should be thick enough over bedrock or hardpan to allow for necessary grading. In rating the soils, the availability of water for sprinkling is assumed.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 10 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 10 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 11 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 15 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 11 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 15.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel or stones.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel and stones; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 12 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 13 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 13 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 10, and interpretations for dwellings without basements and for local roads and streets, given in table 9.

Camp areas require such site preparation as shaping and leveling for 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 for this use 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 camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They should have a surface that is free of stones and boulders and have moderate slopes. Suitability of the soil for traps, tees, or greens was not considered in rating the soils. Irrigation is an assumed management practice.

Wildlife habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 14, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties 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, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties 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 goldenrod, beggarweed, and wheatgrass.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are oak, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, reed canarygrass, cattails, and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat 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 kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and sandhill cranes.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

Engineering properties

Table 15 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 15 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 15 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 15. Also in table 15 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Ranges in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 16 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing 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, but crops can be grown if measures to control soil blowing 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, and 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, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 17 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils 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.

Flooding is the temporary covering of soil with water from overflowing streams or with runoff from adjacent slopes (fig. 7). Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table, that is, perched or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Subsidence is the settlement of organic soils or of soils containing semifluid layers. Initial subsidence generally results from drainage. Total subsidence is initial subsidence plus the slow sinking that occurs over a period of several years as a result of the oxidation or compression of organic material.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*8*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 18, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Inceptisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquept (*Aqu*, meaning water, plus *ept*, from Inceptisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquepts (*Hapl*, meaning simple horizons, plus *aquept*, the suborder of Inceptisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups 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 *Mollic* identifies the subgroup that is thought to be an intergrade to a great group of Mollisols. An example is Mollic Haplaquepts.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is coarse-loamy, mixed, nonacid, mesic, Mollic Haplaquepts.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*6*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Adrian series

The Adrian series consists of very poorly drained, moderately slowly to moderately rapidly permeable soils on lake plains and outwash plains. These soils formed in organic deposits over coarse textured deposits. Slopes are 0 to 2 percent.

Adrian soils are near Edwards, Houghton, and Palms soils. Edwards soils are underlain by marl. Adrian soils have a thinner organic layer than Houghton soils. They have less silt and clay and more sand in the substratum than Palms soils.

Typical pedon of Adrian muck, 1,200 feet north and 1,000 feet east of southwest corner sec. 16, T. 1 N., R. 1 E.

Oap—0 to 10 inches; black (N 2/0) sapric material; moderate medium granular structure; very friable; less than 5 percent fiber; slightly acid; abrupt smooth boundary.

Oa2—10 to 24 inches; black (10YR 2/1) sapric material; weak thick platy structure; friable; 15 percent fiber, less than 5 percent rubbed; medium acid; gradual wavy boundary.

Oa3—24 to 29 inches; black (10YR 2/1) sapric material; weak thick platy structure; friable; 12 percent fiber, less than 5 percent rubbed; medium acid; abrupt smooth boundary.

IIC1g—29 to 35 inches; dark grayish brown (2.5Y 4/2) and grayish brown (10YR 5/2) sand; single grained; loose; 5 percent pebbles; slightly acid; clear smooth boundary.

IIC2g—35 to 60 inches; grayish brown (2.5Y 5/2) gravelly loamy sand with few sandy loam lenses; massive; very friable; 15 percent pebbles; slight effervescence; mildly alkaline.

Depth to the IICg horizon is 16 to 50 inches. Reaction ranges from medium acid to mildly alkaline in the organic material. In some pedons woody fragments make up about 10 percent of the organic material. This material is less than 25 percent fiber in an unrubbed condition and less than 5 percent fiber after rubbing. The content of pebbles in the IICg horizon ranges from 0 to 50 percent. The IICg horizon is not effervescent in some pedons.

Aubbeenaubbee series

The Aubbeenaubbee series consists of somewhat poorly drained soils that are moderately rapidly permeable in the upper part and moderately permeable in the lower part. These soils are on till plains and moraines. They formed in a thin layer of moderately coarse textured glaciofluvial deposits over medium or moderately fine textured glacial till. Slopes are 0 to 3 percent.

Aubbeenaubbee soils are commonly adjacent to Brookston, Capac, Owosso, and Riddles soils. Brookston soils are more gray in the subsoil and have a mollic epipedon. Capac soils have less sand in the upper part of the subsoil. Owosso and Riddles soils do not have grayish mottles and coatings in the subsoil, and they are better drained.

Typical pedon of Aubbeenaubbee sandy loam in an area of Aubbeenaubbee-Capac sandy loams, 0 to 3 percent slopes, 1,300 feet west and 700 feet south of northeast corner sec. 30, T. 1 N., R. 2 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium subangular blocky structure; friable; medium acid; abrupt smooth boundary.

A2—8 to 17 inches; brown (10YR 5/3) sandy loam; few coarse prominent brown (7.5YR 4/4) mottles; weak thick platy structure parting to weak fine subangular blocky; friable; medium acid; clear wavy boundary.

B21t—17 to 25 inches; brown (10YR 4/3) sandy loam; many coarse distinct yellowish brown (10YR 5/6-5/8), grayish brown (10YR 5/2), and dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; friable; thin dark grayish brown (10YR 4/2) clay films; black (10YR 2/1) stains on faces of peds; slightly acid; abrupt wavy boundary.

IIB22t—25 to 35 inches; brown (10YR 5/3) clay loam; many medium distinct yellowish brown (10YR 5/6-5/8), grayish brown (10YR 5/2), and dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; continuous thick grayish brown (10YR 5/2) clay films on faces of peds; 3 percent pebbles; neutral; clear wavy boundary.

IIC—35 to 60 inches; brown (10YR 5/3) loam; few fine faint dark grayish brown (10YR 4/2) and few fine distinct yellowish brown (10YR 5/6-5/8) mottles; massive; firm; 5 percent pebbles; violent effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 32 to 60 inches. Reaction ranges from medium acid to neutral in the upper part of the solum and is slightly acid or neutral in the lower part. The content of pebbles and cobbles ranges from 1 to 8 percent throughout the profile.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 3 or 4. When dry, it has value of 6 or more.

The A2 horizon is brown (10YR 5/3) or pale brown (10YR 6/3) sandy loam or loamy sand and is mottled in most pedons. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Thin horizons of loamy sand are in some pedons. The IIBt horizon is clay loam, loam, or silty clay loam.

The IIC horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or clay loam.

Aurelius series

The Aurelius series consists of very poorly drained soils on lake plains, till plains, outwash plains, and moraines. These soils formed in shallow or very shallow organic deposits over marl. Slopes are 0 to 2 percent.

Aurelius soils are commonly adjacent to Edwards, Houghton, Keowns, and Palms soils. Edwards, Houghton, and Palms soils have a thicker organic layer. Keowns soils do not have an histic epipedon or a marl layer.

Typical pedon of Aurelius muck, 1,260 feet north and 150 feet east of southwest corner sec. 13, T. 2 N., R. 2 W.

Oap—0 to 9 inches; black (N 2/0) sapric material; moderate fine subangular blocky structure; very friable; about 3 percent fiber, less than 1 percent rubbed; few fine roots; mildly alkaline; abrupt smooth boundary.

IILco—9 to 13 inches; black (5YR 2/1) coprogenous earth; weak thin platy structure; firm; hard; few fine roots; neutral; abrupt smooth boundary.

IIILca—13 to 30 inches; grayish brown (2.5YR 5/2) marl; few medium prominent strong brown (7.5YR 5/8) and yellowish brown (10YR 5/6) mottles; massive; friable; few snail shells and shell fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

IVcg—30 to 60 inches; dark gray (5Y 4/1) stratified fine sandy loam, silt loam, and loamy fine sand; few medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

Depth to the IVcg horizon is 24 to 40 inches.

The organic material ranges from black (N 2/0 or 5YR 2/1) to very dark brown (10YR 2/2). It is 1 to 70 percent mineral matter. Reaction ranges from slightly acid to moderately alkaline. In some pedons there are alternating thin strata of organic material and marl.

The IILco horizon does not appear in some pedons. It ranges from black (5YR 2/1) to dark greenish gray (5G 4/1). Reaction ranges from slightly acid to moderately alkaline.

The IIILca horizon ranges from grayish brown (2.5Y 5/2) to white (N 8/0). In some pedons many shells and shell fragments are in this horizon.

The IVcg horizon ranges from dark gray (N 4/0, 5Y 4/1), to light brownish gray (10YR 6/2). It ranges from loamy fine sand to clay loam. Strata of sand and loamy sand are in some pedons.

Boots series

The Boots series consists of very poorly drained, moderately and moderately rapidly permeable soils on lake plains, till plains, and moraines. These soils formed in deep herbaceous organic deposits. Slopes are 0 to 2 percent.

Boots soils are commonly adjacent to Edwards, Houghton, and Palms soils. They are similar to Napoleon soils. Boots soils contain more fiber than Edwards, Houghton, and Palms soils. They have a thicker organic layer than Edwards and Palms soils. Napoleon soils are more acid than Boots soils.

Typical pedon of Boots muck, 700 feet west and 100 feet north of southeast corner sec. 22, T. 3 N., R. 1 W.

Oap—0 to 10 inches; black (5YR 2/1) sapric material; moderate medium granular structure; friable; 15 percent fiber, 5 percent rubbed; 1 percent woody fragments; neutral; abrupt smooth boundary.

Oel—10 to 24 inches; dark brown (7.5YR 3/2) hemic material; weak thick platy structure; friable; 75 percent fiber, 20 percent rubbed; neutral; gradual wavy boundary.

Oe2—24 to 36 inches; dark brown (7.5YR 3/2) hemic material; weak thick platy structure; friable; 80 percent fiber, 25 percent rubbed; neutral; clear wavy boundary.

Oe3—36 to 60 inches; dark reddish brown (5YR 2/2) hemic material; massive; friable; 35 percent fiber, 17 percent rubbed; neutral.

The organic material is more than 51 inches thick. Reaction ranges from medium acid to neutral. The organic material is derived mainly from herbaceous plants. Some pedons are up to 15 percent woody fragments. Fiber content in the upper part is dominantly less than 16 percent when rubbed but ranges to 30 percent. Fiber content in the lower part is dominantly between 17 and 30 percent when rubbed. Some pedons have fibric layers less than 10 inches thick. The organic material has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 1 to 3.

Boyer series

The Boyer series consists of well drained soils that are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. These soils are on outwash plains, moraines, and eskers. They formed in moderately coarse and coarse textured deposits. Slopes range from 0 to 30 percent.

Boyer soils are commonly adjacent to Brady, Marlette, Oshtemo, and Spinks soils. Brady and Oshtemo soils are deeper to the substratum. Also, Brady soils have grayish mottles. Marlette soils contain more silt and clay throughout the profile. Boyer soils contain more clay in the subsoil than Spinks soils.

Typical pedon of Boyer sandy loam, 0 to 6 percent slopes, 1,500 feet north and 50 feet west of southeast corner sec. 34, T. 2 N., R. 1 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; 10 percent pebbles; slightly acid; abrupt smooth boundary.

A2—8 to 14 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; 10 percent pebbles; neutral; clear wavy boundary.

B21t—14 to 24 inches; strong brown (7.5YR 5/6) sandy loam; moderate medium subangular blocky structure; friable; 10 percent pebbles; thin clay films on faces of peds; neutral; gradual wavy boundary.

B22t—24 to 28 inches; strong brown (7.5YR 5/6) gravelly sandy loam; moderate medium subangular blocky structure; friable; 20 percent pebbles; thick clay films on faces of peds and pebbles; neutral; abrupt wavy boundary.

IIC—28 to 60 inches; yellowish brown (10YR 5/6) gravelly sand; single grained; loose; 50 percent pebbles; strong effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 22 to 40 inches. Reaction ranges from medium acid to mildly alkaline in the solum. Pebble content ranges from less than 5 percent to 25 percent in the solum and from 10 percent to 50 percent in the substratum.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The texture is dominantly loamy sand or sandy loam, but the range includes gravelly phases of each. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It has textures similar to those of the Ap horizon. In uncultivated areas an A1 horizon is present.

In some pedons a B1 horizon is present. The B2t horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6, and chroma of 3, 4, or 6. It is dominantly sandy loam or gravelly sandy loam but has thin subhorizons of sandy clay loam. In some pedons a B3 horizon is present.

The IIC horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 5. It is sand or gravelly sand.

Brady series

The Brady series consists of somewhat poorly drained soils that are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. These soils are on outwash plains, valley trains, and lake plains. They formed in moderately coarse and coarse textured deposits. Slopes are 0 to 3 percent. These soils have a lighter colored surface layer than the range defined for the Brady series, but this difference does not affect their usefulness and behavior.

Brady soils are commonly adjacent to Aubbeenaubbee, Gilford, and Oshtemo soils. Aubbeenaubbee soils have more silt and clay in the substratum. Gilford soils are more poorly drained and have a mollic epipedon. Oshtemo soils do not have grayish mottles and are well drained.

Typical pedon of Brady sandy loam, 0 to 3 percent slopes, 900 feet north and 450 feet east of southwest corner sec. 4, T. 1 N., R. 2 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; few fine roots; 5 percent pebbles; medium acid; abrupt smooth boundary.

A2—9 to 14 inches; grayish brown (10YR 5/3) sandy loam; common medium prominent brown (7.5YR 4/4) and strong brown (7.5YR 5/5) mottles; moderate medium platy structure; very friable; 5 percent pebbles; medium acid; clear wavy boundary.

B21t—14 to 24 inches; grayish brown (10YR 5/3) sandy loam; many medium prominent brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; 10 percent pebbles; thin clay films on faces of peds; medium acid; gradual wavy boundary.

B22t—24 to 36 inches; grayish brown (10YR 5/3) sandy loam; many medium prominent brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; 10 percent pebbles; thin clay films on faces of peds; medium acid; clear wavy boundary.

IIB31t—36 to 49 inches; brown (7.5YR 4/4) loamy sand; few fine prominent grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very friable; 2 percent pebbles; clay bridging between sand grains; medium acid; clear wavy boundary.

IIB32—49 to 62 inches; dark yellowish brown (10YR 4/4) sand; few fine distinct grayish brown (10YR 5/2) mottles; single grained; loose; neutral; clear wavy boundary.

IIC—62 to 68 inches; yellowish brown (10YR 5/4) gravelly sand; common medium distinct brown (7.5YR 5/4) mottles; single grained; loose; 17 percent pebbles; violent effervescence; moderately alkaline.

Thickness of the solum and depth to effervescent material range from 40 to 70 inches. Reaction ranges from medium acid to neutral in the solum.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It has value of 6 or more dry. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. The A horizon is sandy loam or loamy sand.

The B2t horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 5. It is sandy loam that is as much as 6 inches of sandy clay loam. The B3 horizon has colors similar to those of the B2t horizon. It is loamy sand or sand. Some pedons do not have a B3 horizon.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4. It is gravelly sand or sand.

Brookston series

The Brookston series consists of very poorly drained, moderately permeable soils on till plains and moraines. These soils formed in medium and moderately fine textured deposits. Slopes are 0 to 2 percent.

Brookston soils are commonly adjacent to Capac, Colwood, Marlette, and Sebewa soils. Capac soils do not have a mollic epipedon. Colwood soils do not have an argillic horizon. Marlette soils do not have a mollic epipedon and are less gray in the subsoil. Sebewa soils have a gravelly sand or sand substratum.

Typical pedon of Brookston loam in an area of Colwood-Brookston loams, 1,500 feet south and 200 feet east of northwest corner sec. 16, T. 2 N., R. 2 E.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to moderate medium granular; very friable; common roots; 2 percent pebbles; slightly acid; abrupt smooth boundary.

A12—10 to 13 inches; very dark gray (10YR 3/1) loam; few fine distinct grayish brown (10YR 5/2) and common fine distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; thin dark grayish brown (10YR 4/2) clay films on faces of peds; common roots; 3 percent pebbles; slightly acid; clear wavy boundary.

B21tg—13 to 17 inches; dark gray (10YR 4/1) clay loam; common medium distinct dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; friable; thin dark grayish brown (10YR 4/2) clay films on faces of peds; common roots; 2 percent pebbles; slightly acid; clear wavy boundary.

B22tg—17 to 25 inches; dark gray (10YR 4/1) clay loam; moderate medium distinct dark brown (7.5YR 4/4) mottles; strong medium subangular blocky structure; firm; thin clay films on faces of peds; few roots; 3 percent pebbles; neutral; clear wavy boundary.

B23tg—25 to 36 inches; gray (10YR 5/1) clay loam; many medium distinct dark brown (7.5YR 4/4) and common medium distinct yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm; thin clay films on faces of peds; few roots; 3 percent pebbles; neutral; gradual wavy boundary.

B3g—36 to 42 inches; gray (10YR 5/1) clay loam; many coarse prominent yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; 3 percent pebbles; neutral; gradual wavy boundary.

C—42 to 60 inches; yellowish brown (10YR 5/6) loam; common medium prominent gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; 2 percent pebbles; strong effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 30 to 42 inches. Reaction is slightly acid or neutral in the solum. Pebble content ranges from 0 to 5 percent.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 8 to 13 inches thick. It is loam, clay loam, or silty clay loam. The mollic epipedon ranges from 11 to 15 inches in thickness and commonly includes part of the argillic horizon.

The B2tg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is clay loam or silty clay loam.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 8. It is mildly alkaline or moderately alkaline. Texture is commonly loam, but it ranges from sandy loam to clay loam.

Capac series

The Capac series consists of somewhat poorly drained, moderately and moderately slowly permeable soils on till plains and moraines. These soils formed in medium and moderately fine textured deposits. Slopes are 0 to 4 percent.

Capac soils are commonly adjacent to Aubbeenaubbee, Brookston, and Marlette soils. Aubbeenaubbee soils have more sand in the upper part of the subsoil. Brookston soils are more gray in the subsoil, have a mollic epipedon, and are more poorly drained. Marlette soils do not have grayish mottles in the upper part of the subsoil and are better drained.

Typical pedon of Capac loam, 0 to 3 percent slopes, 880 feet north and 190 feet west of southeast corner sec. 26, T. 1 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

B&A—9 to 11 inches; light olive brown (2.5YR 5/4) loam (B2); brown (10YR 5/3) coatings on vertical faces of peds (A2); few fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak medium granular structure; friable; few thin discontinuous dark grayish brown (10YR 4/2) clay films on vertical faces of peds; medium acid; clear wavy boundary.

B21t—11 to 15 inches; brown (10YR 5/3) loam; common fine distinct yellowish brown (10YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; firm; light brownish gray (10YR 6/2) fine sandy loam coatings on vertical faces of peds; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds; slightly acid; gradual wavy boundary.

B22tg—15 to 28 inches; grayish brown (10YR 5/2) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; thick continuous dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; gradual wavy boundary.

B23t—28 to 32 inches; brown (10YR 5/3) loam; common medium distinct yellowish brown (10YR 5/6) and common fine faint light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; thick dark grayish brown (10YR 4/2) clay films on faces of peds; mildly alkaline; abrupt wavy boundary.

Cg—32 to 60 inches; grayish brown (10YR 5/2) loam; common fine faint olive gray (5Y 5/2) and common medium distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure in upper part and massive in lower part; friable; slight effervescence; moderately alkaline.

Thickness of the solum and depth to effervescent material range from 26 to 40 inches. Reaction ranges from medium acid to mildly alkaline in the solum. Coarse fragments range from less than 1 percent to 10 percent throughout the pedon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3 moist. It has value of 6 or more dry. The texture is dominantly loam, but the range includes sandy loam or fine sandy loam. In some pedons an A2 horizon is present. In uncultivated areas an A1 horizon is present.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 3. It averages 18 to 35 percent clay.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or 3. It is loam or clay loam.

Ceresco series

The Ceresco series consists of somewhat poorly drained, moderately and moderately rapidly permeable soils on flood plains of streams and rivers. These soils formed in moderately coarse and coarse textured deposits. Slopes are 0 to 2 percent. These soils have a lighter colored surface layer than the range defined for the Ceresco series, but this difference does not affect their usefulness and behavior.

Ceresco soils are commonly adjacent to Cohoctah soils. Cohoctah soils are more gray below the surface layer and are more poorly drained.

Typical pedon of Ceresco fine sandy loam, 200 feet east of southwest corner sec. 25, T. 4 N., R. 1 W.

A1—0 to 15 inches; very dark gray (10YR 3/1) fine sandy loam, light gray (10YR 6/1) dry; moderate medium granular structure; friable; common roots; neutral; abrupt smooth boundary.

B1—15 to 24 inches; stratified dark brown (10YR 4/3) and very dark grayish brown (10YR 3/2) very fine sandy loam; common medium distinct grayish brown (10YR 5/2) and many fine distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

B2—24 to 37 inches; dark yellowish brown (10YR 4/4) very fine sandy loam; common large distinct gray (10YR 6/1) and few fine distinct reddish brown (5YR 4/4) mottles; weak coarse subangular blocky structure; friable; very dark gray (10YR 3/1) stains; few roots; mildly alkaline; gradual wavy boundary.

B3g—37 to 48 inches; grayish brown (10YR 5/2) fine sandy loam; many large prominent yellowish brown (10YR 5/6-5/8), many medium prominent strong brown (7.5YR 5/6), and few fine prominent reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; friable; very dark gray (10YR 3/1) stains; moderately alkaline; abrupt wavy boundary.

IICg—48 to 60 inches; stratified very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) loamy fine sand; common fine prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) and common fine distinct grayish brown (10YR 5/2) mottles; single grained; loose; black (N 2/0) stains; mildly alkaline.

Reaction ranges from slightly acid to mildly alkaline in the upper part of the solum and from neutral to moderately alkaline in the lower part.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2 moist. It has value of 6 or more dry. Texture is dominantly fine sandy loam, but the range includes sandy loam or loamy fine sand.

The B horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, sandy loam, or loamy fine sand.

The C horizon has hue of 10YR, value of 3 to 5, and chroma of 1 or 2. It is loamy fine sand, sandy loam, or loamy sand.

Cohoctah series

The Cohoctah series consists of poorly and very poorly drained, moderately rapidly permeable soils on flood plains. These soils formed in medium and moderately coarse textured deposits. Slopes are 0 to 2 percent.

Cohoctah soils are similar to Gilford and Keowns soils. They are commonly adjacent to Ceresco and Palms soils. Gilford and Keowns soils do not show an irregular decrease in organic carbon with depth. Ceresco soils are less gray. Palms soils have a sapric layer 16 to 50 inches thick.

Typical pedon of Cohoctah silt loam, 150 feet north and 2,250 feet west of southeast corner sec. 33, T. 1 N., R. 2 W.

A11—0 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; common medium prominent strong brown (7.5YR 5/6, 5/8) mottles; moderate medium granular structure; very friable; common fine roots; neutral; clear smooth boundary.

A12g—14 to 19 inches; very dark grayish brown (10YR 3/2) silt loam; common medium prominent strong brown (7.5YR 5/6, 5/8) mottles; weak medium granular structure; very friable; few fine roots; thin (1/8 inch to 1/2 inch) strata of dark grayish brown (10YR 4/2) loamy sand; mildly alkaline; clear wavy boundary.

C1g—19 to 29 inches; dark grayish brown (10YR 4/2) loam; many coarse prominent yellowish brown (10YR 5/6, 5/8) and strong brown (7.5YR 5/6, 5/8) and few fine faint dark gray (10YR 4/1) mottles; weak coarse subangular blocky structure; friable; mildly alkaline; gradual wavy boundary.

C2g—29 to 35 inches; dark grayish brown (10YR 4/2) fine sandy loam; many coarse prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6, 5/8) and few fine faint dark gray (10YR 4/1) mottles; massive; friable; mildly alkaline; abrupt wavy boundary.

C3g—35 to 42 inches; dark gray (10YR 4/1) sandy loam; few fine faint dark brown (10YR 4/3) and very dark grayish brown (10YR 3/2) mottles; massive; friable; slight effervescence; mildly alkaline; abrupt wavy boundary.

C4g—42 to 60 inches; olive gray (5Y 4/2) loamy sand; massive; very friable; strong effervescence; mildly alkaline.

Reaction ranges from neutral to moderately alkaline in the solum. Depth to effervescent material is 20 to 40 inches. The content of pebbles is as much as 5 percent in some pedons.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is dominantly silt loam, but the range includes very fine sandy loam, fine sandy loam, or sandy loam. The A horizon is 10 to 20 inches thick.

The C horizon has hue of 10YR or 5Y, value of 3 to 6, and chroma of 1 or 2. It is stratified with layers of sandy loam, fine sandy loam, or loam. Some pedons have thin strata of sand, loamy sand, and silt loam.

Colwood series

The Colwood series consists of poorly drained and very poorly drained, moderately permeable soils on lake plains, outwash plains, and till plains. These soils formed in stratified deposits with alternating layers of coarse to moderately fine texture. Slopes are 0 to 2 percent.

