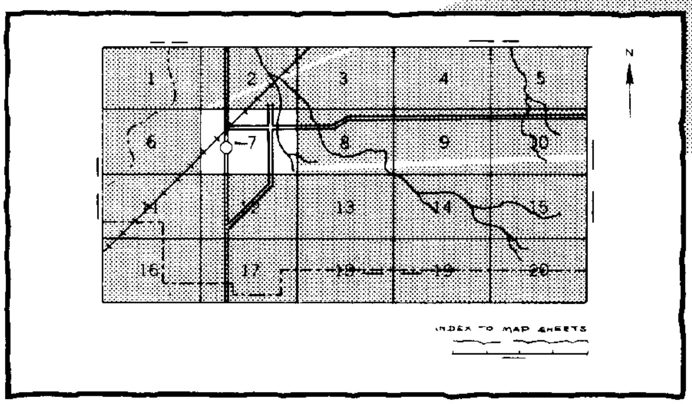
SOIL SURVEY of

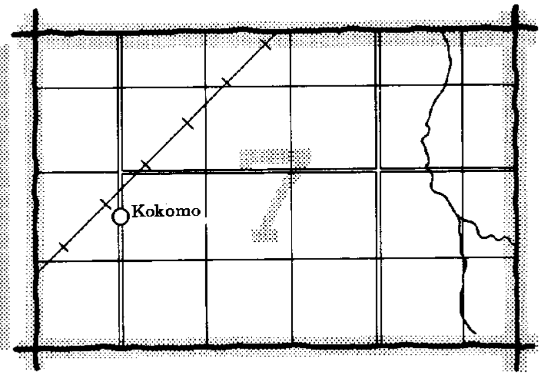
Kalamazoo County, Michigan

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

HOW TO USE

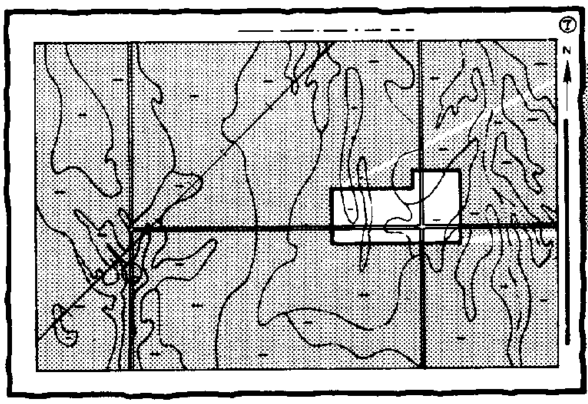
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

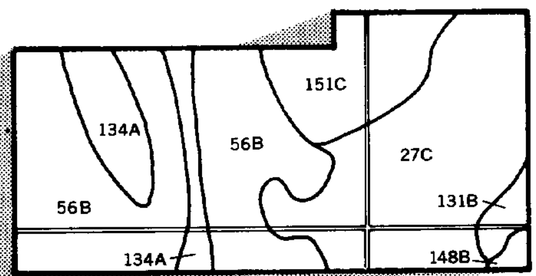




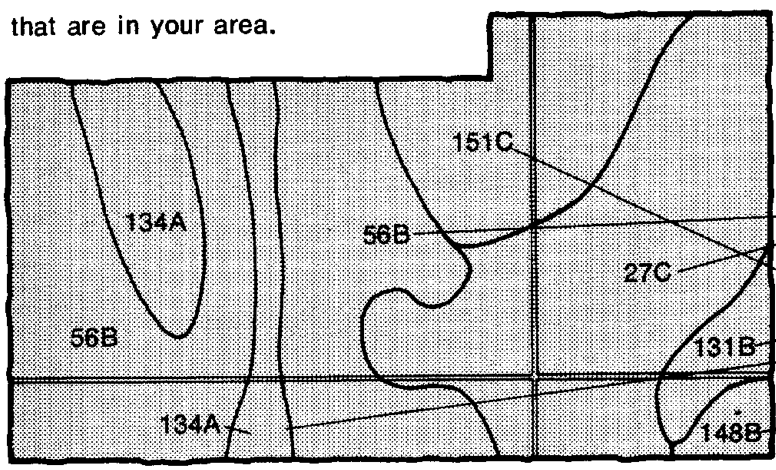
2. Note the number of the map sheet and turn to that sheet.