Colwood soils are commonly adjacent to Aubbeenaubbee, Brookston, Capac, and Kibbie soils. Aubbeenaubbee, Capac, and Kibbie soils are less gray in the subsoil and do not have a mollic epipedon. Brookston soils are not stratified.

Typical pedon of Colwood loam in an area of Colwood-Brookston loams, 1,650 feet west and 50 feet south of northeast corner sec. 24, T. 3 N., R. 1 W.

Ap—0 to 10 inches; black (10YR 2/1) loam; weak fine subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

A3—10 to 15 inches; black (10YR 2/1) silty clay loam; common medium distinct dark gray (10YR 4/1) mottles; moderate medium subangular blocky structure; firm; few fine roots; mildly alkaline; clear smooth boundary.

B2g—15 to 26 inches; dark gray (5Y 4/1) silty clay loam; strong medium subangular blocky structure; firm; few fine roots; mildly alkaline; clear wavy boundary.

C1g—26 to 32 inches; gray (5Y 5/1) fine sandy loam; massive; friable; strong effervescence; moderately alkaline; abrupt wavy boundary.

C2g—32 to 60 inches; stratified grayish brown and brown loam, silty clay loam, fine sandy loam, and clay loam; common medium faint gray (10YR 4/1) and yellowish brown (10YR 5/4) mottles; massive; friable and firm; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. Reaction ranges from slightly acid to mildly alkaline.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is dominantly loam, but the range includes silt loam, fine sandy loam, or very fine sandy loam.

The Bg horizon has hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is mottled. Individual layers are yellowish brown (10YR 5/4, 5/6, 5/8) or light olive brown (2.5Y 5/4, 5/6). This horizon is loam, clay loam, sandy clay loam, silty clay loam, silt loam, or fine sandy loam. Thin strata of silt, fine sand, very fine sand, or silty clay are also in the B horizon.

The C horizon dominantly has hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 or 2, but individual layers of brighter colors occur. It is stratified silty clay loam, loam, silt loam, fine sandy loam, fine sand, and very fine sand. In many pedons strata of clay, clay loam, silty clay, or loamy sand are in the C horizon.

Edwards series

The Edwards series consists of very poorly drained, variably permeable soils on outwash plains, till plains, lake plains, and moraines. These soils formed in organic deposits over marl. Slopes are 0 to 2 percent.

Edwards soils are commonly adjacent to Adrian, Aurelius, Houghton, and Palms soils. Adrian, Houghton, and Palms soils do not have marl in the control section. Aurelius soils have a thinner organic layer.

Typical pedon of Edwards muck, 100 feet west and 450 feet north of southeast corner sec. 10, T. 2 N., R. 2 W.

Oap—0 to 8 inches; black (N 2/0) sapric material; moderate fine granular structure; very friable; less than 1 percent fiber; many fine roots; mildly alkaline; abrupt smooth boundary.

Oa2—8 to 14 inches; black (10YR 2/1) sapric material; weak medium subangular blocky structure; friable; 15 percent fiber, less than 1 percent rubbed; common fine roots; mildly alkaline; gradual wavy boundary.

Oa3—14 to 29 inches; black (10YR 2/1) sapric material; weak thick platy structure; friable; 20 percent fiber, less than 1 percent rubbed; few fine roots; mildly alkaline; abrupt smooth boundary.

IILca1—29 to 33 inches; light gray (10YR 7/2) marl; massive; friable; 5 percent fiber, less than 1 percent rubbed; strong effervescence; moderately alkaline; clear smooth boundary.

IILca2—33 to 60 inches; gray (10YR 5/1) marl; massive; friable; less than 1 percent fiber; strong effervescence; moderately alkaline.

Depth to the IILca horizon is 16 to 49 inches. Reaction ranges from slightly acid to mildly alkaline in the organic material. Some pedons are 10 to 20 percent by volume coarse fragments, which consist of twigs, branches, or logs in the organic material. Individual layers in some pedons have a single log that occupies the major part of the layer.

The surface layer is very dark brown (10YR 2/2) or black (10YR 2/1, N 2/0, broken face and rubbed). Fiber content is less than 10 percent rubbed. The next layers of organic material have hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 0 to 3 on the broken face and rubbed. Thin layers of more fibrous material occur in some pedons. The combined thickness is less than 5 inches. Small shells are in the organic material near the marl contact. They occur throughout the profile in some pedons.

The IILca horizon has hue of 10YR, value of 5 to 8, and chroma of 1 or 2. The marl is more than 6 inches thick.

Eleva variant

The Eleva variant consists of moderately well drained and well drained, moderately rapidly permeable soils on till plains and outwash plains. These soils formed in channery moderately coarse textured deposits over sandstone bedrock. Slopes are 2 to 6 percent.

Eleva variant soils are commonly adjacent to Kibbie and Oshtemo soils. None of these adjacent soils is underlain by bedrock within 60 inches of the surface. Brady and Kibbie soils have grayish mottles in the subsoil and are more poorly drained.

Typical pedon of Eleva Variant channery sandy loam, 2 to 6 percent slopes, 100 feet east and 600 feet south of northwest corner sec. 33, T. 1 N., R. 2 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) channery sandy loam; weak medium subangular blocky structure; friable; 25 percent sandstone fragments; medium acid; abrupt smooth boundary.

A2—8 to 14 inches; yellowish brown (10YR 5/4) channery sandy loam; weak thick platy structure; friable; 25 percent sandstone fragments; slightly acid; clear wavy boundary.

B2t—14 to 28 inches; dark yellowish brown (10YR 4/4) channery sandy loam; moderate medium subangular blocky structure; friable; thin dark brown (10YR 4/3) clay films on faces of peds; 50 percent sandstone fragments; slightly acid; clear irregular boundary.

R—28 inches; dark reddish gray (5YR 4/2) and yellowish brown (10YR 5/6) sandstone; fragmented into 1 to 3 inches thick flagstones in the upper part.

Depth of the soil is 20 to 40 inches. Reaction ranges from strongly acid to slightly acid in the solum below the Ap horizon.

The Ap horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). It is light brownish gray (10YR 6/2) dry. It is 6 to 10 inches thick. Sandstone fragments range from 5 to 30 percent. Some glacial stones and pebbles are in many pedons.

The A2 horizon is yellowish brown (10YR 5/4), brown (10YR 5/3), or pale brown (10YR 6/3). It is 0 to 10 inches thick. Sandstone fragments range from 5 to 30 percent.

The B2t horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4). Sandstone fragments range from 35 to 60 percent. Mottles are in the lower part in some pedons.

Colors of the bedrock have a wide range of hue, value, and chroma. The rock is fragmented in the upper part and is soft in some places.

Gilford series

The Gilford series consists of very poorly drained, moderately rapidly permeable soils on outwash plains, valley trains, and lake plains. These soils formed in moderately coarse and coarse textured deposits. Slopes are 0 to 2 percent.

Gilford soils are commonly adjacent to Brady, Keowns, and Sebewa soils. Brady soils are less gray in the subsoil and are less poorly drained. Keowns soils have more silt, fine sand, and very fine sand in the subsoil and substratum. Sebewa soils have more clay in the subsoil.

Typical pedon of Gilford sandy loam, 440 feet north and 630 feet west of center sec. 5, T. 1 N., R. 1 E.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam; weak fine granular structure; very friable; few roots; 2 percent pebbles; slightly acid; abrupt smooth boundary.

B1g—10 to 15 inches; dark gray (10YR 4/1) sandy loam; common fine prominent yellowish red (5YR 4/8) and common fine distinct light gray (10YR 7/2) mottles; weak fine subangular blocky structure; very friable; very dark grayish brown (10YR 3/2) worm and root channels; few roots; 2 percent pebbles; slightly acid; clear wavy boundary.

B21g—15 to 23 inches; dark gray (10YR 4/1) sandy loam; common fine distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; firm; few roots; few dark gray (N 4/0) coatings on peds; 2 percent pebbles; neutral; abrupt wavy boundary.

B22g—23 to 39 inches; stratified dark grayish brown (2.5Y 4/2) sandy loam and loamy sand; common fine distinct dark gray (N 4/0) mottles; weak coarse subangular blocky structure; friable; few roots; 10 percent pebbles; neutral; abrupt wavy boundary.

IIC1g—39 to 50 inches; grayish brown (2.5Y 5/2) fine sand; common fine prominent light olive brown (2.5Y 5/6) mottles; single grained; loose; strong effervescence; 2 percent pebbles; moderately alkaline; clear wavy boundary.

IIC2—50 to 60 inches; light olive brown (2.5Y 5/4) gravelly loamy sand; single grained; loose; 35 percent pebbles; violent effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. Reaction is slightly acid or neutral. Pebble content ranges from less than 1 percent to 10 percent in the solum.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is dominantly sandy loam, but the range includes loamy sand.

The Bg horizon has hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam, sandy clay loam, or loamy sand.

The IIC horizon has hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is gravelly loamy sand, fine sand, gravelly sand, or sand. Thin strata of silt, sandy loam, or clay loam are in the IIC horizon in some pedons.

Granby series

The Granby series consists of poorly drained and very poorly drained, rapidly permeable soils on outwash plains, on lake plains, and in drainageways. These soils formed in moderately coarse and coarse textured deposits. Slopes are 0 to 2 percent.

Granby soils are commonly adjacent to Adrian, Gilford, Keowns, and Thetford soils. Adrian soils have an histic epipedon. Gilford and Keowns soils have more silt and clay in the subsoil. Thetford soils are less gray and are less poorly drained.

Typical pedon of Granby loamy fine sand, 310 feet north and 200 feet east of center sec. 21, T. 1 N., R. 1 E.

Ap—0 to 10 inches; black (N 2/0) loamy fine sand; weak medium granular structure; very friable; common very fine roots; neutral; abrupt smooth boundary.

B2g—10 to 22 inches; dark gray (10YR 4/1) loamy fine sand; weak very fine subangular blocky structure; very friable; few very fine roots; mildly alkaline; clear wavy boundary.

B3g—22 to 48 inches; grayish brown (10YR 5/2) loamy fine sand; common fine distinct brownish yellow (10YR 6/6) mottles; weak fine subangular blocky structure; very friable; black (N 2/0) segregations; slight effervescence; mildly alkaline; clear wavy boundary.

IICg—48 to 60 inches; grayish brown (10YR 5/2) gravelly sand; few fine distinct olive (5Y 5/4) mottles; single grained; loose; 25 percent pebbles; violent effervescence; moderately alkaline.

The solum is 24 to 52 inches thick. Reaction ranges from medium acid to mildly alkaline in the upper part of the solum and from neutral to moderately alkaline in the lower part.

The Ap horizon has value of 2 or 3 and chroma of 0 to 2. Texture is dominantly loamy fine sand, but the range includes loamy sand, sand, fine sand, fine sandy loam, or sandy loam.

The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is loamy fine sand, loamy sand, fine sand, or sand.

The C horizon has hue of 10YR, 5Y, or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is sand, loamy sand, or gravelly sand.

Hillsdale series

The Hillsdale series consists of well drained, moderately or moderately rapidly permeable soils on till plains and moraines. These soils formed in moderately coarse or coarse textured deposits. Slopes are 2 to 18 percent.

Hillsdale soils are commonly adjacent to Oshtemo, Riddles, and Spinks soils. Hillsdale soils have less clay in the subsoil than Riddles soils. Hillsdale soils have more silt and clay and less sand and coarse fragments in the lower part of the subsoil and substratum than Oshtemo soils. Hillsdale soils have more silt and clay in the subsoil and substratum than Spinks soils.

Typical pedon of Hillsdale sandy loam in an area of Riddles-Hillsdale sandy loams, 6 to 12 percent slopes, 700 feet north and 1,000 feet west of southeast corner sec. 32, T. 1 N., R. 2 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) sandy loam; moderate fine and medium subangular blocky structure; friable; many fine and medium roots; 2 percent pebbles; medium acid; abrupt smooth boundary.

A2—8 to 10 inches; yellowish brown (10YR 5/4) sandy loam, very pale brown (10YR 7/4) dry; weak coarse subangular blocky structure parting to weak fine platy; friable; common fine roots; 2 percent pebbles; brown (10YR 4/3) root and worm channels; slightly acid; abrupt wavy boundary.

B21t—10 to 24 inches; yellowish brown (10YR 5/6) sandy loam; moderate coarse subangular blocky structure; friable; thick brown (7.5YR 4/4) clay films on faces of peds; common fine roots; 2 percent pebbles; brown (10YR 4/3) root and worm channels; medium acid; clear wavy boundary.

B22t—24 to 32 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium subangular blocky structure; friable; thick brown (7.5YR 4/4) clay films on faces of peds; few fine roots; 2 percent pebbles; strongly acid; clear wavy boundary.

B23t—32 to 44 inches; dark yellowish brown (10YR 4/5) sandy loam; moderate coarse subangular blocky structure; friable; thick brown (7.5YR 4/4) clay films on faces of peds; few fine roots; 2 percent pebbles; strongly acid; clear wavy boundary.

B31—44 to 56 inches; dark yellowish brown (10YR 4/6) sandy loam; weak medium subangular blocky structure; very friable and friable; few thin clay films on faces of peds; 2 percent pebbles; strongly acid; gradual smooth boundary.

B32—56 to 66 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; very friable and friable; 2 percent pebbles; medium acid.

Thickness of the solum and depth to effervescent material range from 45 to 80 inches. Pebble content ranges from 2 to 15 percent throughout.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. It is 7 to 10 inches thick. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5 and chroma of 3 to 6. Texture is sandy loam with as much as 6 inches of sandy clay loam. Some pedons have a C horizon.

Houghton series

The Houghton series consists of very poorly drained, moderately slowly to moderately rapidly permeable soils on outwash plains, till plains, lake plains, and moraines. These soils formed in deep herbaceous organic deposits. Slopes range from 0 to 2 percent.

Houghton soils are commonly adjacent to Boots, Edwards, and Palms soils. They are similar to Napoleon soils. Boots and Napoleon soils are hemic. Napoleon soils are also dysic. Edwards and Palms soils have a thinner organic layer.

Typical pedon of Houghton muck, 1,180 feet west and 315 feet north of southeast corner sec. 30, T. 1 N., R. 1 E.

Oa1—0 to 8 inches; black (N 2/0) broken face, black (5YR 2/1) rubbed, sapric material; weak medium granular structure; very friable; about 5 percent fiber; medium acid; abrupt smooth boundary.

Oa2—8 to 18 inches; dark reddish brown (5YR 2/2) broken face, black (5YR 2/1) rubbed, sapric material; weak medium subangular blocky structure; friable; about 5 percent fiber, about 3 percent rubbed; medium acid; clear smooth boundary.

Oa3—18 to 31 inches; dark reddish brown (5YR 2/2) broken face, black (N 2/0) rubbed, sapric material; weak thick platy structure; friable; about 18 percent fiber, about 5 percent rubbed; medium acid; abrupt smooth boundary.

Oa4—31 to 40 inches; black (5YR 2/1) sapric material; massive; friable; about 25 percent fiber, about 5 percent rubbed; slightly acid; abrupt smooth boundary.

Oa5—40 to 60 inches; dark reddish brown (5YR 2/2) sapric material; massive; friable; about 25 percent fiber, about 10 percent rubbed; neutral.

The organic material is more than 51 inches thick. Reaction in the profile ranges from slightly acid to mildly alkaline. The organic material is derived mainly from herbaceous plants. Some pedons contain some wood fragments. Fiber content in the upper part is dominantly 0 to 5 percent when rubbed but ranges to 15 percent. Some pedons have hemic material less than 10 inches thick or fibric material less than 5 inches thick in the lower part. The organic material has hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 0 to 3.

Keowns series

The Keowns series consists of poorly drained, moderately permeable soils on lake plains and outwash plains. These soils formed in stratified coarse to medium textured deposits. Slopes are 0 to 2 percent.

Keowns soils are commonly adjacent to Colwood, Gilford, Granby, and Kibbie soils. Colwood and Kibbie soils have more clay in the subsoil. In addition, Kibbie soils are less gray in the subsoil and are less poorly drained. Gilford soils have less silt and clay in the substratum and more pebbles throughout the soil. Granby soils have less silt and clay throughout the soil.

Typical pedon of Keowns very fine sandy loam, 1,740 feet north and 90 feet west of southeast corner sec. 22, T. 1 N., R. 1 E.

Ap—0 to 10 inches; very dark brown (10YR 2/2) very fine sandy loam; weak medium granular structure; friable; common fine roots; mildly alkaline; abrupt smooth boundary.

B21g—10 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam; few fine faint brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

B22g—16 to 22 inches; grayish brown (10YR 5/2) fine sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

B23—22 to 29 inches; light yellowish brown (2.5Y 6/4) stratified very fine sandy loam and loamy very fine sand; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very friable; mildly alkaline; abrupt wavy boundary.

Cg—29 to 60 inches; light brownish gray (2.5Y 6/2) stratified fine sand, loamy very fine sand, and very fine sandy loam; common large distinct yellowish brown (10YR 5/6) mottles; single grained; massive; loose and very friable; strong effervescence; moderately alkaline.

The solum is 30 to 40 inches thick. Reaction ranges from slightly acid to mildly alkaline.

The Ap horizon is very dark brown (10YR 2/2), black (10YR 2/1), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). Texture is dominantly very fine sandy loam, but the range includes fine sandy loam or silt loam.

The B2 horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 1 to 4. Chroma is 2 or less immediately below the Ap horizon. The B2 horizon is very fine sandy loam, fine sandy loam, or loamy very fine sand. In some profiles a B3 horizon is present. It has colors and textures like those of the B2 horizon.

The C horizon has hue of 10YR, 5Y, or 2.5Y, value of 5 or 6, and chroma of 1 to 3. It is stratified very fine sandy loam, fine sand, very fine sand, and silt loam with some thin strata of silty clay loam.

Kibbie series

The Kibbie series consists of somewhat poorly drained, moderately permeable soils on lake plains and outwash plains. These soils formed in stratified coarse to moderately fine textured deposits. Slopes are 0 to 3 percent.

Kibbie soils are commonly adjacent to Aubbeenaubbee, Colwood, Lenawee, and Sisson soils. Aubbeenaubbee soils are not stratified in the substratum. Colwood and Lenawee soils are grayish in the subsoil and are more poorly drained. In addition, Lenawee soils have more clay in the subsoil. Sisson soils do not have grayish mottles in the subsoil and are well drained.

Typical pedon of Kibbie loam, 0 to 3 percent slopes, 75 feet south and 1,210 feet east of northwest corner sec. 22, T. 1 N., R. 1 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; few very fine roots; slightly acid; abrupt smooth boundary.

A2—9 to 11 inches; brown (10YR 4/3) sandy loam; weak moderate subangular blocky structure; friable; pale brown (10YR 6/3) fine sand coating on faces of peds; very dark grayish brown (10YR 3/2) worm and root channels; few very fine roots; neutral; clear wavy boundary.

B21t—11 to 15 inches; dark brown (10YR 4/3) clay loam; common fine distinct yellowish brown (10YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; thin dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; neutral; clear wavy boundary.

B22t—15 to 20 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure; firm; thick very dark grayish brown (10YR 3/2) clay films on faces of peds; few very fine roots; neutral; clear wavy boundary.

B23t—20 to 28 inches; yellowish brown (10YR 5/4) sandy clay loam; many medium distinct yellowish brown (10YR 5/6) and common fine distinct grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; friable; thin very dark grayish brown (10YR 3/2) clay films on faces of peds; neutral; abrupt wavy boundary.

Cg—28 to 60 inches; grayish brown (10YR 5/2) stratified silt loam, loam, and sandy loam; common medium distinct yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; light gray (2.5Y 7/2) lime segregations; violent effervescence; moderately alkaline.

Thickness of the solum and depth to effervescent material range from 24 to 40 inches. The content of pebbles is less than 1 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. Texture is dominantly fine sandy loam, but the range includes silt loam, sandy loam, or loam. The A2 horizon is pale brown (10YR 6/3) or brown (10YR 5/3, 4/3). It has textures like those of the Ap horizon. The A2 horizon does not occur in some pedons. In uncultivated areas an A1 horizon is present.

The B horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. Coatings on the faces of peds have chroma of 2 or less. This horizon is sandy clay loam, silty clay loam, silt loam, or clay loam. Thin strata of silt, fine sand, and very fine sand are in some pedons.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is stratified silt loam, loam, sandy loam, very fine sandy loam, fine sand, silt, very fine sand, silty clay loam, and loamy very fine sand.

Lenawee series

The Lenawee series consists of poorly drained and very poorly drained, moderately slowly permeable soils on lake plains. These soils formed in stratified deposits with alternating layers of coarse to fine textured deposits. Slopes are 0 to 2 percent. These soils do not have enough clay in their subsoil to satisfy the minimum requirement for the Lenawee series, but this difference does not alter their usefulness or behavior.

Lenawee soils are commonly adjacent to Capac, Colwood, and Kibbie soils. All of these soils have less clay in the subsoil than Lenawee soils. In addition, Capac and Kibbie soils are less gray in the subsoil and are less poorly drained.

Typical pedon of Lenawee silty clay loam, 100 feet east and 1,550 feet north of southwest corner sec. 32, T. 1 N., R. 2 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; moderate coarse subangular blocky structure; very firm; few fine roots; neutral; abrupt smooth boundary.

B21g—8 to 22 inches; dark gray (5Y 4/1) silty clay; few medium prominent yellowish brown (10YR 5/6, 5/8) mottles; moderate very coarse angular blocky structure; very firm; continuous thick black (N 2/0) coatings on vertical faces of peds; few fine roots; mildly alkaline; clear smooth boundary.

B22g—22 to 30 inches; dark gray (5Y 4/1) silty clay loam; few fine prominent yellowish brown (10YR 5/6, 5/8) mottles; weak medium subangular blocky structure; firm; mildly alkaline; abrupt smooth boundary.

Cg—30 to 60 inches; stratified olive brown (2.5Y 4/4) silt loam and clay loam and grayish brown (10YR 5/2) sand; massive; single grained; firm and loose; individual strata range from 1 to 6 inches in thickness; slight effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 25 to 40 inches. Reaction ranges from slightly acid to mildly alkaline.

The A horizon has hue of 10YR, value of 1 to 3, and chroma of 0 to 3. Texture is dominantly silty clay loam, but the range includes silt loam. This horizon is 7 to 9 inches thick.

The Bg horizon has hue of 10YR or 5Y, value of 4 to 6, and chroma of 1 or 2. Thins layers of silt loam are in some pedons.

The C horizon has hue of 10YR or 5Y, value of 4 to 6, and chroma of 1 to 6. It is stratified silt loam, clay loam, silty clay loam, and sand.

Marlette series

The Marlette series consists of well drained and moderately well drained, moderately and moderately slowly permeable soils on till plains and moraines. These soils formed in medium and moderately fine textured deposits. Slopes are 2 to 25 percent.

Marlette soils are commonly adjacent to Boyer, Brookston, Capac, and Owosso soils. Boyer soils are coarse loamy and have a substratum of gravelly sand. Brookston soils have a mollic epipedon, are more gray in the subsoil, and are very poorly drained. Owosso soils have more sand and less clay in the upper part of the subsoil. Capac soils have gray mottles in the subsoil and are somewhat poorly drained.

Typical pedon of Marlette fine sandy loam, 2 to 6 percent slopes, 1,100 feet north and 100 feet west of southeast corner sec. 26, T. 1 N., R. 1 E.

Ap—0 to 9 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; few very fine roots; 3 percent pebbles; slightly acid; abrupt smooth boundary.

B&A—9 to 15 inches; brown (10YR 4/3) loam (B2t); moderate medium subangular blocky structure; firm; brown (10YR 5/3) fine sandy loam (A2), white (10YR 8/2) dry, coatings more than 2 mm thick on faces of peds; vertical extension through the horizon; few very fine roots; few thin discontinuous dark brown (7.5YR 4/4) clay films on faces of peds; 3 percent pebbles; neutral; gradual wavy boundary.

B21t—15 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium angular blocky structure; firm; few very fine roots; many thin dark brown (7.5YR 4/4) clay films on faces of peds; 3 percent pebbles; slightly acid; gradual wavy boundary.

B22t—24 to 31 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and few fine faint dark grayish brown (10YR 4/2) mottles; moderate medium angular blocky structure; firm; few very fine roots; thin dark brown (10YR 4/3) clay films on faces of peds; 3 percent pebbles; mildly alkaline; clear wavy boundary.

C—31 to 60 inches; brown (10YR 5/3) loam; common fine distinct yellowish brown (10YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; few thin discontinuous dark brown (10YR 4/3) clay films on faces of peds to 33 inches; 5 percent pebbles; weak coarse angular blocky structure in the upper part and massive in the lower part; friable; slight effervescence; moderately alkaline.

Thickness of the solum and depth to effervescent material range from 25 to 40 inches. Reaction dominantly ranges from medium acid to neutral in the solum but is mildly alkaline in the lower part. Coarse fragments range from 2 to 10 percent throughout the profile.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). Texture is dominantly fine sandy loam, but the range includes loam, clay loam, or sandy loam. In some pedons a separate A2 horizon is above the B&A horizon. The A2 horizon and the A part of the B&A horizon have hue of 10YR, value of 4 to 6, and chroma of 2 or 3. In uncultivated areas an A1 horizon is present.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. In some pedons the lower part of the B horizon does not have mottles. The B part of the B&A horizon has colors and textures similar to those of the Bt horizon.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or clay loam.

Matherton series

The Matherton series consists of somewhat poorly drained soils that are moderately permeable in the upper part and rapidly permeable in the substratum. These soils are on outwash plains, valley trains, and terraces. They formed in moderately coarse to moderately fine textured deposits underlain by coarse textured deposits. Slopes are 0 to 3 percent.

Matherton soils are commonly adjacent to Aubbeenaubbee, Boyer, and Sebewa soils. Aubbeenaubbee soils have more silt and clay in the substratum than Matherton soils. Boyer soils do not have grayish mottles in the subsoil and are well drained. Sebewa soils are more gray in the subsoil and are more poorly drained.

Typical pedon of Matherton sandy loam, 0 to 3 percent slopes, 1,400 feet east and 1,650 feet north of southwest corner sec. 10, T. 1 N., R. 1. W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; common fine roots; 5 percent pebbles; medium acid; abrupt smooth boundary.

B1—9 to 11 inches; dark grayish brown (10YR 4/2) sandy loam; moderate medium subangular blocky structure; friable; few fine roots; very dark grayish brown (10YR 3/2) worm casts; 3 percent pebbles; neutral; abrupt wavy boundary.

B21t—11 to 24 inches; brown (10YR 5/3) gravelly sandy clay loam; common medium prominent yellowish brown (10YR 5/6, 5/8) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds and pebbles; 20 percent pebbles; neutral; clear wavy boundary.

B22t—24 to 35 inches; brown (10YR 5/3) clay loam; common medium faint yellowish brown (10YR 5/6, 5/8) mottles; moderate medium subangular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; 3 percent pebbles; neutral; abrupt wavy boundary.

B3—35 to 38 inches; brown (10YR 5/3) loam; common medium faint grayish brown (10YR 5/2) and common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; 2 percent pebbles; neutral; abrupt wavy boundary.

IIC—38 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; many medium faint grayish brown (10YR 5/2) mottles; massive; very friable; 22 percent pebbles; slight effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 24 to 40 inches. Reaction ranges from medium acid to neutral in the solum. The content of pebbles ranges from less than 1 percent to 20 percent throughout the solum and from 5 percent to 60 percent in the substratum.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is dominantly loam, but the range includes sandy loam or gravelly phases of each. In some profiles an A2 horizon is present. In uncultivated areas an A1 horizon is present.

The B2t horizon has hue of 10YR or 5Y, value of 4 or 5, and chroma of 2 or 3. It is clay loam, sandy clay loam, loam, or gravelly phases of each.

The IIC horizon has hue of 10YR, 5Y, or 2.5Y, value of 5 to 7, and chroma of 1 to 4. It is gravelly sand, coarse sand, or gravelly sand.

Metea series

The Metea series consists of well drained soils that are very rapidly permeable in the upper part and moderately or moderately slowly permeable in the lower part. These soils formed in coarse textured deposits over medium and moderately fine textured deposits. Slopes are 2 to 12 percent. These soils have an argillic horizon that is thinner than the minimum thickness required for the Metea series, but this difference does not alter their usefulness or behavior.

Metea soils are commonly adjacent to Aubbeenaubbee, Marlette, Owosso, and Spinks soils. Aubbeenaubbee, Marlette, and Owosso soils have more silt and clay in the upper part of the soil. In addition, Aubbeenaubbee soils have grayish mottles and are less well drained. Spinks soils have less silt and clay in the lower part of the subsoil and substratum.

Typical pedon of Metea loamy sand, 2 to 6 percent slopes, 1,920 feet west and 200 feet south of center sec. 23, T. 4 N., R. 2 W.

A1—0 to 4 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many roots; medium acid; abrupt wavy boundary.

B1—4 to 8 inches; yellowish brown (10YR 5/4) loamy sand; weak fine granular structure; very friable; common roots; medium acid; clear irregular boundary.

B21—8 to 16 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.

B22—16 to 27 inches; yellowish brown (10YR 5/4) loamy sand; weak medium granular structure; very friable; few roots; medium acid; clear wavy boundary.

B23—27 to 34 inches; yellowish brown (10YR 5/4) sand; single grained; loose; slightly acid; abrupt wavy boundary.

IIB24t—34 to 38 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin dark brown (10YR 4/3) clay films on faces of peds; neutral; abrupt wavy boundary.

IIC—38 to 60 inches; yellowish brown (10YR 5/8) loam; common coarse distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure in the upper part and massive in the lower part; strong effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 36 to 60 inches.

The A1 horizon, if present, is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Reaction ranges from neutral to medium acid in the Ap and A1 horizons. An A2 horizon is present in some pedons. Texture in the A horizon is dominantly loamy sand, but the range includes sand.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The IIB horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, clay loam, or sandy clay loam.

The IIC horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 8. It is mildly or moderately alkaline loam or clay loam.

Napoleon series

The Napoleon series consists of very poorly drained, moderately and moderately rapidly permeable soils on moraines, outwash plains, till plains, and lake plains. These soils formed in deep herbaceous organic deposits. Slopes are 0 to 2 percent.

Napoleon soils are similar to Boots, Houghton, and Palms soils. Houghton soils are sapric and are less acid. Palms soils have a thinner organic layer. Boots soils are less acid.

Typical pedon of Napoleon muck, 1,320 feet west and 1,320 feet north of southeast corner sec. 36, T. 1 N., R. 1 E.

Oe1—0 to 2 inches; dark reddish brown (5YR 2/2) broken face, black (5YR 2/1) rubbed, hemic material; massive; firm; about 60 percent fiber, 16 percent rubbed; many roots; mainly herbaceous fiber; strongly acid; abrupt smooth boundary.
Oa1—2 to 6 inches; dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 2/2) rubbed, sapric material; massive; very friable; about 40 percent fiber, 9 percent rubbed; few roots; mainly herbaceous fiber; strongly acid; clear wavy boundary.
Oe2—6 to 12 inches; dark reddish brown (5YR 3/3) broken face, dark reddish brown (5YR 3/2) rubbed, hemic material; massive; very friable; about 50 percent fiber, 17 percent rubbed; mainly herbaceous fiber; strongly acid; clear wavy boundary.
Oe3—12 to 60 inches; dark reddish brown (5YR 3/2) broken face, dark reddish brown (5YR 2/2) rubbed, hemic material; massive; very friable; about 65 percent fiber, 20 percent rubbed; mainly herbaceous fiber; strongly acid.

The organic material is more than 51 inches thick. Reaction is very strongly acid or strongly acid. The organic material is derived mainly from herbaceous plants. Some pedons are up to 10 percent woody fragments. Fiber content in the upper 6 inches is dominantly less than 15 percent when rubbed but ranges from 5 to 50 percent. Between 6 and 60 inches, fiber content is dominantly 17 to 35 percent when rubbed. Some pedons have fibric layers less than 10 inches thick. The organic material has hue of 10YR, 7.5YR, or 5YR, value of 2 to 5, and chroma of 1 to 4.

Oshtemo series

The Oshtemo series consists of well drained, moderately rapidly permeable soils on outwash plains, valley trains, and moraines. These soils formed in moderately coarse and coarse textured deposits. Slopes range from 0 to 12 percent.

Oshtemo soils are commonly adjacent to Boyer, Brady, Hillsdale, and Spinks soils. Boyer soils have a thinner solum. Brady soils are grayish in the subsoil. Hillsdale soils have more silt and clay and less sand and gravel in the substratum. Spinks soils contain less silt and clay in the subsoil.

Typical pedon of Oshtemo sandy loam, 0 to 6 percent slopes, 225 feet north and 2,500 feet east of the southwest corner sec. 26, T. 1 N., R. 2 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium subangular blocky structure; very friable; many fine roots; 5 percent pebbles; medium acid; abrupt smooth boundary.
A2—9 to 16 inches; dark yellowish brown (10YR 4/4) sandy loam, very pale brown (10YR 7/3) dry; moderate medium subangular blocky structure; very friable; few fine roots; 5 percent pebbles; medium acid; clear wavy boundary.
B21t—16 to 24 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; thick clay films on faces of peds; few fine roots; 10 percent pebbles; medium acid; gradual wavy boundary.
B22t—24 to 29 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; thick clay films on faces of peds; few fine roots; 5 percent pebbles; slightly acid; clear wavy boundary.
B23t—29 to 34 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; clay bridging between sand grains; few fine roots; 10 percent pebbles; slightly acid; clear irregular boundary.
B3—34 to 50 inches; dark yellowish brown (10YR 4/4) sand and loamy sand; weak medium subangular blocky structure; single grained; loose and very friable; few fine roots; 2 percent pebbles; slightly acid; abrupt irregular boundary.
IIC—50 to 60 inches; brown (10YR 5/3) gravelly sand; single grained; loose; 15 percent pebbles; strong effervescence; moderately alkaline.

Thickness of the solum and depth to effervescent material range from 40 to 66 inches. Reaction ranges from medium acid to neutral in the solum. The content of pebbles ranges from less than 1 percent to 25 percent in the solum and from 10 percent to 65 percent in the substratum.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is dominantly loamy sand or sandy loam, but the range includes gravelly phases of each. The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It has textures like those of the Ap horizon. Some pedons do not have an A2 horizon.

The B2t horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. It is dominantly sandy loam with thin subhorizons of sandy clay loam or loamy sand. In some pedons there are gravelly phases of each. Some pedons do not have a B3 horizon.

The IIC horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is sand or gravelly sand.

Owosso series

The Owosso series consists of well drained soils that are moderately rapidly permeable in the upper part and moderately slowly permeable in the lower part. These soils are on till plains and moraines. They formed in a layer of moderately coarse textured material over medium and moderately fine textured material. Slopes are 2 to 12 percent.

Owosso soils are commonly adjacent to Aubbeenaubbee, Marlette, and Riddles soils. Aubbeenaubbee soils have grayish mottles in the subsoil. Riddles soils have less silt and clay in the lower part of the subsoil and in the substratum. Marlette soils have less sand in the upper part of the subsoil.

Typical pedon of Owosso sandy loam in an area of Owosso-Marlette sandy loams, 6 to 12 percent slopes, 260 feet north and 330 feet east of center sec. 11, T. 1 N., R. 2 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; friable; 10 percent pebbles; many very fine roots; slightly acid; abrupt smooth boundary.

A2—9 to 17 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; friable; 10 percent pebbles; common very fine roots; slightly acid; clear wavy boundary.

B1—17 to 27 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; 13 percent pebbles; few very fine roots; slightly acid; gradual wavy boundary.

B21t—27 to 32 inches; dark yellowish brown (10YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; few thin clay films on faces of peds; 13 percent pebbles; few very fine roots; slightly acid; abrupt wavy boundary.

B22t—32 to 40 inches; dark brown (7.5YR 4/4) clay loam; moderate coarse angular blocky structure; firm; thick continuous dark reddish brown (5Y 3/3) clay films on faces of peds; 3 percent pebbles; slightly acid; clear wavy boundary.

IIC—40 to 60 inches; brown (10YR 4/3) clay loam; weak coarse angular blocky structure in the upper 5 inches and massive in the lower part; firm; slight effervescence; 3 percent pebbles; moderately alkaline.

Thickness of the solum and depth to effervescent material range from 24 to 50 inches. Reaction of the solum ranges from medium acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The content of pebbles and cobbles ranges from 1 to 13 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It has value of 6 or more dry. Texture is dominantly sandy loam, but the range includes fine sandy loam. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is sandy loam, fine sandy loam, or loamy sand. Some pedons do not have an A2 horizon. In uncultivated areas there is an A1 horizon. Some pedons do not have a B1 horizon. The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6.

Texture is dominantly loam, but the range includes loamy sand or loam. The IIBt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam or clay loam.

The IIC horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is loam or clay loam.

Palms series

The Palms series consists of very poorly drained, moderately slowly to moderately rapidly permeable soils on lake plains, outwash plains, till plains, and moraines. These soils formed in organic deposits over moderately coarse to moderately fine textured deposits. Slopes are 0 to 2 percent.

Palms soils are commonly adjacent to Adrian, Aurelius, Edwards, and Houghton soils. Palms soils have more silt and clay and less sand in the substratum than Adrian soils. Aurelius and Edwards soils are underlain by marl. Palms soils have a thinner organic layer than Houghton soils.

Typical pedon of Palms muck, 200 feet west and 50 feet north of southeast corner sec. 23, T. 1 N., R. 2 E.

Oap—0 to 9 inches; black (N 2/0) sapric material; moderate medium granular structure; very friable; less than 1 percent fiber; slightly acid; abrupt smooth boundary.

Oa2—9 to 29 inches; black (10YR 2/1) sapric material; moderate coarse subangular blocky structure; friable; 5 percent fiber, less than 1 percent rubbed; slightly acid; clear smooth boundary.

Oa3—29 to 36 inches; black (10YR 2/1) sapric material; massive; firm; 20 percent fiber, 5 percent rubbed; slightly acid; abrupt smooth boundary.

IICg—36 to 60 inches; gray (5Y 5/1) sandy loam; massive; friable; 5 percent pebbles; thin strata of loamy sand, loam, and silt loam; slight effervescence below 50 inches; mildly alkaline.

The organic layers range from 16 to 50 inches in thickness. Reaction ranges from medium acid to mildly alkaline in the organic material. In some pedons woody fragments make up about 10 percent of the organic material. This material contains less than 25 percent fiber in an unrubbed condition and less than 5 percent fiber when rubbed. The substratum ranges from sandy loam to silty clay loam. Reaction ranges from neutral to moderately alkaline. In some pedons the substratum is effervescent.

Riddles series

The Riddles series consists of well drained, moderately permeable soils on till plains and moraines. These soils formed in medium and moderately coarse textured deposits. Slopes are 2 to 18 percent.

Riddles soils are commonly adjacent to Aubbeenaubbee, Hillsdale, Marlette, and Owosso soils. Aubbeenaubbee soils have grayish mottles in the subsoil. Hillsdale soils have less clay in the subsoil than Riddles soils. Riddles soils are deeper to the substratum than Marlette soils. Owosso soils have more silt and clay in the lower part of the subsoil and in the substratum than Riddles soils.

Typical pedon of Riddles sandy loam in an area of Riddles-Hillsdale sandy loams, 2 to 6 percent slopes, 400 feet west and 1,700 feet south of northeast corner sec. 31, T. 1 N., R. 1 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; friable; 3 percent pebbles; mildly alkaline; abrupt smooth boundary.

A2—8 to 22 inches; yellowish brown (10YR 5/4) sandy loam; weak medium platy structure; very friable; 3 percent pebbles; neutral; gradual wavy boundary.

B21t—22 to 29 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; thin dark brown (10YR 3/3) clay films on horizontal faces of peds; few thin yellowish brown (10YR 5/4) coatings on vertical faces of peds; 2 percent pebbles; slightly acid; gradual wavy boundary.

B22t—29 to 39 inches; brown (10YR 4/3) clay loam; moderate medium subangular blocky structure; firm; continuous thin clay films on faces of peds; 5 percent pebbles; medium acid; gradual wavy boundary.

B23t—39 to 47 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; thin brown (10YR 4/3) clay films on horizontal faces of peds; few thin yellowish brown (10YR 5/4) sandy loam coatings on vertical faces of peds; 5 percent pebbles; strongly acid; gradual wavy boundary.

B3—47 to 60 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; 3 percent pebbles; medium acid; clear wavy boundary.

C—60 to 66 inches; yellowish brown (10YR 5/4) sandy loam; massive; friable; 8 percent pebbles; slight effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 40 to 72 inches. Reaction ranges from strongly acid to neutral in the solum below the Ap horizon. The content of pebbles ranges from 1 to 15 percent throughout the solum.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 to 6. It is sandy loam or loamy sand. In uncultivated areas an A1 horizon is present and the A2 horizon is near maximum thickness.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is dominantly sandy clay loam and clay loam but has subhorizons of sandy loam and loam. The B3 horizon has colors like those of the B2t horizon. It is sandy loam or sandy clay loam that has pockets of sand or loamy sand in some pedons.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. Texture is dominantly sandy loam but ranges to loam.

Sebewa series

The Sebewa series consists of poorly drained and very poorly drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils are on outwash plains, valley trains, and terraces. They formed in medium and moderately fine textured deposits over coarse textured deposits. Slopes are 0 to 2 percent.

Sebewa soils are commonly adjacent to Colwood, Gilford, and Matherton soils. Colwood soils contain more silt and fine sand and less coarse sand and gravel in the substratum than Sebewa soils. Gilford soils have less clay in the subsoil. Matherton soils are less gray in the subsoil, do not have a mollic epipedon, and are less poorly drained than Sebewa soils.

Typical pedon of Sebewa loam, 1,360 feet south and 132 feet east of northwest corner sec. 24, T. 1 N., R. 2 W.

Ap—0 to 8 inches; black (10YR 2/1) loam; moderate fine subangular blocky structure; friable; 5 percent pebbles; few fine roots; neutral; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) loam; common fine faint gray (10YR 5/1) mottles; moderate medium subangular blocky structure; firm; 5 percent pebbles; few fine roots; neutral; abrupt smooth boundary.

B2tg—12 to 24 inches; olive gray (5Y 4/2) loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; 10 percent pebbles; few fine roots; thin gray (5Y 5/1) clay films on faces of peds; slight effervescence in the lower part; mildly alkaline; abrupt wavy boundary.

IICg—24 to 60 inches; grayish brown (10YR 5/2) gravelly sand; common coarse distinct yellowish brown (10YR 5/4) mottles; single grained; loose; 15 percent pebbles; slight effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. Reaction ranges from slightly acid to mildly alkaline in the solum. The content of pebbles ranges from less than 1 percent to

15 percent throughout the solum and from 5 percent to 60 percent in the substratum.

The A horizon has hue of 10YR, value of 1 to 3, and chroma of 1 or 2. Texture is loam or sandy loam. This horizon is 8 to 12 inches thick.

The Bg horizon has hue of 10YR or 5Y, value of 4 to 6, and chroma of 1 or 2. It is mottled. It is loam, clay loam, or sandy clay loam.

The IICg horizon has hue of 10YR or 5Y, value of 5 or 6, and chroma of 1 or 2. It is gravelly sand or coarse sand.

Sisson series

The Sisson series consists of well drained, moderately permeable soils on lake plains and outwash plains. These soils formed in stratified deposits with alternating layers of moderately fine to coarse textured sediments. Slopes are 2 to 12 percent.

Sisson soils are commonly adjacent to Boyer, Colwood, Kibbie, and Marlette soils. Sisson soils have more clay and silt in the subsoil than Boyer soils. Colwood and Kibbie soils have grayish colors or mottles in the subsoil. Marlette soils have a nonstratified substratum of medium to moderately fine textured material.

Typical pedon of Sisson fine sandy loam, 2 to 6 percent slopes, 425 feet east and 100 feet north of southwest corner sec. 21, T. 1 N., R. 2 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, light grayish brown (10YR 6/2) dry; weak fine subangular blocky structure; very friable; few roots; slightly acid; abrupt smooth boundary.

B1—8 to 13 inches; yellowish brown (10YR 5/6) fine sandy loam; moderate fine platy structure; very friable; medium acid; clear irregular boundary.

B21t—13 to 25 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; thin clay films on faces of peds; friable; medium acid; gradual wavy boundary.

B22t—25 to 34 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; thin clay films on faces of peds; firm; medium acid; clear wavy boundary.

B3—34 to 38 inches; yellowish brown (10YR 5/4) stratified fine sandy loam and silt loam; weak moderate subangular blocky structure; friable; medium acid; abrupt irregular boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) stratified very fine sandy loam, fine sandy loam, and silt loam; massive; friable; strong effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 24 to 42 inches. Reaction ranges from medium acid to neutral in the solum. Pebbles are less than 1 percent throughout the solum.

The Ap horizon is dark brown (10YR 4/3), brown (10YR 5/3), or dark grayish brown (10YR 4/2) fine sandy loam, silt loam, very fine sandy loam, loam, sandy loam, or loamy fine sand. In uncultivated areas an A1 horizon is present. In some pedons an A2 horizon is present.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam, fine sandy loam, silt loam, loam, sandy clay loam, or clay loam.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 6. It is stratified silt loam, very fine sandy loam, fine sand, silt, very fine sand, and loamy very fine sand. Thin lenses of sand and clay are in some pedons.

Spinks series

The Spinks series consists of well drained, moderately rapidly permeable and rapidly permeable soils on outwash plains and moraines. These soils formed in coarse textured deposits. Slopes are 0 to 30 percent.

Spinks soils are near Boyer, Metea, Oshtemo, and Thetford soils. Boyer, Metea, and Oshtemo soils have more silt and clay in the subsoil than Spinks soils. Metea soils also have more silt and clay in the substratum. Thetford soils have grayish mottles in the subsoil.

Typical pedon of Spinks loamy sand, 0 to 6 percent slopes, 100 feet north and 800 feet west of southeast corner sec. 12, T. 1 N., R. 2 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; many roots; neutral; abrupt smooth boundary.

A2—10 to 22 inches; yellowish brown (10YR 5/4) loamy sand, very pale brown (10YR 7/3) dry; weak medium subangular blocky structure; few fine roots; slightly acid; abrupt wavy boundary.

A&B—22 to 60 inches; yellowish brown (10YR 5/6) sand (A2); single grained; loose; 1 to 5 mm thick bands of dark yellowish brown (10YR 4/4) loamy sand (B2t); massive; very friable; clay bridging between sand grains in bands; slightly acid.

The solum ranges from 36 to more than 60 inches in thickness. Reaction typically ranges from medium acid to neutral in the solum, but many pedons are mildly alkaline in the lower part of the A&B horizon. The content of pebbles ranges from 0 to 15 percent throughout the pedon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Texture is dominantly loamy sand, but the range includes sand.

The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is loamy sand or sand. The A part of the A&B horizon has colors and textures like those of the A2 horizon. The B part of the A&B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The individual bands or lamellae of the B part are loamy sand or light sandy loam, but the weighted clay content of the combined bands averages within the loamy sand textural class. The bands are 1/8 inch to 4 inches thick, are commonly discontinuous, are spaced 3 to 8 inches apart, and have a cumulative thickness of more than 6 inches. Depth to the first band of the B horizon ranges from 18 to about 32 inches.

Thetford series

The Thetford series consists of somewhat poorly drained, moderately rapidly permeable soils on outwash plains and lake plains. These soils formed in coarse textured deposits. Slopes are 0 to 3 percent.

Thetford soils are commonly adjacent to Brady, Gilford, Granby, and Spinks soils. Brady soils contain more clay. Gilford and Granby soils are more gray in the subsoil and have a mollic epipedon. Spinks soils do not have grayish mottles.

Typical pedon of Thetford loamy sand, 0 to 3 percent slopes, 700 feet east and 100 feet south of northwest corner sec. 19, T. 1 N., R. 1 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

A2—10 to 15 inches; brown (10YR 5/3) sand; common medium faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose; few fine roots; 1 percent pebbles; slightly acid; abrupt wavy boundary.

A&B—15 to 58 inches; brown (10YR 5/3) sand (A2); single grained; loose; 1 to 4 inches thick, dark grayish brown (10YR 4/2) lamellae of loamy sand (B2t); common medium distinct gray (10YR 5/1), grayish brown (10YR 5/2), and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; clay bridging between sand grains; 4 percent pebbles; slightly acid; abrupt irregular boundary.

C—58 to 60 inches; yellowish brown (10YR 5/4) sand; common fine faint yellowish brown (10YR 5/6) and pale brown (10YR 6/3) mottles; single grained; loose; slight effervescence; mildly alkaline.

Thickness of the solum and depth to effervescent material range from 30 to 70 inches. Reaction in the solum ranges from medium acid to neutral.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 1 to 3. It is 6 to 10 inches thick. In uncultivated areas an A1 horizon is present.

The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is loamy sand or sand. The A part of the A&B horizon has hue of 10YR, value of 5 to 8, and chroma of 2 or 3. It is sand or loamy sand. The B part of the A&B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The individual bands or lamellae of the Bt part are loamy sand, sandy loam, or sand. They range from 1/2 inch to 3 inches in thickness, are commonly discontinuous, are spaced 1 to 6 inches apart, and have a cumulative thickness of more than 6 inches. The A&B horizon is 8 to 50 inches thick.

The C horizon has hue of 10YR, value of 5 or 6, and chroma of 1 to 4.