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





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

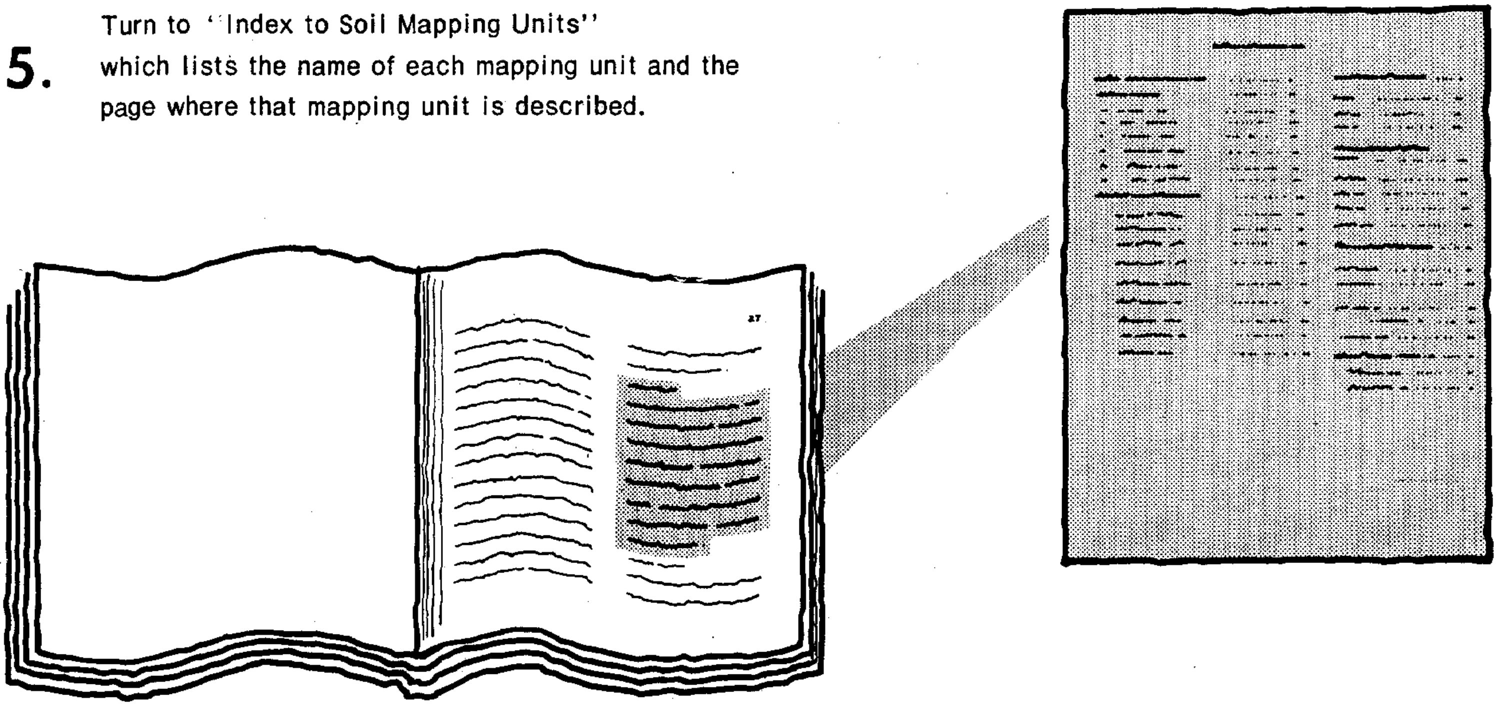


Symbols

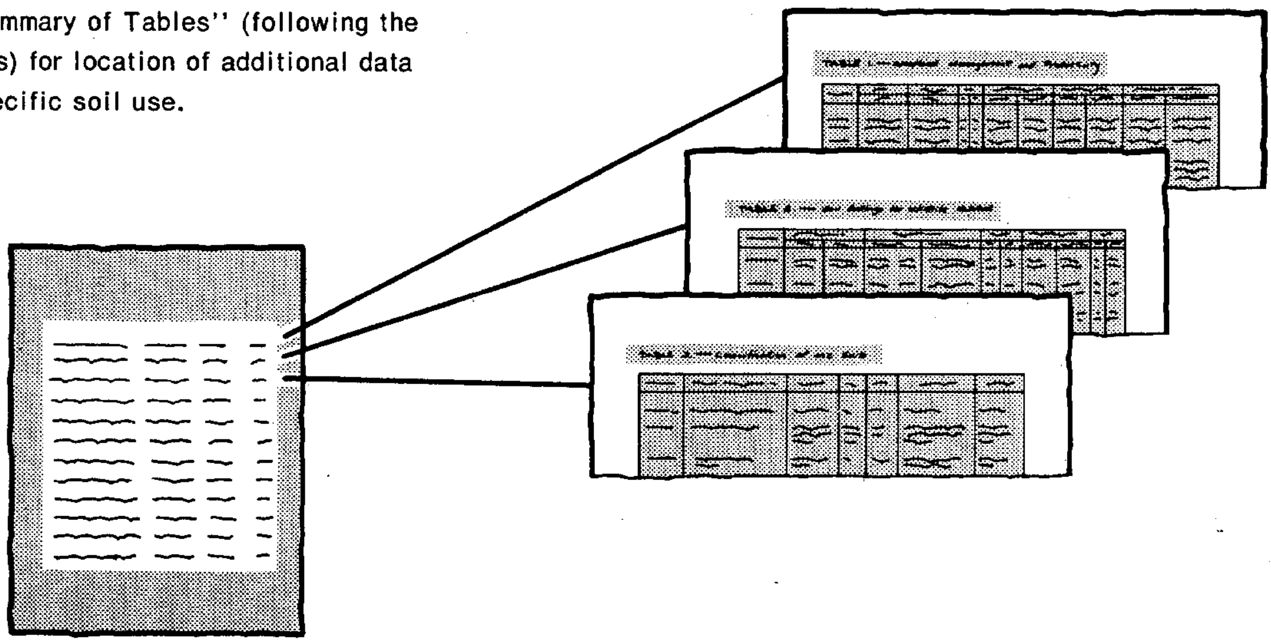
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

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



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



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

This 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 1972 to 1977. Soil names and descriptions were approved in June 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 Kalamazoo County Soil Conservation District.