Formation of the soils

The paragraphs that follow describe the factors of soil formation (*3*), relate them to the formation of soils in the survey area, and explain the processes of soil formation.

Factors of soil formation

Soil forms through the interaction of five major factors: the physical, chemical, and mineral composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the parent material.

Climate and plant and animal life are the active forces 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. In extreme cases, it determines the soil profile almost entirely. Finally, time is needed to change the parent material into a soil profile. It may 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, the unconsolidated mass from which a soil forms, determines the limits of the chemical and mineralogical composition of the soil. The parent material of the soils of Ingham County was deposited by glaciers or by melt water from glaciers that covered the county 10,000 to 12,000 years ago. Some of this material has been reworked and redeposited by subsequent actions of water and wind. Parent material can be of common glacial origin, but its properties vary greatly, sometimes within small areas, depending on how the material was deposited. The dominant parent material in Ingham County was deposited as glacial till, outwash deposits, lacustrine deposits, alluvium, and organic material.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of 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 Ingham County is calcareous. Its texture is loam, clay loam, or sandy loam. Marlette soils, for example, formed in glacial till. They typically are moderately fine textured and have well developed structure in the subsoil.

Outwash material is deposited by running water from melting glaciers. The size of the particles varies according to the speed of the stream that carries them. As the speed of the stream decreases, 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, and other coarse particles. The Boyer soils in Ingham County, for example, formed in deposits of outwash material.

Lacustrine material is deposited from still, or ponded, glacial melt water. Because the coarser fragments drop out of the moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remain to settle out in still water. In Ingham County soils formed in lacustrine deposits are typically medium textured, moderately fine textured, and fine textured. Lenawee soils, for example, formed in lacustrine material.

Alluvium is deposited by floodwaters of present streams in recent time. This material varies in texture, depending on the speed of the water from which it was deposited. Examples of alluvial soil are the Ceresco and Cohoctah soils.

Organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions in the outwash plains, flood plains, moraines, and till plains. Grasses and sedges around the edges of these depressions died. Because of the wetness, the plant remains did not decompose but remained around the edge of the depression. Later, water-tolerant trees grew in the areas. As these trees died, their residue became a part of the organic accumulation. Consequently, the depressions were eventually filled with organic material and developed into areas of muck. Houghton soils formed in organic material.

Plant and animal life

Green plants have been the principal organisms influencing the soil in Ingham County. Bacteria, fungi, earthworms, and the activities of man have also been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic material on the soil depends on the kinds of plants that grew on the soil. The remains of these plants accumulate on the surface, 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 Ingham County was mainly deciduous forest. Differences in natural soil drainage and minor changes in parent material affected the composition of the forest species.

In general, the well drained upland soils, such as Boyer, Marlette, and Oshtemo soils, were mainly covered with sugar maple, oak, and hickory trees. The poorly drained and very poorly drained soils were covered with soft maple, elm, and ash. Colwood and Brookston soils formed under wet conditions, and they contain a considerable amount of organic matter.

Climate

Climate determines the kind of plant and animal life on and in the soil. It also determines the amount of water available for the weathering of minerals and the transporting of soil material. Through its influence on temperatures in the soil, it determines the rate of chemical reaction that occurs in the soil. These influences are important, but they affect large areas rather than a relatively small area, such as a county.

The climate in Ingham County, presumably similar to that in which the soils formed, is cool and humid. Thus, the soils in the county differ from those formed in a dry, warm climate or in a hot, moist climate. Climate is uniform throughout the county. Its effect is modified locally according to the proximity to large lakes. Only minor differences in the soils of Ingham County result from the differences in climate.

Relief

Relief, or topography, has a marked influence on the soils of Ingham County through its influence on natural drainage, erosion, plant cover, and soil temperature. Slopes range from 0 to 30 percent. Natural soil drainage ranges from well drained on the ridgetops 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 well aerated soils the iron and aluminum compounds are brightly colored and oxidized. In poorly aerated soils the color is dull gray and mottled. Riddles soils are examples of well drained, well aerated soils. Brookston soils are examples of poorly aerated, very poorly drained soils. Both formed in similar parent material.

Time

Time, usually a long time, is required for the development of distinct horizons from parent material. The differences in length of time that the parent materials have been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly. Others develop slowly.

The soils in Ingham County range from young to mature. The glacial deposits in which many of the soils in Ingham County formed have been exposed to soil-forming factors long enough for the development of distinct horizons. Some soils forming in recent alluvial sediments have not been in place long enough for the development of distinct horizons.

The Cohoctah soil, formed in alluvial material, is an example of a young soil. The Riddles soil is an example of a mature soil. The effect of more time on leaching of lime from this soil is evident.

Genesis and morphology

The processes responsible for the development of the soil horizons from the unconsolidated parent material are referred to as soil genesis. The physical, chemical, and biological properties of the various soil horizons are referred to as soil morphology.

Several processes were involved in the development of soil horizons in the soils of Ingham County: (1) accumulation of organic matter, (2) leaching of lime (calcium carbonates) and other bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals. In most soils of Ingham County more than one of these processes have been active in the development of the horizons.

Organic matter accumulated at the surface to form an A1 horizon. The A1 horizon is mixed into a plow layer (Ap) when the soil is plowed. In the soils of Ingham County, the surface layer ranges from high to low in organic matter content. Brookston soils, for example, are high in content of organic matter in the surface layer. Spinks soils are low in content of organic matter.

Leaching of carbonates and other bases has occurred in most of the soils. Soil scientists generally agree that leaching of bases usually precedes the translocation of silicate clay minerals. Many of the soils are moderately to strongly leached. For example, Riddles soils are leached of carbonates to a depth of 60 inches, whereas Marlette soils are leached to a depth of only 31 inches. Difference in the depth of leaching is a result of time, relief, and parent material as soil-forming factors.

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 horizons indicates the reduction and loss of iron. Lenawee soils, for example, are strongly gleyed.

Translocation of clay minerals has contributed to horizon development. The eluviated or leached A2 horizon typically has a platy structure, is lower in content of clay, and typically is lighter in color than the illuviated B horizon. The B horizon typically has an accumulation of clay, or clay films, in pores and on the faces of peds. These soils were probably leached of carbonates and soluble salts to a considerable extent before the translocation of silicate clays. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in soils. Marlette soils are an example of soils having translocated silicate clays in the form of clay films accumulated in the B horizon.

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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. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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 coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light 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.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. 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.

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 (or contour farming). 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 40 or 80 inches (1 or 2 meters).

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. Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

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 for 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, as for example in "hillpeats" and "climatic moors."

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 running 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 a bare surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

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 (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of 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. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered 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.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Frost action. Freezing and thawing of soil moisture. Frost action can damage 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 assorted and unassorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. Many are interbedded or laminated.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

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 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (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, which is the upper limit of saturation.

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.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

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. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

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 A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II 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.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

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.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

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. Inadequate strength for supporting 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 greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy 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. 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 mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three single 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.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

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. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state.

Polypedon. A volume of soil having properties within the limits of a soil series, the lowest and most homogeneous category of soil taxonomy. A "soil individual."

Poorly graded. Refers to 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 outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree 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. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

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.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground 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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

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. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

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.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that 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: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

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 that are separated from adjoining 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. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. 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."

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 or management.

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 it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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. 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 condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements in soils, in only extremely small amounts, essential to plant growth. Examples are zinc, cobalt, manganese, copper, and iron.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams emerging from hills or mountains and spreading sediments onto the lowland as a series of adjacent alluvial fans.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within 1 year; specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by melt water streams, in a glacial lake or other body of still water in front of a glacier.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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 a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a 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.

ILLUSTRATIONS

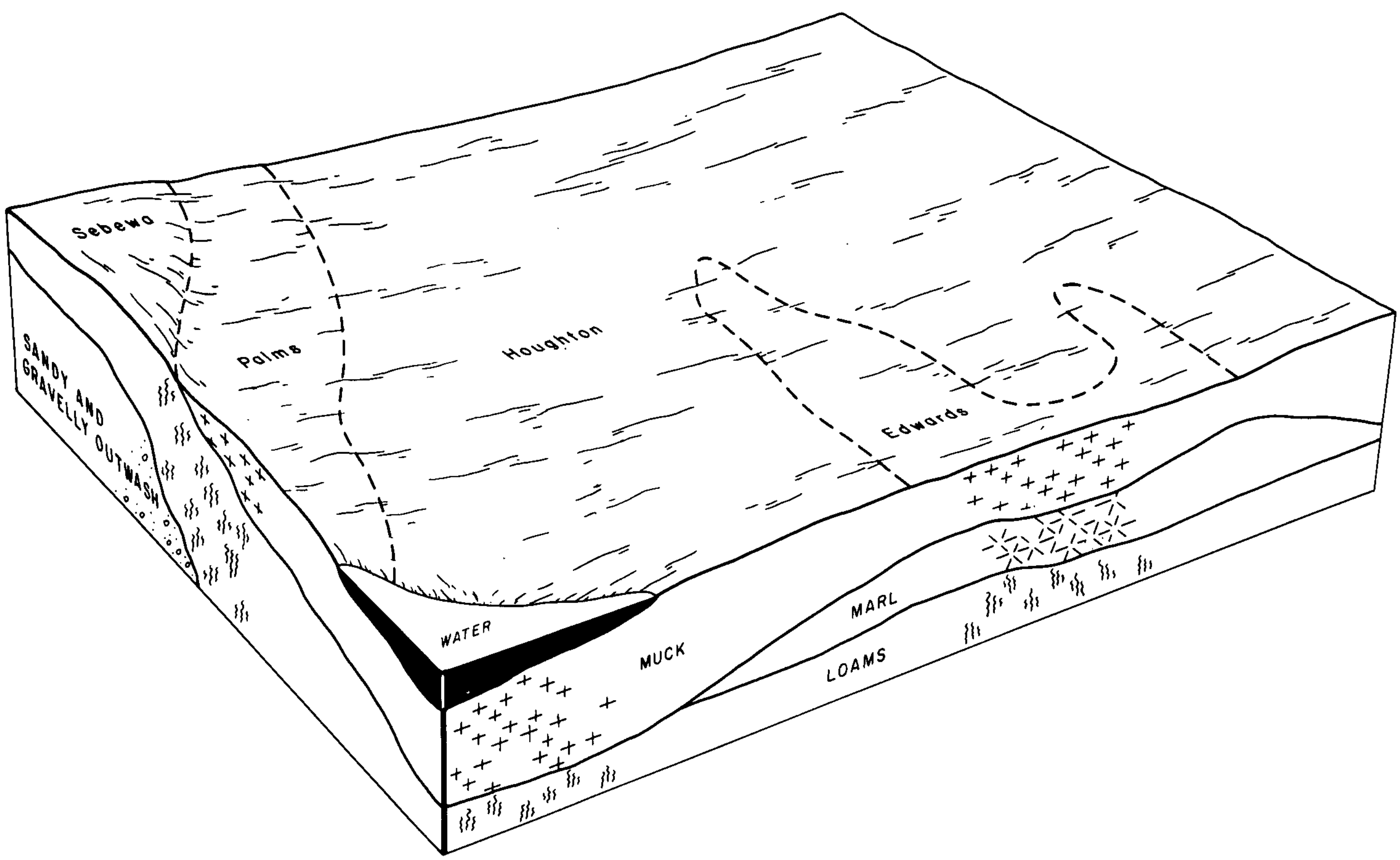

Figure 1.—Pattern of Houghton, Palms, and Edwards soils in association 3.

Figure 2.—Head lettuce in an area of Houghton muck. The small building in the foreground houses the pump that removes excess water.

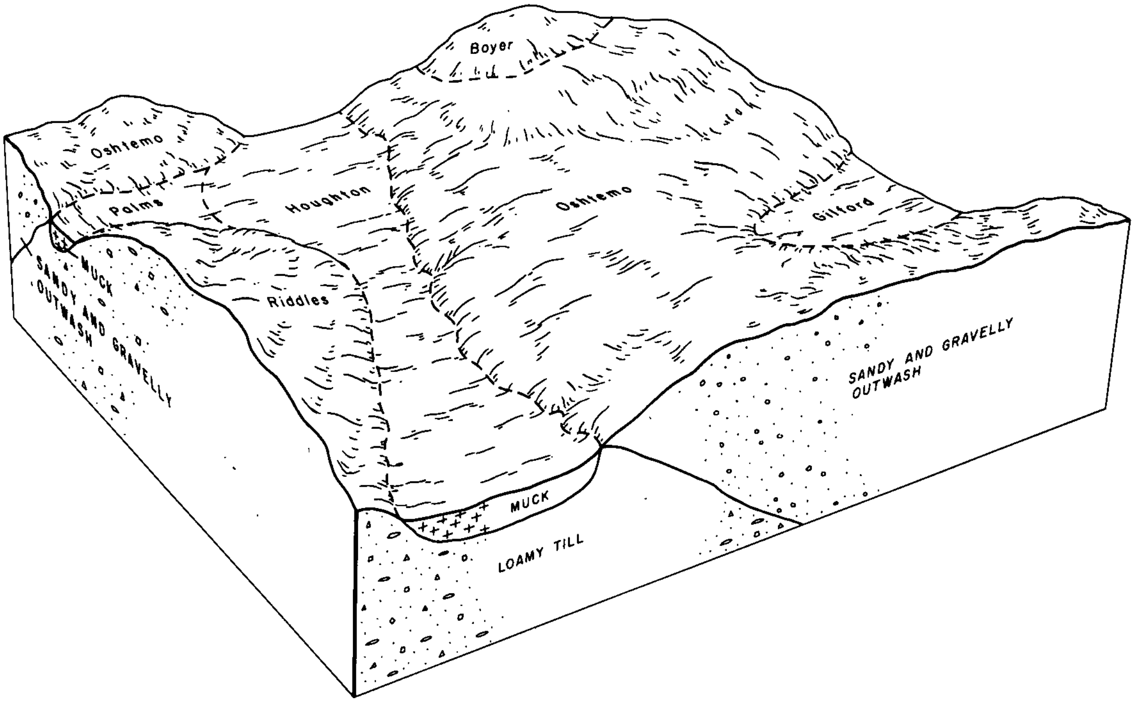

Figure 3.—Pattern of Oshtemo, Houghton, and Riddles soils in association 4.

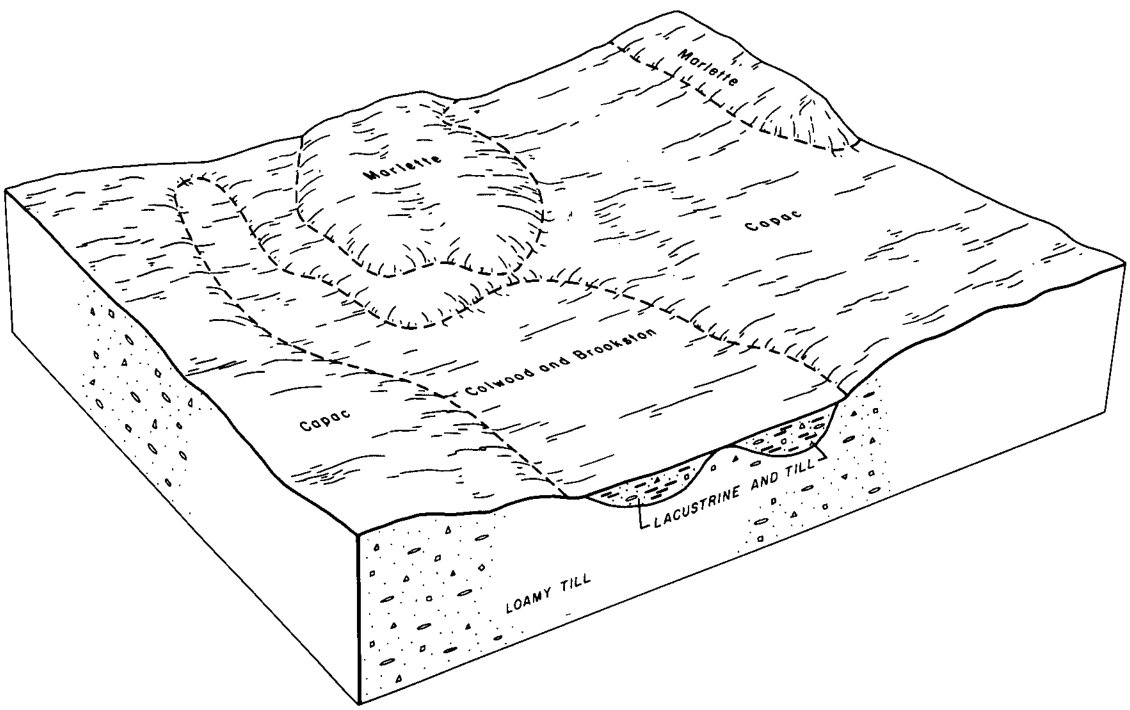

Figure 4.—Pattern of Capac, Marlette, and Colwood soils in association 5.

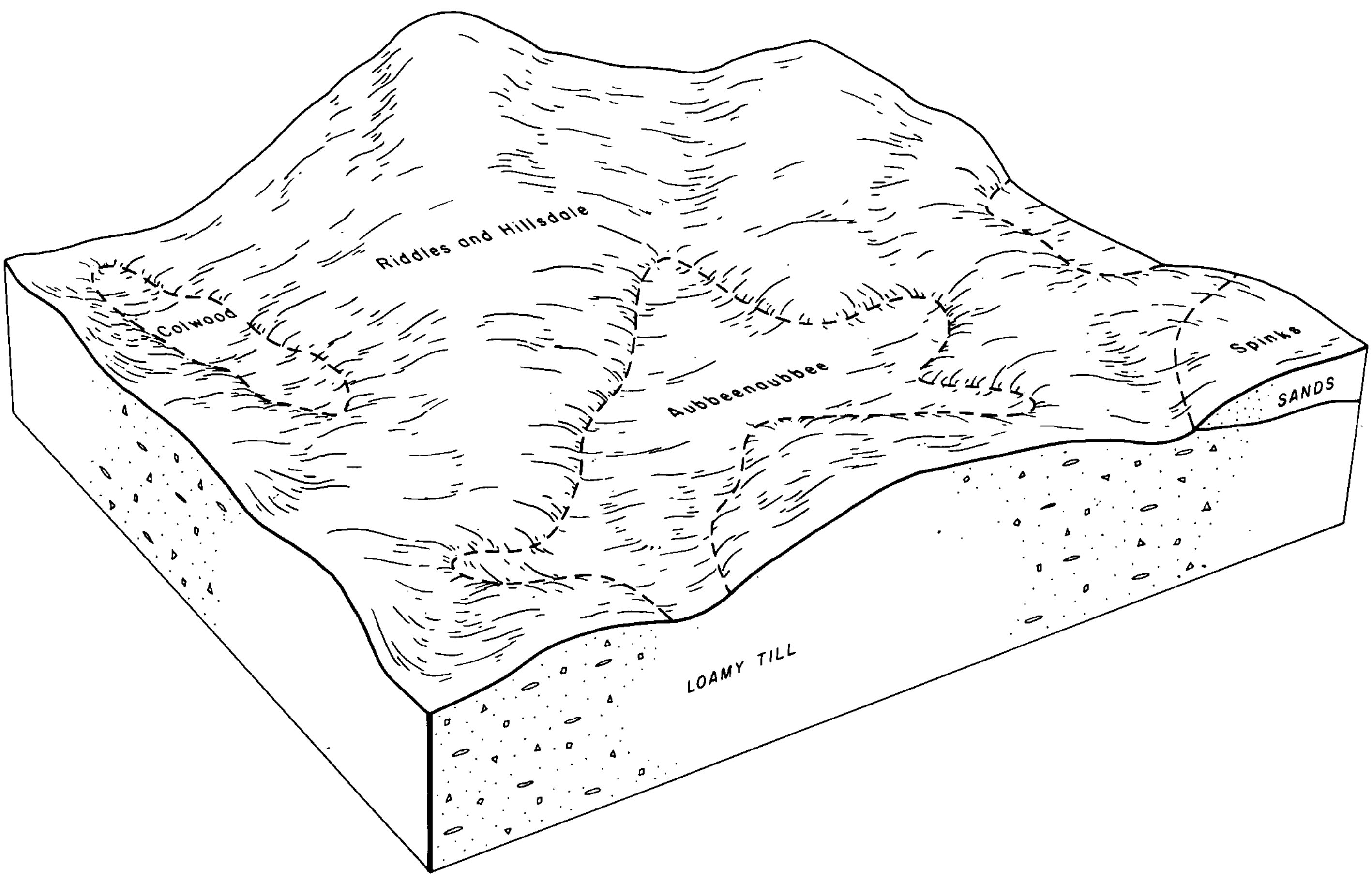

Figure 5.—Pattern of Riddles and Hillsdale, and Aubbeenaubbee soils in association 7.

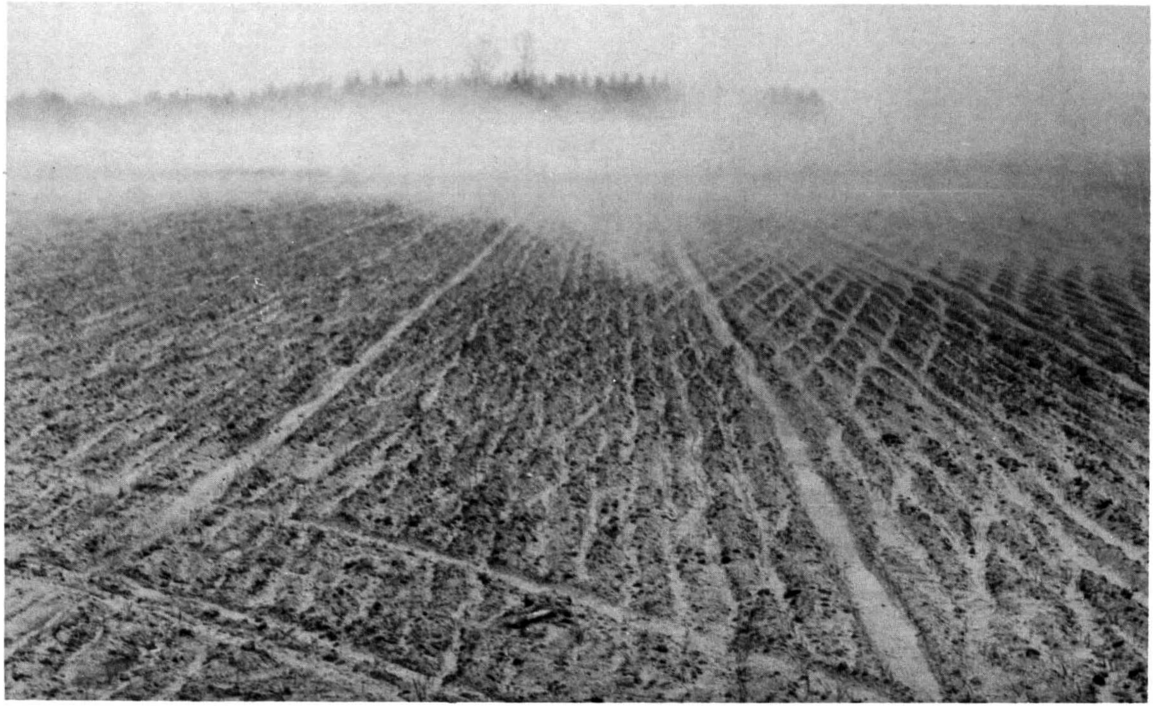

Figure 6.—Soil blowing in an unprotected area of Oshtemo-Spinks loamy sands, 0 to 6 percent slopes.

Figure 7.—Flooded mint field on Boots and Edwards soils. These soils are subject to frequent flooding of long duration.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature[1]						Precipitation[1]				
	Average daily maximum	Average daily minimum	Average daily	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[2]	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	Snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	30.2	15.6	22.9	56	-10	0	1.64	.8	2.4	4	9.7
February----	32.5	16.6	24.6	54	-9	0	1.47	.7	2.2	4	7.9
March-------	41.5	24.5	33.0	71	1	14	2.24	1.2	3.1	6	6.3
April-------	56.8	35.6	46.2	80	16	78	2.94	1.9	3.9	7	2.2
May---------	68.4	45.3	56.9	86	28	254	2.95	1.6	4.2	6	T
June--------	78.2	55.8	67.0	92	38	517	3.64	2.4	4.8	7	0
July--------	81.9	59.2	70.6	93	44	645	3.09	1.8	4.2	6	0
August------	80.6	57.8	69.2	94	42	602	3.05	1.7	4.2	6	0
September---	72.9	50.4	61.7	91	31	365	2.47	1.5	3.4	6	0
October-----	62.4	41.3	51.8	84	22	152	2.18	1.0	3.2	5	0
November----	46.0	30.7	38.3	71	7	20	2.29	1.4	3.1	6	4.3
December----	33.9	20.3	27.1	60	-4	0	1.86	.8	2.8	5	8.8
Year------	57.1	37.8	47.4	96	-12	2,647	29.84	25.3	34.1	67	39.4

[1]Recorded in the period 1947-76 at East Lansing.

[2]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).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 27	May 10	May 25
2 years in 10 later than--	April 21	May 6	May 19
5 years in 10 later than--	April 9	April 25	May 8
First freezing temperature in fall:			
1 year in 10 earlier than--	October 19	October 5	September 22
2 years in 10 earlier than--	October 24	October 11	September 27
5 years in 10 earlier than--	November 4	October 24	October 5

[1]Recorded at East Lansing Weather Bureau (January 1930 through June 1948) and Lansing National Weather Service Capital City Airport (July 1948 through December 1974).

TABLE 3.--GROWING SEASON[1]

Probability[2]	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	236	205	172
8 years in 10	226	197	164
5 years in 10	208	182	149
2 years in 10	189	166	134
1 year in 10	179	158	127

[1]Recorded at East Lansing Weather Bureau (January 1930 through June 1948) and Lansing National Weather Service Capital City Airport (July 1948 through December 1974).

[2]Probability of a growing season that will be less than or equal to the indicated value.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Adrian muck	5,125	1.4
AnA	Aubbeenaubbee-Capac sandy loams, 0 to 3 percent slopes	21,950	6.1
Au	Aurelius muck	1,120	0.3
Bo	Boots muck	800	0.2
BrB	Boyer sandy loam, 0 to 6 percent slopes	3,910	1.1
BsD	Boyer-Spinks loamy sands, 12 to 18 percent slopes	1,725	0.5
BsE	Boyer-Spinks loamy sands, 18 to 30 percent slopes	430	0.1
ByA	Brady sandy loam, 0 to 3 percent slopes	6,100	1.7
CaA	Capac loam, 0 to 3 percent slopes	58,100	16.2
Ce	Ceresco fine sandy loam	1,325	0.4
Ch	Cohoctah silt loam	3,025	0.8
Co	Colwood-Brookston loams	32,500	9.1
Ed	Edwards muck	3,125	0.9
EvB	Eleva Variant channery sandy loam, 2 to 6 percent slopes	200	0.1
Gf	Gilford sandy loam	8,950	2.5
Gr	Granby loamy fine sand	1,950	0.5
Ha	Histosols and Aquents, ponded	430	0.1
Hn	Houghton muck	24,200	6.8
Ka	Keowns very fine sandy loam	4,650	1.3
KbA	Kibbie loam, 0 to 3 percent slopes	4,200	1.2
Ln	Lenawee silty clay loam	860	0.2
MaB	Marlette fine sandy loam, 2 to 6 percent slopes	30,000	8.4
MaC	Marlette fine sandy loam, 6 to 12 percent slopes	9,300	2.6
MeD2	Marlette loam, 12 to 18 percent slopes, eroded	1,865	0.5
MoE	Marlette-Boyer complex, 18 to 25 percent slopes	455	0.1
MrA	Matherton sandy loam, 0 to 3 percent slopes	2,575	0.7
MtB	Metea loamy sand, 2 to 6 percent slopes	2,650	0.7
MtC	Metea loamy sand, 6 to 12 percent slopes	560	0.3
Na	Napoleon muck	1,050	0.3
OsB	Oshtemo sandy loam, 0 to 6 percent slopes	6,650	2.0
OsC	Oshtemo sandy loam, 6 to 12 percent slopes	2,715	0.9
OtB	Oshtemo-Spinks loamy sands, 0 to 6 percent slopes	5,850	1.6
OtC	Oshtemo-Spinks loamy sands, 6 to 12 percent slopes	2,830	0.8
OwB	Owosso-Marlette sandy loams, 2 to 6 percent slopes	15,100	4.2
OwC	Owosso-Marlette sandy loams, 6 to 12 percent slopes	2,640	0.7
Pa	Palms muck	5,825	1.6
Pt	Pits	900	0.3
RdB	Riddles-Hillsdale sandy loams, 2 to 6 percent slopes	8,950	2.5
RdC	Riddles-Hillsdale sandy loams, 6 to 12 percent slopes	2,600	0.7
RdD	Riddles-Hillsdale sandy loams, 12 to 18 percent slopes	325	0.1
Sb	Sebewa loam	7,100	2.0
SnB	Sisson fine sandy loam, 2 to 6 percent slopes	850	0.2
SnC	Sisson fine sandy loam, 6 to 12 percent slopes	470	0.1
SpB	Spinks loamy sand, 0 to 6 percent slopes	10,500	2.9
SpC	Spinks loamy sand, 6 to 12 percent slopes	3,755	1.0
ThA	Thetford loamy sand, 0 to 3 percent slopes	3,030	0.8
Ud	Udorthents and Udipsamments	2,200	0.6
UeB	Urban land-Boyer-Spinks complex, 0 to 10 percent slopes	3,450	1.0
UpA	Urban land-Capac-Colwood complex, 0 to 4 percent slopes	13,950	3.9
UtB	Urban land-Marlette complex, 2 to 12 percent slopes	22,140	6.2
Uu	Urban land-Fluvaquents complex	950	0.3
	Water	1,850	0.5
	Total	357,760	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[All yields were estimated for a high level of management. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Corn	Corn silage	Oats	Winter wheat	Soybeans	Grass-legume hay	Grass hay
	Bu	Ton	Bu	Bu	Bu	Ton	Ton
Ad------------------------ Adrian	75	13	---	---	23	---	3.0
AnA------------------------ Aubbeenaubbee-Capac	100	16	80	49	37	3.6	---
Au------------------------ Aurelius	70	13	---	---	22	---	2.5
Bo------------------------ Boots	80	13	---	---	22	---	3.0
BrB------------------------ Boyer	80	13	60	35	30	3.4	---
BsD------------------------ Boyer-Spinks	50	10	45	24	---	2.5	---
BsE------------------------ Boyer-Spinks	---	---	---	---	---	---	---
ByA------------------------ Brady	80	12	60	35	30	3.0	---
CaA------------------------ Capac	105	17	80	45	36	3.6	---
Ce------------------------ Ceresco	---	---	---	---	---	---	---
Ch------------------------ Cohoctah	---	---	---	---	---	3.5	---
Co------------------------ Colwood-Brookston	120	20	80	59	48	5.2	---
Ed------------------------ Edwards	75	12	---	---	---	---	3.0
EvB------------------------ Eleva variant	70	11	50	30	28	3.0	---
Gf------------------------ Gilford	100	16	80	45	35	4.0	---
Gr------------------------ Granby	75	10	55	35	30	---	---
Ha------------------------ Histosols and Aquents	---	---	---	---	---	---	---
Hn------------------------ Houghton	85	14	---	---	25	---	3.0
Ka------------------------ Keowns	100	18	70	48	35	4.0	---
KbA------------------------ Kibbie	110	18	80	50	40	4.0	---
Ln------------------------ Lenawee	105	17	75	48	38	3.0	---
MaB------------------------ Marlette	100	18	75	45	40	4.5	---

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Winter wheat	Soybeans	Grass-legume hay	Grass hay
	Bu	Ton	Bu	Bu	Bu	Ton	Ton
MaC------------------------ Marlette	85	15	75	42	33	4.0	---
MeD2----------------------- Marlette	65	11	50	30	---	3.0	---
MoE------------------------ Marlette-Boyer	---	---	---	---	---	2.2	---
MrA------------------------ Matherton	105	17	80	45	36	4.0	---
MtB------------------------ Metea	85	14	60	42	30	3.5	---
MtC------------------------ Metea	75	12	50	38	26	3.0	---
Na------------------------- Napoleon	---	---	---	---	---	---	---
OsB------------------------ Oshtemo	75	12	60	35	30	2.5	---
OsC------------------------ Oshtemo	65	11	55	32	26	2.5	---
OtB------------------------ Oshtemo-Spinks	68	11	54	30	28	2.5	---
OtC------------------------ Oshtemo-Spinks	61	10	49	29	23	2.3	---
OwB------------------------ Owosso-Marlette	97	17	78	45	35	3.8	---
OwC------------------------ Owosso-Marlette	82	15	76	42	25	3.5	---
Pa------------------------- Palms	85	14	---	---	25	---	3.0
Pt*. Pits							
RdB------------------------ Riddles-Hillsdale	100	16	75	44	38	3.9	---
RdC------------------------ Riddles-Hillsdale	90	15	55	39	35	3.5	---
RdD------------------------ Riddles-Hillsdale	82	13	40	35	31	3.1	---
Sb------------------------- Sebewa	105	17	80	50	36	4.6	---
SnB------------------------ Sisson	105	17	80	50	35	4.0	---
SnC------------------------ Sisson	90	15	70	47	32	3.6	---
SpB------------------------ Spinks	65	11	60	30	20	3.0	---
SpC------------------------ Spinks	57	10	55	30	18	2.4	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Winter wheat	Soybeans	Grass-legume hay	Grass hay
	Bu	Ton	Bu	Bu	Bu	Ton	Ton
ThA------------------------ Thetford	80	12	60	35	30	3.0	---
Ud------------------------ Udorthents and Udipsamments	---	---	---	---	---	---	---
UeB------------------------ Urban land-Boyer-Spinks	---	---	---	---	---	---	---
UpA------------------------ Urban land-Capac-Colwood	---	---	---	---	---	---	---
UtB------------------------ Urban land-Marlette	---	---	---	---	---	---	---
Uu------------------------ Urban land-Fluvaquents	---	---	---	---	---	---	---

* See map unit description for the composition and behavior of the map unit.

TABLE 6.--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)	Climate (c)
		Acres	Acres	Acres	Acres
I	---	---	---	---	---
II	181,110	54,900	126,210	---	---
III	110,410	27,520	55,780	27,110	---
IV	12,220	2,050	10,170	---	---
V	4,350	---	4,350	---	---
VI	3,800	2,750	1,050	---	---
VII	---	---	---	---	---
VIII	---	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means the information was not available]

Soil name and map symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Trees to plant
Ad: Adrian	Slight	Severe	Severe	Severe	Severe	Red maple	51	
						Silver maple	76	
						White ash	51	
						Quaking aspen	56	
						Tamarack	45	
						Green ash	51	
AnA*:								
Aubbeenaubbee	Slight	Slight	Slight	Slight	Moderate	White oak	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore, green ash, white ash.
						Pin oak	85	
						Yellow-poplar	85	
						Northern red oak	75	
Capac	Slight	Slight	Slight	Slight	Severe	Sugar maple	61	Eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						Paper birch	---	
						Quaking aspen	---	
						Black oak	---	
						Red maple	---	
						Yellow birch	---	
Au: Aurelius	Slight	Severe	Severe	Severe	Severe	Red maple	46	
						Silver maple	---	
						Black ash	---	
						Swamp white oak	---	
Bo: Boots	Slight	Severe	Severe	Severe	Severe	Tamarack	50	
BrB: Boyer	Slight	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						White oak	---	
						American basswood	---	
						Sugar maple	---	
BsD*:								
Boyer	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						White oak	---	
						American basswood	---	
						Sugar maple	---	
Spinks	Moderate	Moderate	Moderate	Slight	Moderate	Northern red oak	65	Red pine, eastern white pine, jack pine, Scotch pine.
						White oak	65	
						Shagbark hickory	65	
						Eastern white pine	65	
						Red pine	65	
BsE*:								
Boyer	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						White oak	---	
						American basswood	---	
						Sugar maple	---	
Spinks	Moderate	Moderate	Moderate	Slight	Moderate	Northern red oak	65	Red pine, eastern white pine, jack pine, Scotch pine.
						White oak	65	
						Shagbark hickory	65	
						Eastern white pine	65	
						Red pine	65	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
ByA: Brady	Slight	Slight	Slight	Slight	Moderate	Quaking aspen	60	White spruce, northern white-cedar, eastern white pine, Norway spruce, Austrian pine, American sycamore, red maple.
						White ash	---	
						Red maple	---	
						Silver maple	---	
						Eastern cottonwood	---	
						Swamp white oak	---	
						American basswood	---	
CaA: Capac	Slight	Slight	Slight	Slight	Severe	Sugar maple	61	Eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						Paper birch	---	
						Quaking aspen	---	
						Black oak	---	
						Red maple	---	
						Yellow birch	---	
Ce: Ceresco	Slight	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, white spruce, eastern cottonwood.
						White ash	---	
						Red maple	---	
						Silver maple	---	
						Eastern cottonwood	---	
						American sycamore	---	
						Common hackberry	---	
						Black walnut	---	
Ch: Cohoctah	Slight	Severe	Severe	Moderate	Severe	Red maple	66	Eastern cottonwood, American sycamore.
						Eastern cottonwood	---	
						Silver maple	---	
						White ash	---	
						Swamp white oak	---	
						American sycamore	---	
Co*:								
Colwood	Slight	Severe	Severe	Severe	Severe	Red maple	61	White spruce, Austrian pine, northern white-cedar, eastern cottonwood, eastern white pine.
						White ash	61	
						Northern red oak	61	
						Silver maple	86	
						Green ash	61	
						Swamp white oak	61	
Brookston	Slight	Severe	Severe	Moderate	Severe	Northern red oak	66	Black spruce, eastern white pine, white spruce, red maple, white ash, northern white-cedar.
						White oak	---	
						Silver maple	---	
						Red maple	---	
						White ash	---	
						American basswood	---	
						American sycamore	---	
Ed: Edwards	Slight	Severe	Severe	Severe	Severe	Red maple	51	
						White ash	51	
						Green ash	---	
						Black cherry	---	
						Swamp white oak	---	
						Silver maple	76	
						Northern white-cedar	27	
						Black ash	---	
EvB: Eleva variant	Slight	Slight	Moderate	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce, eastern cottonwood.
						Sugar maple	61	
						Red maple	64	
						Eastern cottonwood	100	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
Gf: Gilford	Slight	Severe	Severe	Moderate	Severe	Silver maple	70	Eastern white pine, silver maple, Austrian pine, Norway spruce, white spruce, European larch, eastern cottonwood.
						American basswood	---	
						Pin oak	---	
						Red maple	---	
						White ash	---	
						Swamp white oak	---	
						Bur oak	---	
Gr: Granby	Slight	Severe	Severe	Severe	Severe	Red maple	41	Eastern white pine, Norway spruce, white spruce, silver maple, white ash.
						Silver maple	66	
						American basswood	41	
						Pin oak	---	
						Eastern white pine	41	
						Eastern cottonwood	76	
Hn: Houghton	Slight	Severe	Severe	Severe	Severe	Red maple	51	
						Silver maple	76	
						White ash	51	
						Quaking aspen	56	
						Tamarack	45	
						Green ash	---	
						Northern white-cedar	27	
Ka: Keowns	Slight	Severe	Moderate	Moderate	Severe	Silver maple	---	Silver maple, red maple, white ash.
						Red maple	90	
						White ash	---	
KbA: Kibbie	Slight	Slight	Slight	Slight	Severe	Northern red oak	66	White spruce, eastern white pine, eastern cottonwood, white ash, Norway spruce.
						White oak	---	
						White ash	66	
						American basswood	66	
						Quaking aspen	70	
						Pin oak	---	
						Eastern cottonwood	101	
Ln: Lenawee	Slight	Severe	Severe	Moderate	Severe	Red maple	70	White spruce, Norway spruce, eastern white pine, northern white-cedar.
						White ash	71	
						American basswood	71	
						Silver maple	70	
MaB, MaC, MeD2: Marlette	Slight	Slight	Slight	Slight	Moderate	Sugar maple	61	White spruce, eastern cottonwood.
						Northern red oak	---	
						White ash	---	
						Black walnut	---	
						American basswood	---	
						Black cherry	---	
						White oak	---	
MoE*:								
Marlette	Moderate	Moderate	Slight	Slight	Moderate	Sugar maple	61	White spruce, eastern cottonwood.
						Northern red oak	---	
						White ash	---	
						Black walnut	---	
						American basswood	---	
						Black cherry	---	
						White oak	---	
Boyer	Moderate	Moderate	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						White oak	---	
						American basswood	---	
						Sugar maple	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
MrA---------------- Matherton	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- Swamp white oak----- White oak----------- Bitternut hickory--- Shagbark hickory---- White ash----------- American basswood--- Northern pin oak----	66 --- --- --- --- --- --- ---	White spruce, Norway spruce, eastern white pine, northern white-cedar
MtB, MtC----------- Metea	Slight	Slight	Moderate	Slight	Moderate	Northern red oak---- White oak----------- Sugar maple--------- American basswood--- Black cherry-------- Black walnut-------- Shagbark hickory----	66 --- --- --- --- --- ---	Eastern white pine, red pine, white spruce, black walnut, European alder, Norway spruce.
Na----------------- Napoleon	Slight	Severe	Severe	Severe	Severe	Red maple----------- Silver maple-------- Swamp white oak-----	46 --- ---	
OsB, OsC----------- Oshtemo	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- White oak----------- American basswood--- Sugar maple---------	70 --- --- ---	Eastern white pine, red pine, white spruce, jack pine.
OtB*, OtC*: Oshtemo-----------	Slight	Slight	Moderate	Slight	Moderate	Northern red oak---- White oak----------- American basswood--- Sugar maple---------	70 --- --- ---	Eastern white pine, red pine, white spruce, jack pine.
Spinks------------	Slight	Slight	Moderate	Slight	Moderate	Northern red oak---- White oak----------- Shagbark hickory---- Eastern white pine-- Red pine------------	65 65 65 65 65	Red pine, eastern white pine, jack pine, Scotch pine.
OwB*, OwC*: Owosso------------	Slight	Slight	Slight	Slight	Moderate	Northern red oak---- Black cherry-------- Bitternut hickory--- Sugar maple--------- American beech------ White ash----------- Yellow-poplar-------	70+ --- --- --- --- --- ---	Black walnut, black cherry, eastern cottonwood, white ash, yellow-poplar, eastern white pine.
Marlette----------	Slight	Slight	Slight	Slight	Moderate	Sugar maple--------- Northern red oak---- White ash----------- Black walnut-------- American basswood--- Black cherry-------- White oak-----------	61 --- --- --- --- --- ---	White spruce, eastern cottonwood.
Pa----------------- Palms	Slight	Severe	Severe	Severe	Severe	Red maple----------- Silver maple-------- White ash----------- Quaking aspen------- Northern white-cedar Tamarack------------ Black ash-----------	51 76 51 56 27 45 ---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
RdB*, RdC*, RdD*:								
Riddles	Slight	Slight	Slight	Slight	Moderate	Northern red oak Red maple White ash Green ash Black walnut Yellow-poplar	75 75 75 75 --- ---	Black walnut, eastern cottonwood, red pine, white spruce.
Hillsdale	Slight	Slight	Slight	Slight	Moderate	Northern red oak Black walnut White ash Sugar maple Black cherry American basswood Yellow-poplar	66 --- --- --- --- --- ---	Black walnut, eastern white pine, white spruce, red pine, yellow-poplar.
Sb Sebewa	Slight	Severe	Moderate	Moderate	Severe	Red maple White ash American basswood Black spruce Pin oak Northern red oak	85 --- --- --- 85 75	White spruce, eastern white pine, northern white-cedar, Norway spruce, white ash, red maple.
SnB, SnC Sisson	Slight	Slight	Slight	Slight	Moderate	Northern red oak Yellow-poplar White ash American basswood White oak Sugar maple Black walnut Black cherry	70+ --- --- --- --- --- --- ---	Yellow-poplar, black walnut, eastern white pine, white spruce, Norway spruce, red pine, black cherry.
SpB, SpC Spinks	Slight	Slight	Moderate	Slight	Moderate	Northern red oak White oak Shagbark hickory Eastern white pine Red pine	65 65 65 65 65	Red pine, eastern white pine, jack pine, Scotch pine.
ThA Thetford	Slight	Slight	Moderate	Slight	Moderate	Quaking aspen White ash Red maple Eastern cottonwood Sugar maple Northern red oak American basswood	60 --- --- --- --- --- ---	White spruce, Norway spruce, eastern white pine.
UeB*: Urban land.								
Boyer	Slight	Slight	Slight	Slight	Moderate	Northern red oak White oak American basswood Sugar maple	66 --- --- ---	Eastern white pine, red pine, white spruce.
Spinks	Slight	Slight	Moderate	Slight	Moderate	Northern red oak White oak Shagbark hickory Eastern white pine Red pine	65 65 65 65 65	Red pine, eastern white pine, jack pine, Scotch pine.
UpA*: Urban land.								

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
UpA*:								
Capac	Slight	Slight	Slight	Slight	Severe	Sugar maple	61	Eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						Paper birch	---	
						Quaking aspen	---	
						Black oak	---	
						Red maple	---	
						Yellow birch	---	
Colwood	Slight	Severe	Severe	Severe	Severe	Red maple	61	White spruce, Austrian pine, northern white-cedar, eastern cottonwood, eastern white pine.
						White ash	61	
						Northern red oak	61	
						Silver maple	86	
						Green ash	61	
						Swamp white oak	61	
UtB*:								
Urban land.								
Marlette	Slight	Slight	Slight	Slight	Moderate	Sugar maple	61	White spruce, eastern cottonwood.
						Northern red oak	---	
						White ash	---	
						Black walnut	---	
						American basswood	---	
						Black cherry	---	
						White oak	---	

* See map unit description for the composition and behavior of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means greater than. Absence of an entry means that trees of the height class do not normally grow on this soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ad: Adrian	---	Silky dogwood	Austrian pine	Northern white-cedar, Scotch pine, eastern white pine.	---
AnA*:					
Aubbeenaubbee	---	Autumn-olive, Amur honeysuckle, blackhaw, mapleleaf viburnum, cornelian cherry dogwood, American cranberrybush, shadblow serviceberry, rose-of-sharon.	---	Norway spruce, white spruce, American basswood, eastern white pine.	
Capac	---	White spruce, silky dogwood, American cranberrybush.	Eastern white pine, northern white-cedar.	---	European alder, Carolina poplar.
Au: Aurelius	Silky dogwood	Austrian pine, Amur privet, nannyberry viburnum, northern white-cedar.	---	---	Carolina poplar.
Bo: Boots	---	Late lilac, nannyberry viburnum, common ninebark.	Japanese tree lilac.	Almondleaf willow.	Carolina poplar.
BrB: Boyer	Silky dogwood	Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, Amur privet.	Red pine, tamarack.	Eastern white pine, jack pine, Scotch pine, white ash.	---
BsD*, BsE*:					
Boyer	Silky dogwood	Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, Amur privet.	Red pine, tamarack.	Eastern white pine, jack pine, Scotch pine, white ash.	---
Spinks	---	Tatarian honeysuckle, Vanhoutte spirea, Amur privet, autumn-olive.	Red pine, white spruce.	Eastern white pine	Lombardy poplar.
ByA: Brady	---	White spruce, silky dogwood, whitebelle honeysuckle, blue spruce, Tatarian honeysuckle.	Northern white-cedar, eastern white pine.	Norway spruce, red pine, green ash.	Carolina poplar.
CaA: Capac	---	White spruce, silky dogwood, American cranberrybush.	Eastern white pine, northern white-cedar.	---	European alder, Carolina poplar.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Ce: Ceresco	---	White spruce, whitebelle honeysuckle, silky dogwood.	Eastern white pine, northern white-cedar, tall purple willow, Siberian crabapple.	---	Carolina poplar.
Ch: Cohoctah	---	Silky dogwood	Northern white-cedar, Siberian crabapple.	---	Green ash.
Co*: Colwood	---	Siberian crabapple, silky dogwood, Tatarian honeysuckle, white spruce, Amur privet, arrowwood, hawthorn.	Northern white-cedar, Norway spruce, eastern white pine, tamarack.	---	Carolina poplar.
Brookston	Silky dogwood	Shadblow serviceberry.	White spruce, nannyberry viburnum, black spruce, northern white-cedar, Siberian crab-apple.	Eastern white pine, Norway spruce, green ash.	---
Ed: Edwards	---	Amur privet, silky dogwood, redosier dogwood.	Austrian pine, nannyberry viburnum, tamarack, eastern white pine.	Scotch pine, northern white-cedar, Norway spruce.	Carolina poplar.
EvB: Eleva variant	---	White spruce, lilac.	American mountainash, Siberian crabapple.	Eastern white pine, Scotch pine, jack pine.	---
Gf: Gilford	---	Austrian pine, white spruce, shadblow serviceberry, silky dogwood, hawthorn.	Eastern white pine, Norway spruce, green ash, northern white-cedar, black spruce.	---	Carolina poplar.
Gr: Granby	---	Silky dogwood, Amur privet, white spruce.	Eastern white pine, northern white-cedar, Norway spruce, tamarack.	---	---
Ha*: Histosols.					
Aquents.					
Hn: Houghton	Vanhoutte spirea	Silky dogwood, Amur privet, white spruce, redosier dogwood.	Eastern white pine, tamarack, Austrian pine.	Northern white-cedar, Norway spruce, Scotch pine.	Carolina poplar.
Ka: Keowns	---	Northern white-cedar, redosier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
KbA: Kibbie	---	Silky dogwood, white spruce, blue spruce, American cranberrybush.	Northern white-cedar, eastern white pine, green ash.	Norway spruce, red pine, white ash.	Carolina poplar.
Ln: Lenawee	---	Silky dogwood	Eastern white pine	Green ash	---
MaB, MaC, MeD2: Marlette	---	White spruce, autumn-olive, late lilac, silky dogwood.	Norway spruce, red pine, Austrian pine, American mountainash, eastern white pine.	---	Carolina poplar.
MoE*:					
Marlette	---	White spruce, autumn-olive, late lilac, silky dogwood.	Norway spruce, red pine, Austrian pine, American mountainash, eastern white pine.	---	Carolina poplar.
Boyer	Silky dogwood	Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, Amur privet.	Red pine, tamarack.	Eastern white pine, jack pine, Scotch pine, white ash.	---
MrA: Matherton	---	Silky dogwood, white spruce.	Northern white-cedar, eastern white pine.	Norway spruce	Carolina poplar.
MtB, MtC: Metea	Silky dogwood	Autumn-olive, Amur privet, Tatarian honeysuckle, late lilac.	Red pine, white spruce.	Eastern white pine, Norway spruce.	Carolina poplar, European alder.
Na: Napoleon	Silky dogwood	Austrian pine, Amur privet, nannyberry viburnum, northern white-cedar.	---	---	Carolina poplar.
OsB, OsC: Oshtemo	Silky dogwood	Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, red pine.	Red pine, white spruce.	Eastern white pine, jack pine, Scotch pine, white ash.	Carolina poplar.
OtB*, OtC*:					
Oshtemo	Silky dogwood	Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, red pine.	Red pine, white spruce.	Eastern white pine, jack pine, Scotch pine, white ash.	Carolina poplar.
Spinks	---	Tatarian honeysuckle, Vanhoutte spirea, Amur privet, autumn-olive.	Red pine, white spruce.	Eastern white pine	Lombardy poplar.
OwB*, OwC*:					
Owosso	Silky dogwood	Tatarian honeysuckle.	Blue spruce, red pine, white spruce.	Eastern white pine, green ash.	Carolina poplar, European alder.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
OwB*, OwC*:					
Marlette	---	White spruce, autumn-olive, late lilac, silky dogwood.	Norway spruce, red pine, Austrian pine, American mountainash, eastern white pine.	---	Carolina poplar.
Pa. Palms	Vanhoutte spirea	Silky dogwood, Tatarian honeysuckle, American cranberrybush, white spruce.	Eastern white pine, Austrian pine, tamarack.	Northern white-cedar, Norway spruce, Scotch pine, green ash.	---
Pt*. Pits					
RdB*, RdC*, RdD*:					
Riddles	---	Autumn-olive	Northern white-cedar, red pine, white spruce.	Norway spruce, Scotch pine.	---
Hillsdale	---	Persian lilac, late lilac.	White spruce, red pine.	Eastern white pine	Carolina poplar.
Sb. Sebewa	---	White spruce, silky dogwood, Amur privet.	Eastern white pine, northern white-cedar, black spruce.	---	---
SnB, SnC. Sisson	Silky dogwood	Tatarian honeysuckle, Amur privet.	Red pine	Eastern white pine, green ash.	Carolina poplar.
SpB, SpC. Spinks	---	Tatarian honeysuckle, Vanhoutte spirea, Amur privet, autumn-olive.	Red pine, white spruce.	Eastern white pine	Lombardy poplar.
ThA. Thetford	---	White spruce, silky dogwood, Tatarian honeysuckle.	Eastern white pine, northern white-cedar, Austrian pine.	Norway spruce, red pine.	Carolina poplar.
Ud*:					
Udorthents.					
Udipsamments.					
UeB*:					
Urban land.					
Boyer	Silky dogwood	Autumn-olive, Vanhoutte spirea, Tatarian honeysuckle, Amur privet.	Red pine, tamarack.	Eastern white pine, jack pine, Scotch pine, white ash.	---
Spinks	---	Tatarian honeysuckle, Vanhoutte spirea, Amur privet, autumn-olive.	Red pine, white spruce.	Eastern white pine	Lombardy poplar.
UpA*:					
Urban land.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
UpA*:					
Capac	---	White spruce, silky dogwood, American cranberrybush.	Eastern white pine, northern white-cedar.	---	European alder, Carolina poplar.
Colwood	---	Siberian crabapple, silky dogwood, Tatarian honeysuckle, white spruce, Amur privet, arrowwood, hawthorn.	Northern white-cedar, Norway spruce, eastern white pine, tamarack.	---	Carolina poplar.
UtB*:					
Urban land.					
Marlette	---	White spruce, autumn-olive, late lilac, silky dogwood.	Norway spruce, red pine, Austrian pine, American mountainash, eastern white pine.	---	Carolina poplar.
Uu*:					
Urban land.					
Fluvaquents.					

* See map unit description for the composition and behavior of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ad---------------- Adrian	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: excess humus, floods, wetness.
AnA*:						
Aubbeenaubbee----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness, low strength.	Moderate: wetness.
Capac------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Au---------------- Aurelius	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.	Severe: floods, wetness, excess humus.
Bo---------------- Boots	Severe: wetness, excess humus, floods.	Severe: wetness, low strength, floods.	Severe: wetness, low strength, floods.	Severe: wetness, low strength, floods.	Severe: wetness, low strength, floods.	Severe: excess humus, wetness, floods.
BrB--------------- Boyer	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
BsD*, BsE*:						
Boyer------------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Spinks-----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ByA--------------- Brady	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Moderate: wetness.
CaA--------------- Capac	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
Ce---------------- Ceresco	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, frost action, wetness.	Severe: floods.
Ch---------------- Cohoctah	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, frost action, wetness.	Severe: floods, wetness.
Co*:						
Colwood----------	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.	Severe: wetness, floods.
Brookston--------	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.	Severe: wetness, floods.

See footnote at end of table.

TABLE 9.--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
Ed-----------------Edwards	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: excess humus, wetness, floods.
EvB----------------Eleva variant	Moderate: depth to rock.	Slight----------	Moderate: depth to rock.	Moderate: slope.	Moderate: frost action.	Moderate: small stones, thin layer.
Gf-----------------Gilford	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, floods.	Severe: wetness, floods.
Gr-----------------Granby	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Ha*:						
Histosols.						
Aquents.						
Hn-----------------Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: excess humus, wetness, floods.
Ka-----------------Keowns	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods.
KbA----------------Kibbie	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action, low strength.	Moderate: wetness.
Ln-----------------Lenawee	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: low strength, wetness, floods.	Severe: wetness, floods.
MaB----------------Marlette	Moderate: too clayey, wetness.	Moderate: low strength.	Moderate: low strength, wetness.	Moderate: slope, low strength.	Severe: low strength.	Slight.
MaC----------------Marlette	Moderate: slope, too clayey.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
MeD2---------------Marlette	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
MoE*:						
Marlette-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Boyer--------------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MrA----------------Matherton	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength, wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 9.--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
MtB: Metea	Severe: cutbanks cave.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Moderate: frost action.	Moderate: too sandy.
MtC: Metea	Severe: cutbanks cave.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Moderate: slope, frost action.	Moderate: too sandy, slope.
Na: Napoleon	Severe: wetness, excess humus, floods.	Severe: wetness, low strength, floods.	Severe: wetness, low strength, floods.	Severe: wetness, low strength, floods.	Severe: wetness, low strength, floods.	Severe: wetness, excess humus, floods.
OsB: Oshtemo	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
OsC: Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
OtB*:						
Oshtemo	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: too sandy.
Spinks	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: too sandy.
OtC*:						
Oshtemo	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: too sandy, slope.
Spinks	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: too sandy, slope.
OwB*:						
Owosso	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Slight.
Marlette	Moderate: too clayey, wetness.	Moderate: low strength.	Moderate: low strength, wetness.	Moderate: slope, low strength.	Severe: low strength.	Slight.
OwC*:						
Owosso	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
Marlette	Moderate: slope, too clayey.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
Pa: Palms	Severe: wetness, excess humus, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, excess humus.
Pt*. Pits						
RdB*:						
Riddles	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 9.--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
RdB*:						
Hillsdale	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
RdC*:						
Riddles	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
Hillsdale	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
RdD*:						
Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Hillsdale	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sb: Sebewa	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
SnB: Sisson	Severe: cutbanks cave.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength.	Slight.
SnC: Sisson	Severe: cutbanks cave.	Moderate: slope, low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
SpB: Spinks	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: too sandy.
SpC: Spinks	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: too sandy, slope.
ThA: Thetford	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, too sandy.
Ud*:						
Udorthents.						
Udipsamments.						
UeB*:						
Urban land.						
Boyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
Spinks	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: too sandy.
UpA*:						
Urban land.						
Capac	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.

See footnote at end of table.

TABLE 9.--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
UpA*:						
Colwood	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.	Severe: wetness, floods.
UtB*:						
Urban land.						
Marlette	Moderate: too clayey, wetness.	Moderate: low strength.	Moderate: low strength, wetness.	Moderate: slope, low strength.	Severe: low strength.	Slight.
Uu*:						
Urban land.						
Fluvaquents.						

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ad: Adrian	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
AnA*:					
Aubbeenaubbee	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, seepage.	Poor: wetness.
Capac	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Au: Aurelius	Severe: floods, wetness, subsides.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Poor: wetness.
Bo: Boots	Severe: wetness, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, excess humus.
BrB: Boyer	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: small stones.
BsD*, BsE*:					
Boyer	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: slope.
Spinks	Severe: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage, slope.	Poor: too sandy, seepage, slope.
ByA: Brady	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
CaA: Capac	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ce: Ceresco	Severe: floods, wetness.	Severe: seepage, floods, wetness.	Severe: seepage, floods, wetness.	Severe: seepage, floods, wetness.	Poor: wetness.
Ch: Cohoctah	Severe: wetness, floods.	Severe: floods, seepage, wetness.	Severe: seepage, floods, wetness.	Severe: seepage, floods, wetness.	Poor: wetness.
Co*:					
Colwood	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 10.--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
Co*:					
Brookston	Severe: wetness, percs slowly, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Ed Edwards	Severe: floods, wetness, percs slowly.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness, excess humus.
EvB Eleva variant	Severe: depth to rock.	Severe: seepage.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: small stones, area reclaim.
Gf Gilford	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness.
Gr Granby	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy, seepage.
Ha*:					
Histosols.					
Aquents.					
Hn Houghton	Severe: wetness, floods, percs slowly.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
Ka Keowns	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
KbA Kibbie	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Ln Lenawee	Severe: percs slowly, wetness, floods.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
MaB Marlette	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
MaC Marlette	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
MeD2 Marlette	Severe: slope, percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
MoE*:					
Marlette	Severe: slope, percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
Boyer	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: slope.

See footnote at end of table.

TABLE 10.--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
MrA: Matherton	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness.	Poor: wetness.
MtB: Metea	Moderate: percs slowly.	Severe: seepage.	Slight	Severe: seepage.	Fair: too clayey.
MtC: Metea	Moderate: percs slowly, slope.	Severe: slope, seepage.	Slight	Severe: seepage.	Fair: slope, too clayey.
Na: Napoleon	Severe: wetness, floods.	Severe: excess humus, seepage, wetness.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, excess humus.
OsB: Oshtemo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, seepage.
OsC: Oshtemo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope, too sandy, seepage.
OtB*:					
Oshtemo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, seepage.
Spinks	Slight	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
OtC*:					
Oshtemo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope, too sandy, seepage.
Spinks	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
OwB*:					
Owosso	Severe: percs slowly.	Moderate: slope.	Slight	Severe: seepage.	Good.
Marlette	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
OwC*:					
Owosso	Severe: percs slowly.	Severe: slope.	Slight	Severe: seepage.	Fair: slope.
Marlette	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Pa: Palms	Severe: wetness, floods, subsides.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, hard to pack.
Pt*. Pits					

See footnote at end of table.

TABLE 10.--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
RdB*:					
Riddles	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Hillsdale	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
RdC*:					
Riddles	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Hillsdale	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
RdD*:					
Riddles	Severe: slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
Hillsdale	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage, slope.	Poor: slope.
Sb Sebewa	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, small stones, seepage.
SnB Sisson	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
SnC Sisson	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
SpB Spinks	Slight	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
SpC Spinks	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
ThA Thetford	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness.
Ud*:					
Udorthents.					
Udipsamments.					
UeB*:					
Urban land.					
Boyer	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: small stones.
Spinks	Slight	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
UpA*:					
Urban land.					

See footnote at end of table.

TABLE 10.--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
UpA*:					
Capac	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Colwood	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
UtB*:					
Urban land.					
Marlette	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Uu*:					
Urban land.					
Fluvaquents.					

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ad----- Adrian	Poor: wetness, low strength.	Good-----	Unsuited: excess fines, excess humus.	Poor: wetness, excess humus.
AnA*:				
Aubbeenaubbee-----	Poor: wetness.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: small stones.
Capac-----	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Au----- Aurelius	Poor: wetness.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
Bo----- Boots	Poor: low strength, wetness.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
BrB----- Boyer	Good-----	Good-----	Good-----	Good.
BsD*, BsE*:				
Boyer-----	Fair: slope.	Good-----	Good-----	Poor: slope.
Spinks-----	Fair: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope.
ByA----- Brady	Poor: wetness.	Good-----	Good-----	Good.
CaA----- Capac	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ce----- Ceresco	Poor: wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
Ch----- Cohoctah	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Co*:				
Colwood-----	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Brookston-----	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Ed----- Edwards	Poor: low strength, wetness.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
EvB----- Eleva variant	Poor: thin layer, area reclaim.	Poor: thin layer.	Unsuited: thin layer.	Poor: small stones.
Gf----- Gilford	Poor: wetness, frost action.	Good-----	Unsuited: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Gr Granby	Poor: wetness.	Good	Unsuited: excess fines.	Poor: wetness.
Ha*: Histosols.				
Aquents.				
Hn Houghton	Poor: wetness, low strength.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
Ka Keowns	Poor: wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: wetness.
KbA Kibbie	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ln Lenawee	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
MaB Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, small stones.
MaC Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer, small stones.
MeD2 Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
MoE*: Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Boyer	Fair: slope.	Good	Good	Poor: slope.
MrA Matherton	Poor: wetness.	Good	Good	Fair: thin layer.
MtB Metea	Fair: low strength.	Poor: thin layer.	Unsuited: excess fines.	Fair: too sandy.
MtC Metea	Fair: low strength.	Poor: thin layer.	Unsuited: excess fines.	Fair: too sandy, slope.
Na Napoleon	Poor: low strength, wetness.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
OsB Oshtemo	Good	Good	Good	Fair: small stones.
OsC Oshtemo	Good	Good	Good	Fair: slope, small stones.
OtB*: Oshtemo	Good	Good	Good	Fair: too sandy, small stones.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OtB*:				
Spinks	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
OtC*:				
Oshtemo	Good	Good	Good	Fair: too sandy, slope, small stones.
Spinks	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
OwB*:				
Owosso	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: small stones.
Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, small stones.
OwC*:				
Owosso	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, small stones.
Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer, small stones.
Pa Palms	Poor: wetness, low strength.	Unsuited: excess humus, excess fines.	Unsuited: excess humus, excess fines.	Poor: wetness, excess humus.
Pt*. Pits				
RdB*:				
Riddles	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Hillsdale	Fair: frost action, low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
RdC*:				
Riddles	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Hillsdale	Fair: frost action, low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: slope.
RdD*:				
Riddles	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Hillsdale	Fair: slope, frost action, low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: slope.
Sb Sebewa	Poor: wetness.	Good	Good	Poor: wetness.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SnB: Sisson	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
SnC: Sisson	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
SpB: Spinks	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
SpC: Spinks	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
ThA: Thetford	Poor: wetness.	Good	Unsuited: excess fines.	Fair: too sandy.
Ud*: Udorthents.				
Udipsamments.				
UeB*: Urban land.				
Boyer	Good	Good	Good	Good.
Spinks	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
UpA*: Urban land.				
Capac	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Colwood	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
UtB*: Urban land.				
Marlette	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, small stones.
Uu*: Urban land.				
Fluvaquents.				

* See map unit description for the composition and behavior of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ad----------------- Adrian	Seepage--------	Seepage, wetness.	Floods, frost action.	Wetness, fast intake, soil blowing.	Not needed-----	Wetness.
AnA*:						
Aubbeenaubbee----	Seepage--------	Wetness--------	Frost action---	Wetness, soil blowing.	Not needed-----	Wetness.
Capac------------	Favorable------	Wetness--------	Frost action---	Wetness, soil blowing.	Not needed-----	Wetness.
Au----------------- Aurelius	Seepage--------	Wetness--------	Floods, excess humus, frost action.	Floods, soil blowing, wetness.	Not needed-----	Wetness.
Bo----------------- Boots	Seepage--------	Excess humus, wetness.	Frost action, excess humus, floods.	Wetness, soil blowing, floods.	Not needed-----	Wetness.
BrB---------------- Boyer	Seepage--------	Seepage--------	Not needed-----	Droughty, soil blowing.	Soil blowing, too sandy.	Droughty.
BsD*, BsE*:						
Boyer------------	Slope, seepage.	Seepage--------	Not needed-----	Fast intake, droughty, soil blowing.	Slope, soil blowing, too sandy.	Slope, droughty.
Spinks-----------	Seepage, slope.	Seepage--------	Not needed-----	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
ByA---------------- Brady	Seepage--------	Seepage, wetness.	Frost action---	Wetness, soil blowing.	Not needed-----	Wetness.
CaA---------------- Capac	Favorable------	Wetness--------	Frost action---	Wetness--------	Not needed-----	Wetness.
Ce----------------- Ceresco	Seepage--------	Piping, wetness.	Floods, frost action.	Floods, wetness, soil blowing.	Not needed-----	Wetness.
Ch----------------- Cohoctah	Seepage--------	Piping, wetness.	Floods, frost action.	Wetness, floods, soil blowing.	Not needed-----	Wetness.
Co*:						
Colwood----------	Seepage--------	Piping, wetness.	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
Brookston--------	Favorable------	Wetness--------	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
Ed----------------- Edwards	Seepage--------	Excess humus, wetness.	Frost action, floods, excess humus.	Floods, soil blowing, wetness.	Not needed-----	Wetness.
EvB---------------- Eleva variant	Depth to rock, seepage.	Thin layer-----	Not needed-----	Droughty, rooting depth.	Depth to rock	Droughty, depth to rock.
Gf----------------- Gilford	Seepage--------	Seepage, wetness.	Floods, frost action.	Wetness, soil blowing.	Not needed-----	Wetness.
Gr----------------- Granby	Seepage--------	Seepage, wetness.	Floods---------	Wetness, droughty, fast intake.	Not needed-----	Wetness, droughty.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ha*:						
Histosols.						
Aquents.						
Hn: Houghton	Seepage	Excess humus, wetness.	Frost action, excess humus, floods.	Soil blowing, wetness, floods.	Not needed	Wetness.
Ka: Keowns	Seepage	Wetness, piping.	Floods, frost action.	Wetness, soil blowing, floods.	Not needed	Wetness.
KbA: Kibbie	Seepage	Piping, wetness.	Frost action	Wetness	Not needed	Wetness, erodes easily.
Ln: Lenawee	Seepage	Wetness	Floods, frost action.	Wetness, floods.	Not needed	Wetness.
MaB: Marlette	Favorable	Wetness	Favorable	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.
MaC: Marlette	Slope	Favorable	Not needed	Soil blowing, slope.	Soil blowing	Slope.
MeD2: Marlette	Slope	Favorable	Not needed	Slope	Slope	Slope.
MoE*:						
Marlette	Slope	Favorable	Not needed	Soil blowing, slope.	Slope, soil blowing.	Slope.
Boyer	Slope, seepage.	Seepage	Not needed	Fast intake, droughty, soil blowing.	Slope, soil blowing, too sandy.	Slope, droughty.
MrA: Matherton	Seepage	Seepage, wetness.	Frost action	Wetness, soil blowing.	Not needed	Wetness.
MtB: Metea	Seepage	Piping	Not needed	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
MtC: Metea	Slope, seepage.	Piping	Not needed	Fast intake, soil blowing, slope.	Too sandy, soil blowing.	Slope.
Na: Napoleon	Seepage	Excess humus, wetness.	Floods, excess humus, frost action.	Wetness, floods, soil blowing.	Not needed	Wetness.
OsB: Oshtemo	Seepage	Seepage	Not needed	Soil blowing	Too sandy, soil blowing.	Favorable.
OsC: Oshtemo	Slope, seepage.	Seepage	Not needed	Slope, soil blowing.	Too sandy, soil blowing.	Slope.
OtB*:						
Oshtemo	Seepage	Seepage	Not needed	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
Spinks	Seepage	Seepage	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
OtC*:						
Oshtemo	Slope, seepage.	Seepage	Not needed	Fast intake, soil blowing, slope.	Too sandy, soil blowing.	Slope.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
OtC*:						
Spinks	Seepage, slope.	Seepage	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Slope, droughty.
OwB*:						
Owosso	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Favorable.
Marlette	Favorable	Wetness	Favorable	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.
OwC*:						
Owosso	Seepage, slope.	Favorable	Not needed	Soil blowing, slope.	Soil blowing	Slope.
Marlette	Slope	Favorable	Not needed	Soil blowing, slope.	Soil blowing	Slope.
Pa Palms	Seepage	Excess humus, wetness.	Floods, frost action, excess humus.	Wetness, soil blowing, floods.	Not needed	Wetness.
Pt*. Pits						
RdB*:						
Riddles	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Favorable.
Hillsdale	Seepage	Favorable	Not needed	Soil blowing	Soil blowing, too sandy.	Favorable.
RdC*:						
Riddles	Slope, seepage.	Favorable	Not needed	Slope, soil blowing.	Soil blowing	Slope.
Hillsdale	Slope, seepage.	Favorable	Not needed	Slope, soil blowing.	Soil blowing, too sandy.	Slope.
RdD*:						
Riddles	Slope, seepage.	Favorable	Not needed	Slope, soil blowing.	Slope, soil blowing.	Slope.
Hillsdale	Slope, seepage.	Favorable	Not needed	Slope, soil blowing.	Slope, soil blowing, too sandy.	Slope.
Sb Sebewa	Seepage	Seepage, wetness.	Frost action, floods.	Wetness, floods.	Not needed	Wetness.
SnB Sisson	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Erodes easily.
SnC Sisson	Seepage, slope.	Favorable	Not needed	Soil blowing, slope.	Soil blowing	Slope, erodes easily.
SpB Spinks	Seepage	Seepage	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
SpC Spinks	Seepage, slope.	Seepage	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Slope, droughty.
ThA Thetford	Seepage	Piping, seepage, wetness.	Favorable	Wetness, fast intake, droughty.	Not needed	Droughty, wetness.
Ud*: Udorthents.						

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ud*:						
Udipsamments.						
UeB*:						
Urban land.						
Boyer	Seepage	Seepage	Not needed	Droughty, soil blowing.	Soil blowing, too sandy.	Droughty.
Spinks	Seepage	Seepage	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
UpA*:						
Urban land.						
Capac	Favorable	Wetness	Frost action	Wetness, soil blowing.	Not needed	Wetness.
Colwood	Seepage	Piping, wetness.	Floods, frost action.	Wetness, floods.	Not needed	Wetness.
UtB*:						
Urban land.						
Marlette	Favorable	Wetness	Favorable	Wetness	Wetness	Favorable.
Uu*:						
Urban land.						
Fluvaquents.						

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ad: Adrian	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, floods, wetness.
AnA*:					
Aubbeenaubbee	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Capac	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Au: Aurelius	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: floods, wetness, excess humus.
Bo: Boots	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: floods, excess humus, wetness.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.
BrB: Boyer	Slight	Slight	Moderate: small stones, slope.	Slight	Slight.
BsD*, BsE*:					
Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
Spinks	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.
ByA: Brady	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
CaA: Capac	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Ce: Ceresco	Severe: wetness, floods.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
Ch: Cohoctah	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: floods, wetness.
Co*:					
Colwood	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.
Brookston	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
Ed: Edwards	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.

See footnote at end of table.

TABLE 13.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
EvB: Eleva variant	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.	Moderate: small stones, thin layer.
Gf: Gilford	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
Gr: Granby	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
Ha*: Histosols.					
Aquents.					
Hn: Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.
Ka: Keowns	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
KbA: Kibbie	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Ln: Lenawee	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
MaB: Marlette	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight	Slight.
MaC: Marlette	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
MeD2: Marlette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
MoE*: Marlette	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
MrA: Matherton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
MtB: Metea	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
MtC: Metea	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
Na: Napoleon	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.	Severe: wetness, excess humus.	Severe: wetness, excess humus, floods.

See footnote at end of table.

TABLE 13.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
OsB: Oshtemo	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
OsC: Oshtemo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
OtB*:					
Oshtemo	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: too sandy.
Spinks	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
OtC*:					
Oshtemo	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
Spinks	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
OwB*:					
Owosso	Moderate: percs slowly.	Slight	Moderate: slope, small stones, percs slowly.	Slight	Slight.
Marlette	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight	Slight.
OwC*:					
Owosso	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Marlette	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Pa: Palms	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.
Pt*. Pits					
RdB*:					
Riddles	Slight	Slight	Moderate: slope.	Slight	Slight.
Hillsdale	Slight	Slight	Moderate: slope.	Slight	Slight.
RdC*:					
Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Hillsdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

See footnote at end of table.

TABLE 13.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
RdD*:					
Riddles	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Hillsdale	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Sb: Sebewa	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
SnB: Sisson	Slight	Slight	Moderate: slope.	Slight	Slight.
SnC: Sisson	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
SpB: Spinks	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
SpC: Spinks	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
ThA: Thetford	Severe: wetness.	Moderate: too sandy, wetness.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.
Ud*: Udorthents.					
Udipsamments.					
UeB*: Urban land.					
Boyer	Slight	Slight	Moderate: small stones, slope.	Slight	Slight.
Spinks	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
UpA*: Urban land.					
Capac	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Colwood	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.
UtB*: Urban land.					
Marlette	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight	Slight.
Uu*: Urban land.					
Fluvaquents.					

* See map unit description for the composition and behavior of the map unit.

TABLE 14.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates 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
Ad: Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
AnA*:										
Aubbeenaubbee	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Capac	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
Au: Aurelius	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Bo: Boots	Good	Good	Poor	Good	Poor	Good	Good	Good	Good	Good.
BrB: Boyer	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BsD*, BsE*:										
Boyer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Spinks	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
ByA: Brady	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
CaA: Capac	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
Ce: Ceresco	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Ch: Cohoctah	Poor	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Co*:										
Colwood	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Brookston	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ed: Edwards	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
EvB: Eleva variant	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Fair	Poor	Very poor.
Gf: Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gr: Granby	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ha*:										
Histosols.										
Aquents.										
Hn: Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

See footnote at end of table.

TABLE 14.--WILDLIFE HABITAT POTENTIALS--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
Ka------------------ Keowns	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Good	Good.
KbA----------------- Kibbie	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
Ln------------------ Lenawee	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
MaB----------------- Marlette	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MaC----------------- Marlette	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MeD2---------------- Marlette	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MoE*:										
Marlette-----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Boyer--------------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
MrA----------------- Matherton	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
MtB----------------- Metea	Poor	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
MtC----------------- Metea	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Na------------------ Napoleon	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
OsB----------------- Oshtemo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
OsC----------------- Oshtemo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
OtB*:										
Oshtemo------------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Spinks-------------	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
OtC*:										
Oshtemo------------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Spinks-------------	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
OwB*:										
Owosso-------------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Marlette-----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 14.--WILDLIFE HABITAT POTENTIALS--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
OwC*:										
Owosso	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Marlette	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pa: Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Poor.
Pt*. Pits										
RdB*:										
Riddles	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Hillsdale	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RdC*:										
Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Hillsdale	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RdD*:										
Riddles	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hillsdale	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Sb: Sebewa	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
SnB: Sisson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
SnC: Sisson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
SpB: Spinks	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
SpC: Spinks	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
ThA: Thetford	Poor	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
Ud*:										
Udorthents.										
Udipsamments.										
UeB*:										
Urban land.										
Boyer	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Spinks	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 14.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
UpA*: Urban land.										
Capac----------------	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
Colwood------------	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
UtB*: Urban land.										
Marlette-----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Uu*: Urban land.										
Fluvaquents.										

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ad----------------- Adrian	0-29	Sapric material	Pt	A-8	---	---	---	---	---	---	---
	29-60	Sand, gravelly loamy sand, fine sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
AnA*: Aubbeenaubbee-----	0-17	Sandy loam------	SM, SM-SC	A-2-4, A-4	0	100	75-95	60-80	30-40	<25	NP-6
	17-25	Sandy loam, loam, loamy sand.	SM	A-2-4, A-1-B, A-4	0	100	80-95	40-75	15-40	<20	NP
	25-35	Sandy clay loam, clay loam.	CL, SC	A-6, A-2-6	0	95-100	90-100	80-90	30-55	25-35	11-16
	35-60	Loam, silt loam, clay loam.	CL, CL-ML, ML	A-4, A-6	0-3	85-90	80-90	70-85	50-60	20-35	2-14
Capac-------------	0-8	Sandy loam------	SM, SM-SC	A-4, A-2	0-5	95-100	90-100	60-70	30-40	<25	NP-7
	8-31	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	50-80	25-40	5-20
	31-60	Loam------------	C, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-75	15-35	5-15
Au----------------- Aurelius	0-9	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	9-13	Coprogenous earth.	OL	A-8	0	---	---	---	---	---	---
	13-30	Marl------------	---	---	0	100	95-100	80-90	60-80	---	---
	30-60	Stratified sand to clay loam.	SM, ML	A-2, A-4	0	95-100	90-100	70-90	30-80	<40	NP-10
Bo----------------- Boots	0-10	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	10-60	Hemic material	Pt	A-8	0	---	---	---	---	---	---
BrB---------------- Boyer	0-8	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	8-28	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	28-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
BsD*, BsE*: Boyer-------------	0-11	Loamy sand------	SM, SM-SC	A-2, A-1	0-5	95-100	65-95	45-75	15-30	<20	NP-6
	11-23	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	23-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
Spinks------------	0-5	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	5-40	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
	40-60	Fine sand-------	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP
ByA---------------- Brady	0-14	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	95-100	75-100	60-70	25-40	<25	NP-7
	14-36	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	95-100	75-95	60-80	25-45	15-35	NP-16
	36-49	Loamy sand, sandy loam.	SM	A-2	0-5	95-100	75-95	55-70	15-35	---	NP
	49-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-5	40-75	35-70	20-55	0-10	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
CaA----------------- Capac	0-9	Loam------------	CL, ML, CL-ML	A-4	0-5	95-100	90-100	80-95	60-75	<25	3-10
	9-32	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	50-80	25-40	5-20
	32-60	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-75	15-35	5-15
Ce------------------ Ceresco	0-48	Fine sandy loam, very fine sandy loam.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	100	60-90	30-75	10-20	NP-6
	48-60	Sandy loam, loamy fine sand, silt loam.	SM, ML, CL, SC	A-2, A-4	0	95-100	80-100	60-95	15-80	15-30	NP-8
Ch------------------ Cohoctah	0-19	Silt loam--------	ML	A-4	0	100	100	85-100	55-90	<30	NP-6
	19-42	Loam, fine sandy loam, sandy loam.	ML, SM, SC, CL	A-4, A-2	0	95-100	80-100	70-90	30-70	<30	NP-10
	42-60	Loam, sandy loam, loamy sand.	ML, SM, SC, CL	A-4, A-2	0	95-100	80-100	65-90	20-70	<30	NP-10
Co*:											
Colwood------------	0-10	Loam------------	ML	A-4, A-6	0	100	100	85-100	60-90	30-40	2-12
	10-26	Loam, silty clay loam, silt loam.	CL, CL-ML	A-6, A-4	0	100	100	80-100	50-90	20-40	6-20
	26-60	Stratified silty clay loam to fine sand.	SM, ML	A-2, A-4	0	100	95-100	70-100	30-80	<35	NP-10
Brookston----------	0-13	Loam------------	CL	A-4, A-6	0	98-100	98-100	85-100	60-90	22-40	8-18
	13-42	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	98-100	85-100	75-95	60-85	36-52	18-30
	42-60	Loam, sandy loam, clay loam.	CL	A-4, A-6	0-3	90-100	85-95	78-90	55-70	22-30	7-15
Ed------------------ Edwards	0-29	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	29-60	Marl------------	---	---	0	100	95-100	80-90	60-80	---	---
EvB----------------- Eleva variant	0-8	Channery sandy loam.	SM, SM-SC, SC	A-2-4, A-1-B	0-20	70-90	60-80	35-55	20-30	<20	NP-10
	8-28	Channery sandy loam.	SM, SC, SM-SC, SP-SM	A-2-4, A-2-6, A-1-B	5-20	65-85	55-75	30-50	12-30	<25	NP-10
	28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Gf------------------ Gilford	0-10	Sandy loam------	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	10-39	Sandy loam, fine sandy loam.	SM, SC, SM-SC	A-2-4	0	90-100	90-100	55-70	20-35	15-30	NP-8
	39-60	Loamy sand, sand, gravelly loamy sand.	SM, SP, SP-SM	A-3, A-1-B, A-2-4	0	85-100	75-100	18-60	3-20	---	NP
Gr------------------ Granby	0-10	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	10-60	Sand, loamy fine sand, gravelly sand.	SP, SP-SM	A-3, A-2	0	75-100	70-100	50-70	0-5	---	NP
Ha*: Histosols.											
Aquents.											
Hn------------------ Houghton	0-66	Sapric material	Pt	A-8	0	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ka------------------ Keowns	0-10	Very fine sandy loam.	ML, SM	A-4	0	100	100	65-100	35-90	<20	NP-4
	10-29	Silt loam, very fine sandy loam, sandy loam.	ML, CL, SM, SC	A-4, A-2	0	100	100	60-100	30-85	<20	NP-10
	29-60	Stratified silt to fine sand.	ML, SM	A-2, A-4	0	100	100	70-100	30-95	<20	NP-4
KbA----------------- Kibbie	0-11	Loam------------	ML	A-4, A-6	0	100	100	75-95	50-85	25-40	2-14
	11-28	Clay loam, silty clay loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	0	90-100	85-100	80-100	35-90	25-45	6-25
	28-60	Stratified silt loam to fine sand.	ML, SM, SC, CL	A-4, A-2	0	100	95-100	70-95	30-80	<30	NP-10
Ln------------------ Lenawee	0-8	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	50-95	25-45	11-22
	8-30	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	80-95	25-55	11-30
	30-60	Silt loam, clay loam.	CL, CL-ML	A-6, A-4, A-7	0	100	95-100	95-100	85-95	25-45	6-22
MaB----------------- Marlette	0-9	Fine sandy loam	SM, SM-SC	A-4, A-2	0-5	95-100	85-95	60-70	30-40	<25	NP-7
	9-31	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	31-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
MaC----------------- Marlette	0-9	Fine sandy loam	SM, SM-SC	A-4, A-6	0-5	95-100	85-95	60-70	30-40	<25	NP-7
	9-31	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	31-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
MeD2---------------- Marlette	0-6	Loam------------	CL, ML, CL-ML	A-4	0-5	95-100	85-95	80-95	60-70	20-30	3-10
	6-22	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
MoE*:											
Marlette-----------	0-4	Sandy loam------	SM, SM-SC	A-4, A-6	0-5	95-100	85-95	60-70	30-40	<25	NP-7
	4-22	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
Boyer--------------	0-11	Loamy sand------	SM, SM-SC	A-2, A-1	0-5	95-100	65-95	45-75	15-30	<20	NP-6
	11-23	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	23-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
MrA----------------- Matherton	0-11	Sandy loam------	SM	A-2, A-4	0-5	95-100	90-100	55-70	25-40	<20	NP-4
	11-38	Gravelly sandy clay loam, clay loam, loam.	SC, CL, CL-ML, SM-SC	A-6, A-4	0-5	95-100	65-95	55-85	35-70	25-40	5-20
	38-60	Sand and gravel	GP, SP, SP-SM, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-90	30-55	0-10	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
MtB----------------- Metea	0-8	Loamy sand------	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	8-34	Loamy sand, loamy fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	34-38	Clay loam, sandy clay loam, silty clay loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	38-60	Loam, silty clay loam, clay loam.	CL, ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18
MtC----------------- Metea	0-6	Loamy sand------	SM	A-2-4	0	100	100	50-80	15-35	---	NP
	6-34	Loamy sand, loamy fine sand, sand.	SP-SM, SM	A-2-4	0	100	100	50-80	10-35	---	NP
	34-38	Clay loam, sandy clay loam, silty clay loam.	CL, SC	A-6, A-7	0	90-100	90-95	75-95	40-75	25-50	12-30
	38-60	Loam, silty clay loam, clay loam.	CL, ML	A-4, A-6	0-3	85-95	80-90	75-90	50-75	25-40	5-18
Na------------------ Napoleon	0-6	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	6-60	Hemic material	Pt	A-8	0	---	---	---	---	---	---
OsB----------------- Oshtemo	0-16	Sandy loam------	SM, SM-SC	A-2, A-4	0	95-100	60-95	60-70	25-40	15-25	2-7
	16-34	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	34-50	Loamy sand, sand	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	50-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
OsC----------------- Oshtemo	0-13	Sandy loam------	SM, SM-SC	A-2, A-4	0	95-100	60-95	60-70	25-40	15-25	2-7
	13-34	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	34-47	Loamy sand------	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	47-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
OtB*:											
Oshtemo------------	0-20	Loamy sand------	SM	A-2, A-1	0	95-100	60-95	40-70	15-30	---	NP
	20-36	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	36-51	Loamy sand------	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	51-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
Spinks-------------	0-8	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	8-48	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
	48-60	Fine sand-------	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
OtC*:											
Oshtemo-----------	0-16	Loamy sand------	SM	A-2, A-1	0	95-100	60-95	40-70	15-30	---	NP
	16-36	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	60-95	60-85	25-45	12-30	2-16
	36-46	Loamy sand------	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	46-60	Stratified coarse sand to gravel.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0-5	40-90	35-85	20-60	0-10	---	NP
Spinks------------	0-8	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	8-48	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
	48-60	Fine sand-------	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP
OwB*:											
Owosso------------	0-9	Sandy loam------	SM, SM-SC, SC	A-2, A-4	0-5	95-100	75-100	50-70	20-45	12-29	NP-10
	9-32	Sandy loam, loam, fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0-5	95-100	75-100	60-90	25-45	15-30	NP-10
	32-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	90-95	85-95	60-90	25-40	6-21
Marlette----------	0-9	Sandy loam------	SM, SM-SC	A-4, A-2	0-5	95-100	85-95	60-70	30-40	<25	NP-7
	9-31	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	31-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
OwC*:											
Owosso------------	0-9	Sandy loam------	SM, SM-SC, SC	A-2, A-4	0-5	95-100	75-100	50-70	20-45	12-29	NP-10
	9-32	Sandy loam, loam, fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0-5	95-100	75-100	60-90	25-45	15-30	NP-10
	32-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	90-95	85-95	60-90	25-40	6-21
Marlette----------	0-9	Sandy loam------	SM, SM-SC	A-4, A-6	0-5	95-100	85-95	60-70	30-40	<25	NP-7
	9-29	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	29-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
Pa----------------- Palms	0-36	Sapric material	Pt	---	---	---	---	---	---	---	---
	36-60	Clay loam, silty clay loam, sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
Pt*. Pits											
RdB*:											
Riddles-----------	0-22	Sandy loam------	SM, SC, SM-SC	A-2-4, A-4	0	95-100	85-95	50-70	25-40	20-30	2-10
	22-47	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	47-66	Clay loam, sandy loam, loam.	CL, SM, SC, ML	A-4, A-6, A-2	0-3	85-95	80-90	50-90	30-70	15-30	2-15

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
RdB*:											
Hillsdale	0-10	Sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	95-100	90-100	60-90	20-65	15-30	2-10
	10-32	Sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	90-100	60-85	15-50	15-30	2-10
	32-66	Sandy loam, sandy clay loam, loam.	SM, SC, SM-SC	A-2-4, A-2-6, A-4, A-6	0-5	95-100	90-100	65-85	30-50	12-38	2-19
RdC*:											
Riddles	0-18	Sandy loam	SM, SC, SM-SC	A-2-4, A-4	0	95-100	85-95	50-70	25-40	20-30	2-10
	18-47	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	47-60	Clay loam, sandy loam, loam.	CL, SM, SC, ML	A-4, A-6, A-2	0-3	85-95	80-90	50-90	30-70	15-30	2-15
Hillsdale	0-10	Sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	95-100	90-100	60-90	20-65	15-30	2-10
	10-32	Sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	90-100	60-85	15-50	15-30	2-10
	32-66	Sandy loam, sandy clay loam, loam.	SM, SC, SM-SC	A-2-4, A-2-6, A-4, A-6	0-5	95-100	90-100	65-85	30-50	12-38	2-19
RdD*:											
Riddles	0-12	Sandy loam	SM, SC, SM-SC	A-2-4, A-4	0	95-100	85-95	50-70	25-40	20-30	2-10
	12-47	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	47-60	Clay loam, sandy loam, loam.	CL, SM, SC, ML	A-4, A-6, A-2	0-3	85-95	80-90	50-90	30-70	15-30	2-15
Hillsdale	0-6	Sandy loam	SM, SC, ML, CL	A-2-4, A-4	0-5	95-100	90-100	60-90	20-65	15-30	2-10
	6-32	Sandy loam	SM, SM-SC, SC	A-2-4, A-4	0-5	95-100	90-100	60-85	15-50	15-30	2-10
	32-62	Sandy loam, sandy clay loam, loam.	SM, SC, SM-SC	A-2-4, A-2-6, A-4, A-6	0-5	95-100	90-100	65-85	30-50	12-38	2-19
Sb Sebewa	0-12	Loam	CL, CL-ML	A-4, A-6	0	95-100	80-100	75-95	50-90	22-35	6-12
	12-24	Sandy clay loam, loam, gravelly clay loam.	SC, CL	A-4, A-6	0	95-100	65-95	55-85	40-75	25-40	8-20
	24-60	Sand and gravel	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	---	NP
SnB Sisson	0-13	Fine sandy loam	CL, ML, SM, SC	A-4	0	100	100	60-85	35-55	<28	NP-10
	13-34	Loam, clay loam, silt loam.	CL	A-4, A-6	0	100	100	85-100	60-90	18-40	7-25
	34-60	Stratified silt loam to fine sand.	CL, ML, SM, SC	A-2, A-4, A-6	0	100	95-100	65-95	25-90	<35	NP-15

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
SnC: Sisson	0-8	Fine sandy loam	CL, ML, SM, SC	A-4	0	100	100	60-85	35-55	<28	NP-10
	8-29	Loam, clay loam, silt loam.	CL	A-4, A-6	0	100	100	85-100	60-90	18-40	7-25
	29-60	Stratified silt loam to fine sand.	CL, ML, SM, SC	A-2, A-4, A-6	0	100	95-100	65-95	25-90	<35	NP-15
SpB: Spinks	0-10	Loamy sand	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	10-22	Loamy sand	SM	A-2-4	0	100	80-100	50-90	15-25	---	NP
	22-60	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
SpC: Spinks	0-8	Loamy sand	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	8-18	Loamy sand	SM	A-2-4	0	100	80-100	50-90	15-25	---	NP
	18-55	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
	55-60	Fine sand	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP
ThA: Thetford	0-15	Loamy sand	SM	A-2, A-4	0	95-100	90-100	70-85	20-45	<20	NP-4
	15-58	Loamy sand, sand, sandy loam.	SM, SP-SM	A-2, A-4	0	95-100	90-100	60-80	10-40	<20	NP-4
	58-60	Very fine sand, fine sand, sand.	SM, SP, SP-SM	A-2, A-4, A-3	0	95-100	70-100	50-85	0-45	<20	NP-4
Ud*: Udorthents.											
Udipsamments.											
UeB*: Urban land.											
Boyer	0-8	Sandy loam	SM, SM-SC	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	8-26	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	26-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
Spinks	0-8	Loamy sand	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	8-22	Loamy sand	SM	A-2-4	0	100	80-100	50-90	15-25	---	NP
	22-48	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
	48-60	Fine sand	SP-SM, SM	A-2-4, A-3	0	100	80-100	50-90	5-25	---	NP
UpA*: Urban land.											
Capac	0-9	Loam	CL, ML, CL-ML	A-4	0-5	95-100	90-100	80-95	60-75	<25	3-10
	9-32	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	50-80	25-40	5-20
	32-60	Loam	C, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-75	15-35	5-15
Colwood	0-10	Loam	ML	A-4, A-6	0	100	100	85-100	60-90	30-40	2-12
	10-28	Loam, silty clay loam, silt loam.	CL, CL-ML	A-6, A-4	0	100	100	80-100	50-90	20-40	6-20
	28-60	Stratified silty clay loam to fine sand.	SM, ML	A-2, A-4	0	100	95-100	70-100	30-80	<35	NP-10

See footnote at end of table.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
UtB*:											
Urban land.											
Marlette	0-9	Loam	CL-ML, ML, CL	A-4	0-5	95-100	85-95	70-95	40-70	20-30	3-10
	9-31	Loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-100	55-90	20-40	5-25
	31-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	85-95	75-95	50-75	20-40	5-25
Uu*:											
Urban land.											
Fluvaquents.											

* See map unit description for the composition and behavior of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Wind erodibility group and organic matter are for the surface layer. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Ad----------------- Adrian	0-29	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.8	---------------	---	---	3	55-75
	29-60	---	1.40-1.75	6.0-20	0.03-0.08	6.1-8.4	Low------------	---			
AnA*:											
Aubbeenaubbee----	0-17	---	---	2.0-6.0	0.16-0.18	6.1-7.3	Low------------	0.24	5	3	1-3
	17-25	---	---	6.0-20	0.09-0.14	5.6-6.5	Low------------	0.24			
	25-35	---	---	0.6-2.0	0.16-0.18	5.6-7.3	Moderate------	0.32			
	35-60	---	---	0.6-2.0	0.10-0.19	7.4-8.4	Low------------	0.32			
Capac-------------	0-8	5-15	1.43-1.73	2.0-6.0	0.13-0.15	5.6-7.3	Low------------	0.32	5	3	1-3
	8-31	18-35	1.44-1.81	0.2-2.0	0.14-0.18	5.6-7.3	Low------------	0.32			
	31-60	10-25	1.47-1.90	0.2-2.0	0.14-0.16	7.4-8.4	Low------------	0.32			
Au----------------- Aurelius	0-9	---	0.32-0.52	0.2-6.0	0.35-0.45	6.6-8.4	---------------	---	---	3	40-60
	9-13	---	---	0.06-0.2	0.24-0.34	6.6-8.4	---------------	---			
	13-30	---	---	0.06-0.2	0.24-0.34	7.4-8.4	---------------	---			
	30-60	0-35	1.56-1.89	0.6-2.0	0.18-0.24	7.4-8.4	Low------------	---			
Bo----------------- Boots	0-10	---	---	0.2-6.0	0.35-0.45	6.6-7.3	---------------	---	---	3	40-65
	10-60	---	---	0.6-6.0	0.35-0.45	6.6-7.3	---------------	---			
BrB---------------- Boyer	0-8	5-15	1.15-1.60	2.0-6.0	0.10-0.15	5.6-7.3	Low------------	0.24	4	3	0.5-2
	8-28	10-18	1.25-1.60	2.0-6.0	0.12-0.18	5.6-7.8	Low------------	0.24			
	28-60	0-10	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low------------	0.10			
BsD*, BsE*:											
Boyer-------------	0-11	5-15	1.15-1.60	6.0-20	0.10-0.12	5.6-7.3	Low------------	0.10	4	2	0.5-2
	11-23	10-18	1.25-1.60	2.0-6.0	0.12-0.18	5.6-7.8	Low------------	0.24			
	23-60	0-10	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low------------	0.10			
Spinks------------	0-5	2-15	1.14-1.60	6.0-20	0.08-0.10	5.6-7.3	Low------------	0.17	5	2	2-4
	5-40	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low------------	0.17			
	40-60	0-10	1.20-1.47	6.0-20	0.04-0.06	6.6-8.4	Low------------	0.17			
ByA---------------- Brady	0-14	2-15	1.25-1.41	2.0-6.0	0.12-0.15	5.6-7.3	Low------------	0.20	5	3	2-4
	14-36	5-22	1.35-1.45	2.0-6.0	0.12-0.17	5.1-6.5	Low------------	0.20			
	36-49	5-20	1.25-1.50	2.0-20	0.08-0.10	5.1-6.5	Low------------	0.20			
	49-60	0-10	1.25-1.50	>20	0.02-0.04	6.6-8.4	Low------------	0.10			
CaA---------------- Capac	0-9	10-18	1.43-1.73	0.6-2.0	0.18-0.20	5.6-7.3	Low------------	0.32	5	5	1-3
	9-32	18-35	1.44-1.81	0.2-2.0	0.14-0.18	5.6-7.3	Low------------	0.32			
	32-60	10-25	1.47-1.90	0.2-2.0	0.14-0.16	7.4-8.4	Low------------	0.32			
Ce----------------- Ceresco	0-48	2-15	1.12-1.59	2.0-6.0	0.13-0.22	6.1-7.8	Low------------	0.20	5	3	1-4
	48-60	10-20	1.46-1.95	0.6-6.0	0.08-0.13	6.1-8.4	Low------------	0.20			
Ch----------------- Cohoctah	0-19	5-20	1.12-1.59	2.0-6.0	0.13-0.22	6.1-7.8	Low------------	0.28	5	3	1-4
	19-42	5-27	1.48-1.80	2.0-6.0	0.12-0.20	6.1-8.4	Low------------	0.28			
	42-60	2-25	1.46-1.95	2.0-6.0	0.08-0.20	6.1-8.4	Low------------	0.28			
Co*:											
Colwood-----------	0-10	5.-25	1.14-1.60	0.6-2.0	0.20-0.24	6.1-7.8	Low------------	0.28	5	5	1-4
	10-26	18-35	1.26-1.59	0.6-2.0	0.17-0.22	6.1-8.4	Moderate------	0.43			
	26-60	0.-12	1.20-1.47	0.6-2.0	0.12-0.22	7.4-8.4	Low------------	0.43			
Brookston---------	0-13	---	---	0.6-2.0	0.21-0.24	6.6-7.3	Moderate------	0.28	5	6	1-3
	13-42	---	---	0.6-2.0	0.15-0.19	6.6-7.3	Moderate------	0.28			
	42-60	---	---	0.2-2.0	0.05-0.19	7.4-8.4	Moderate------	0.28			
Ed----------------- Edwards	0-29	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.8	---------------	---	---	3	55-75
	29-60	---	---	---	---	7.4-8.4	---------------	---			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
EvB----------------	0-8	3-15	1.10-1.65	2.0-6.0	0.06-0.12	5.1-7.3	Low-----------	0.17	3	8	0.5-3
Eleva variant	8-28	10-18	1.20-1.60	2.0-6.0	0.06-0.09	5.1-6.5	Low-----------	0.17			
	28	---	---	---	---	---	--------------	---			
Gf----------------	0-10	10-20	1.50-1.70	2.0-6.0	0.13-0.15	6.1-7.3	Low-----------	0.20	5	3	4-7
Gilford	10-39	8-17	1.60-1.80	2.0-6.0	0.12-0.14	6.1-7.3	Low-----------	0.20			
	39-60	3-12	1.70-1.90	6.0-20	0.05-0.08	6.6-8.4	Low-----------	0.15			
Gr----------------	0-10	2.-14	0.92-1.59	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2	4-6
Granby	10-60	0.-10	1.45-1.74	6.0-20	0.05-0.09	5.6-8.4	Low-----------	0.17			
Ha*:											
Histosols.											
Aquents.											
Hn----------------	0-66	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	--------------	---	---	3	>70
Houghton											
Ka----------------	0-10	7-15	1.20-1.70	0.6-2.0	0.13-0.22	6.6-8.4	Low-----------	0.28	5	3	3-7
Keowns	10-29	10-18	1.30-1.70	0.6-2.0	0.12-0.22	6.6-8.4	Low-----------	0.28			
	29-60	5-12	1.55-1.75	0.6-2.0	0.11-0.22	7.4-8.4	Low-----------	0.28			
KbA---------------	0-11	5-25	1.43-1.73	0.6-2.0	0.16-0.24	5.6-7.3	Low-----------	0.28	5	5	1-3
Kibbie	11-28	5-35	1.44-1.81	0.6-2.0	0.17-0.22	5.6-7.3	Low-----------	0.43			
	28-60	2-18	1.47-1.90	0.6-2.0	0.12-0.22	7.4-8.4	Low-----------	0.43			
Ln----------------	0-8	20-35	0.91-1.55	0.6-2.0	0.17-0.22	5.6-6.0	Moderate-----	0.28	4	7	2-5
Lenawee	8-30	35-45	1.39-1.78	0.2-0.6	0.18-0.20	6.6-7.8	Moderate-----	0.28			
	30-60	18-40	1.51-1.80	0.6-2.0	0.18-0.22	7.4-7.8	Low-----------	0.28			
MaB---------------	0-9	10-18	1.31-1.78	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.32	5	3	1-3
Marlette	9-31	18-30	1.31-1.86	0.2-0.6	0.18-0.20	5.6-7.8	Low-----------	0.32			
	31-60	15-25	1.33-1.89	0.2-0.6	0.12-0.19	7.4-8.4	Low-----------	0.32			
MaC---------------	0-9	10-18	1.31-1.78	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.32	5	3	1-3
Marlette	9-31	18-30	1.31-1.86	0.2-2.0	0.18-0.20	5.6-7.8	Low-----------	0.32			
	31-60	15-25	1.33-1.89	0.2-2.0	0.12-0.19	7.4-8.4	Low-----------	0.32			
MeD2--------------	0-6	10-18	1.31-1.78	2.0-6.0	0.18-0.22	5.6-7.3	Low-----------	0.32	5	5	1-3
Marlette	6-22	18-30	1.31-1.86	0.2-2.0	0.18-0.20	5.6-7.8	Low-----------	0.32			
	22-60	15-25	1.33-1.89	0.2-2.0	0.12-0.19	7.4-8.4	Low-----------	0.32			
MoE*:											
Marlette---------	0-4	10-18	1.31-1.78	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.32	5	3	1-3
	4-22	18-30	1.31-1.86	0.2-2.0	0.18-0.20	5.6-7.8	Low-----------	0.32			
	22-60	15-25	1.33-1.89	0.2-2.0	0.12-0.19	7.4-8.4	Low-----------	0.32			
Boyer------------	0-11	5-15	1.15-1.60	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	4	2	0.5-2
	11-23	10-18	1.25-1.60	2.0-6.0	0.12-0.18	5.6-7.8	Low-----------	0.24			
	23-60	0-10	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
MrA---------------	0-11	10-20	1.29-1.72	2.0-6.0	0.13-0.15	5.6-7.3	Low-----------	0.20	4	3	2-3
Matherton	11-38	20-35	1.40-1.83	0.6-2.0	0.16-0.18	5.6-7.3	Low-----------	0.32			
	38-60	0-10	1.50-1.65	6.0-20	0.02-0.04	7.4-8.4	Low-----------	0.10			
MtB---------------	0-8	---	---	>20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2	2-4
Metea	8-34	---	---	>20	0.06-0.11	5.1-7.3	Low-----------	0.17			
	34-38	---	---	0.6-2.0	0.15-0.19	5.6-7.3	Moderate-----	0.32			
	38-60	---	---	0.6-2.0	0.05-0.19	7.4-8.4	Low-----------	0.32			
MtC---------------	0-6	---	---	>20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2	2-4
Metea	6-34	---	---	>20	0.06-0.11	5.1-7.3	Low-----------	0.17			
	34-38	---	---	0.6-2.0	0.15-0.19	5.6-7.3	Moderate-----	0.32			
	38-60	---	---	0.6-2.0	0.05-0.19	7.4-8.4	Low-----------	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Na----------------	0-6	---	---	0.2-6.0	0.35-0.45	<4.5	--------------	---	---	3	40-65
Napoleon	6-60	---	---	0.6-6.0	0.45-0.55	<4.5	--------------	---			
OsB---------------	0-16	2-12	1.15-1.60	2.0-6.0	0.10-0.15	5.1-6.5	Low-----------	0.24	5	3	0.5-3
Oshtemo	16-34	10-22	1.20-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24			
	34-50	5-15	1.20-1.60	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17			
	50-60	0-15	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
OsC---------------	0-13	2-12	1.15-1.60	2.0-6.0	0.10-0.15	5.1-6.5	Low-----------	0.24	5	3	0.5-3
Oshtemo	13-34	10-32	1.20-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24			
	34-47	5-15	1.20-1.60	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17			
	47-60	0-15	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
OtB*:											
Oshtemo---------	0-20	2-12	1.15-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----------	0.24	5	2	0.5-3
	20-36	10-32	1.20-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24			
	36-51	5-15	1.20-1.60	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17			
	51-60	0-15	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
Spinks----------	0-8	2-15	1.14-1.60	6.0-20	0.08-0.10	5.6-7.3	Low-----------	0.17	5	2	2-4
	8-48	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low-----------	0.17			
	48-60	0-10	1.20-1.47	6.0-20	0.04-0.06	6.6-8.4	Low-----------	0.17			
OtC*:											
Oshtemo---------	0-16	2-12	1.15-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----------	0.24	5	2	0.5-3
	16-36	10-32	1.20-1.60	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24			
	36-46	5-15	1.20-1.60	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17			
	46-60	0-15	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			
Spinks----------	0-8	2-15	1.14-1.60	6.0-20	0.08-0.10	5.6-7.3	Low-----------	0.17	5	2	2-4
	8-48	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low-----------	0.17			
	48-60	0-10	1.20-1.47	6.0-20	0.04-0.06	6.6-8.4	Low-----------	0.17			
OwB*:											
Owosso----------	0-9	5-18	1.10-1.64	2.0-6.0	0.13-0.18	5.1-7.3	Low-----------	0.24	5	3	1-2
	9-32	10-22	1.10-1.64	2.0-6.0	0.09-0.17	5.1-7.3	Low-----------	0.24			
	32-60	18-35	1.31-1.78	0.2-0.6	0.14-0.20	5.1-8.4	Moderate-----	0.37			
Marlette--------	0-9	10-18	1.31-1.78	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.32	5	3	1-3
	9-31	18-30	1.31-1.86	0.2-0.6	0.18-0.20	5.6-7.8	Low-----------	0.32			
	31-60	15-25	1.33-1.89	0.2-0.6	0.12-0.19	7.4-8.4	Low-----------	0.32			
OwC*:											
Owosso----------	0-9	5-18	1.10-1.64	2.0-6.0	0.13-0.18	5.1-7.3	Low-----------	0.24	5	3	1-2
	9-32	10-22	1.10-1.64	2.0-6.0	0.09-0.17	5.1-7.3	Low-----------	0.24			
	32-60	18-35	1.31-1.78	0.2-0.6	0.14-0.20	5.1-8.4	Moderate-----	0.37			
Marlette--------	0-9	10-18	1.31-1.78	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.32	5	3	1-3
	9-29	18-30	1.31-1.86	0.2-2.0	0.18-0.20	5.6-7.8	Low-----------	0.32			
	29-60	15-25	1.33-1.89	0.2-2.0	0.12-0.19	7.4-8.4	Low-----------	0.32			
Pa----------------	0-36	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-8.4	--------------	---	---	3	>75
Palms	36-60	7-35	1.46-2.00	0.2-2.0	0.14-0.22	6.1-8.4	Low-----------	---			
Pt*.											
Pits											
RdB*:											
Riddles---------	0-22	---	---	2.0-6.0	0.13-0.15	6.1-7.3	Low-----------	0.24	5	3	1-3
	22-47	---	---	0.6-2.0	0.16-0.18	5.1-7.3	Moderate-----	0.32			
	47-66	---	---	0.6-2.0	0.05-0.19	6.6-8.4	Low-----------	0.32			
Hillsdale-------	0-10	2-15	1.10-1.65	0.6-6.0	0.13-0.22	5.1-7.3	Low-----------	0.24	5	3	1-3
	10-32	5-15	1.20-1.85	2.0-6.0	0.13-0.15	4.5-6.5	Low-----------	0.24			
	32-66	10-22	1.20-1.85	0.6-6.0	0.12-0.18	4.5-6.5	Low-----------	0.24			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
RdC*:											
Riddles----------	0-18	---	---	2.0-6.0	0.13-0.15	6.1-7.3	Low----------	0.24	5	3	1-3
	18-56	---	---	0.6-2.0	0.16-0.18	5.1-7.3	Moderate-----	0.32			
	56-60	---	---	0.6-2.0	0.05-0.19	6.6-8.4	Low----------	0.32			
Hillsdale--------	0-10	2-15	1.10-1.65	0.6-6.0	0.13-0.22	5.1-7.3	Low----------	0.24	5	3	1-3
	10-32	5-15	1.20-1.85	2.0-6.0	0.13-0.15	4.5-6.5	Low----------	0.24			
	32-66	10-22	1.20-1.85	0.6-6.0	0.12-0.18	4.5-6.5	Low----------	0.24			
RdD*:											
Riddles----------	0-12	---	---	2.0-6.0	0.13-0.15	6.1-7.3	Low----------	0.24	5	3	1-3
	12-47	---	---	0.6-2.0	0.16-0.18	5.1-7.3	Moderate-----	0.32			
	47-60	---	---	0.6-2.0	0.05-0.19	6.6-8.4	Low----------	0.32			
Hillsdale--------	0-6	2-15	1.10-1.65	0.6-6.0	0.13-0.22	5.1-7.3	Low----------	0.24	5	3	1-3
	6-32	5-15	1.20-1.85	2.0-6.0	0.13-0.15	4.5-6.5	Low----------	0.24			
	32-62	10-22	1.20-1.85	0.6-6.0	0.12-0.18	4.5-6.5	Low----------	0.24			
Sb--------------- Sebewa	0-12	10-25	1.12-1.59	0.6-2.0	0.18-0.22	6.1-7.8	Low----------	0.24	5	5	1-4
	12-24	18-35	1.48-1.80	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.32			
	24-60	0-3	1.56-1.74	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.10			
SnB-------------- Sisson	0-13	10-20	1.30-1.80	0.6-2.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	1-3
	13-34	18-35	1.30-1.80	0.6-2.0	0.15-0.22	6.1-7.8	Moderate-----	0.43			
	34-60	5-22	1.30-1.90	0.6-2.0	0.05-0.22	7.4-8.4	Low----------	0.43			
SnC-------------- Sisson	0-8	10-20	1.30-1.80	0.6-2.0	0.13-0.18	6.1-7.3	Low----------	0.24	5	3	1-3
	8-29	18-35	1.30-1.80	0.6-2.0	0.15-0.22	6.1-7.8	Moderate-----	0.43			
	29-60	5-22	1.30-1.80	0.6-2.0	0.05-0.22	7.4-8.4	Low----------	0.43			
SpB-------------- Spinks	0-10	2-15	1.14-1.60	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17	5	2	2-4
	10-22	3-15	1.26-1.59	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17			
	22-60	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low----------	0.17			
SpC-------------- Spinks	0-8	2-15	1.14-1.60	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17	5	2	2-4
	8-18	3-15	1.26-1.59	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17			
	18-55	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low----------	0.17			
	55-60	0-10	1.20-1.47	6.0-20	0.04-0.06	6.6-8.4	Low----------	0.17			
ThA-------------- Thetford	0-15	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
	15-58	8-18	1.35-1.45	2.0-6.0	0.08-0.13	5.6-7.8	Low----------	0.17			
	58-60	0-10	1.25-1.50	6.0-20	0.05-0.08	7.4-8.4	Low----------	0.17			
Ud*:											
Udorthents.											
Udipsamments.											
UeB*:											
Urban land.											
Boyer------------	0-8	5-15	1.15-1.60	2.0-6.0	0.10-0.15	5.6-7.3	Low----------	0.24	4	3	0.5-2
	8-26	10-18	1.25-1.60	2.0-6.0	0.12-0.18	5.6-7.8	Low----------	0.24			
	26-60	0-10	1.20-1.50	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
Spinks-----------	0-8	2-15	1.14-1.60	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17	5	2	2-4
	8-22	3-15	1.26-1.59	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17			
	22-48	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low----------	0.17			
	48-60	0-10	1.20-1.47	6.0-20	0.04-0.06	6.6-8.4	Low----------	0.17			
UpA*:											
Urban land.											
Capac------------	0-9	10-18	1.43-1.73	0.6-2.0	0.18-0.20	5.6-7.3	Low----------	0.32	5	5	1-3
	9-32	18-35	1.44-1.81	0.2-2.0	0.14-0.18	5.6-7.3	Low----------	0.32			
	32-60	10-25	1.47-1.90	0.2-2.0	0.14-0.16	7.4-8.4	Low----------	0.32			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
UpA*:											
Colwood---------	0-10	5.-25	1.14-1.60	0.6-2.0	0.20-0.24	6.1-7.8	Low-----------	0.28	5	5	1-4
	10-28	18-35	1.26-1.59	0.6-2.0	0.17-0.22	6.1-8.4	Moderate-----	0.43			
	28-60	0.-12	1.20-1.47	0.6-2.0	0.12-0.22	7.4-8.4	Low-----------	0.43			
UtB*:											
Urban land.											
Marlette--------	0-9	10-18	1.31-1.78	2.0-6.0	0.18-0.22	5.6-7.3	Low-----------	0.32	5	5	1-3
	9-31	18-30	1.31-1.86	0.2-0.6	0.18-0.20	5.6-7.8	Low-----------	0.32			
	31-60	15-25	1.33-1.89	0.2-0.6	0.12-0.19	7.4-8.4	Low-----------	0.32			
Uu*:											
Urban land.											
Fluvaquents.											

* See map unit description for the composition and behavior of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Total		Uncoated steel	Concrete
					Ft			In			
Ad----------------- Adrian	A/D	Frequent-----	Long-------	Nov-May	0-1.0	Apparent	Nov-May	29-33	High------	High------	Moderate.
AnA*:											
Aubbeenaubbee-----	B	None----------	---	---	1.0-3.0	Apparent	Jan-Apr	---	High------	High------	Moderate.
Capac-------------	B	None----------	---	---	1.0-2.0	Apparent	Nov-May	---	High------	High------	Low.
Au----------------- Aurelius	B/D	Frequent-----	Long-------	Sep-May	0-0.5	Apparent	Sep-Jun	7-23	High------	High------	Low.
Bo----------------- Boots	A/D	Frequent-----	Long-------	Nov-May	0-1.0	Apparent	Nov-Aug	40-55	High------	Moderate	Low.
BrB---------------- Boyer	B	None----------	---	---	>6.0	---	---	---	Low-------	Low-------	Moderate.
BsD*, BsE*:											
Boyer-------------	B	None----------	---	---	>6.0	---	---	---	Low-------	Low-------	Moderate.
Spinks------------	A	None----------	---	---	>6.0	---	---	---	Low-------	Low-------	Low.
ByA---------------- Brady	B	None----------	---	---	1.0-3.0	Apparent	Nov-May	---	High------	Low-------	Moderate.
CaA---------------- Capac	B	None----------	---	---	1.0-2.0	Apparent	Nov-May	---	High------	High------	Low.
Ce----------------- Ceresco	B	Common-------	Long-------	Mar-May	1.0-2.0	Apparent	Sep-May	---	High------	Low-------	Low.
Ch----------------- Cohoctah	B/D	Common-------	Long-------	Jan-Dec	0-1.0	Apparent	Sep-May	---	High------	High------	Low.
Co*:											
Colwood-----------	B/D	Frequent-----	Brief------	Mar-Apr	0-1.0	Apparent	Oct-May	---	High------	High------	Low.
Brookston---------	B/D	Frequent-----	Brief------	Dec-May	0-1.0	Apparent	Dec-May	---	High------	High------	Low.
Ed----------------- Edwards	B/D	Frequent-----	Long-------	Sep-May	0-0.5	Apparent	Sep-Jun	25-30	High------	High------	Low.
EvB---------------- Eleva variant	B	None----------	---	---	>2.5	Apparent	Jan-Apr	---	Moderate	Low-------	Moderate.
Gf----------------- Gilford	B/D	Frequent-----	Brief------	Dec-May	0-1.0	Apparent	Dec-May	---	High------	High------	Moderate.
Gr----------------- Granby	A/D	Frequent-----	Brief------	Mar-Apr	0-1.0	Apparent	Nov-Jun	---	Moderate	High------	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Total		Uncoated steel	Concrete
					Ft			In			
Ha*:											
Histosols.											
Aquents.											
Hn Houghton	A/D	Frequent	Long	Nov-May	0-1.0	Apparent	Sep-Jun	55-60	High	High	Low.
Ka Keowns	B/D	Frequent	Brief	Mar-Apr	0-1.0	Apparent	Oct-May	---	High	High	Low.
KbA Kibbie	B	None	---	---	1.0-2.0	Apparent	Nov-May	---	High	Low	High.
Ln Lenawee	B/D	Frequent	Brief	Mar-May	0-1.0	Apparent	Nov-May	---	High	High	Low.
MaB Marlette	B	None	---	---	2.5-6.0	Apparent	Dec-Apr	---	Moderate	Low	Moderate.
MaC, MeD2 Marlette	B	None	---	---	>6.0	---	---	---	Moderate	Low	Moderate.
MoE*:											
Marlette	B	None	---	---	>6.0	---	---	---	Moderate	Low	Moderate.
Boyer	B	None	---	---	>6.0	---	---	---	Low	Low	Moderate.
MrA Matherton	B	None	---	---	1.0-2.0	Apparent	Nov-May	---	High	High	Moderate.
MtB, MtC Metea	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
Na Napoleon	A/D	Frequent	Long	Oct-May	0-1.0	Apparent	Sep-Jun	50-59	High	Moderate	High.
OsB, OsC Oshtemo	B	None	---	---	>6.0	---	---	---	Low	Low	High.
OtB*, OtC*:											
Oshtemo	B	None	---	---	>6.0	---	---	---	Low	Low	High.
Spinks	A	None	---	---	>6.0	---	---	---	Low	Low	Low.
OwB*:											
Owosso	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
Marlette	B	None	---	---	2.5-6.0	Apparent	Dec-Apr	---	Moderate	Low	Moderate.
OwC*:											
Owosso	B	None	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
Marlette	B	None	---	---	>6.0	---	---	---	Moderate	Low	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Total		Uncoated steel	Concrete
					Ft			In			
Pa----------------- Palms	A/D	Frequent----	Long-------	Nov-May	0-1.0	Apparent	Nov-May	25-32	High------	High------	Moderate
Pt*. Pits											
RdB*, RdC*, RdD*: Riddles-----------	B	None---------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate
Hillsdale---------	B	None---------	---	---	>6.0	---	---	---	Moderate	Low-------	High.
Sb----------------- Sebewa	B/D	Frequent----	Brief------	Mar-May	0-1.0	Apparent	Sep-May	---	High------	High------	Low.
SnB, SnC----------- Sisson	B	None---------	---	---	>6.0	---	---	---	Moderate	Low-------	Low.
SpB, SpC----------- Spinks	A	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Low.
ThA---------------- Thetford	A	None---------	---	---	1.0-2.0	Apparent	Feb-May	---	Moderate	Low-------	Moderate
Ud*: Udorthents.											
Udipsamments.											
UeB*: Urban land.											
Boyer-------------	B	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Moderate
Spinks------------	A	None---------	---	---	>6.0	---	---	---	Low-------	Low-------	Low.
UpA*: Urban land.											
Capac-------------	B	None---------	---	---	1.0-2.0	Apparent	Nov-May	---	High------	High------	Low.
Colwood-----------	B/D	Frequent----	Brief------	Mar-Apr	0-1.5	Apparent	Oct-May	---	High------	High------	Low.
UtB*: Urban land.											
Marlette----------	B	None---------	---	---	2.5-6.0	Apparent	Dec-Apr	---	Moderate	Low-------	Moderate
Uu*: Urban land.											
Fluvaquents.											

* See map unit description for the composition and behavior of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Aubbeenaubbee	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Aurelius	Fine-silty, carbonatic, mesic Histic Humaquepts
Boots	Euic, mesic Typic Medihemists
Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
*Brady	Coarse-loamy, mixed, mesic Aquollic Hapludalfs
Brookston	Fine-loamy, mixed, mesic Typic Argiaquolls
Capac	Fine-loamy, mixed, mesic Aeric Ochraqualfs
*Ceresco	Coarse-loamy, mixed, mesic Fluvaquentic Hapludolls
Cohoctah	Coarse-loamy, mixed, mesic Fluvaquentic Haplaquolls
Colwood	Fine-loamy, mixed, mesic Typic Haplaquolls
Edwards	Marly, euic, mesic Limnic Medisaprists
Eleva variant	Loamy-skeletal, mixed, mesic Typic Hapludalfs
Fluvaquents	Loamy, mixed, nonacid, mesic Fluvaquents
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Granby	Sandy, mixed, mesic Typic Haplaquolls
Hillsdale	Coarse-loamy, mixed, mesic Typic Hapludalfs
Histosols and Aquents	Loamy, mixed, nonacid, mesic Haplaquents and euic, mesic Medisaprists
Houghton	Euic, mesic Typic Medisaprists
Keowns	Coarse-loamy, mixed, nonacid, mesic Mollic Haplaquepts
Kibbie	Fine-loamy, mixed, mesic Aquollic Hapludalfs
*Lenawee	Fine, mixed, nonacid, mesic Mollic Haplaquepts
Marlette	Fine-loamy, mixed, mesic Glossoboric Hapludalfs
Matherton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Udollic Ochraqualfs
*Metea	Loamy, mixed, mesic Arenic Hapludalfs
Napoleon	Dysic, mesic Typic Medihemists
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Owosso	Fine-loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Sisson	Fine-loamy, mixed, mesic Typic Hapludalfs
Spinks	Sandy, mixed, mesic Psammentic Hapludalfs
Thetford	Sandy, mixed, mesic Psammaquentic Hapludalfs
Udorthents and Udipsamments	Loamy, mixed, nonacid, mesic Udorthents and mixed, mesic Udipsamments

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