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.

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Issued November 1979

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Summary of tables

Foreword

The Soil Survey of Kalamazoo 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.

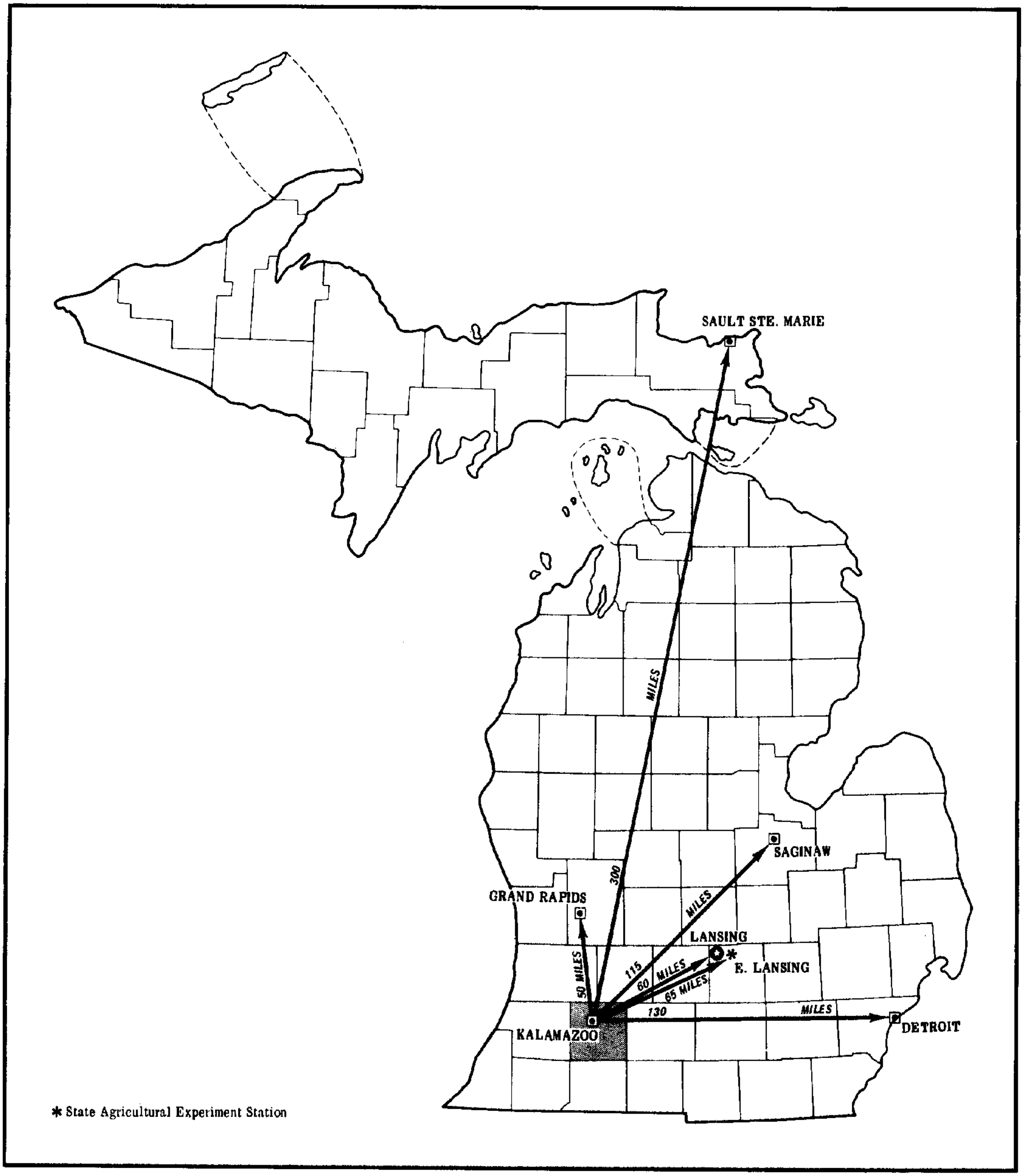
This soil survey has been prepared for many different users. Farmers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use 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 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 Kalamazoo County in Michigan.

SOIL SURVEY OF KALAMAZOO COUNTY, MICHIGAN

By Franklin R. Austin, Soil Conservation Service

Fieldwork by Franklin R. Austin and Gary R. Konwinski, Soil Conservation Service

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

KALAMAZOO COUNTY is in the southwestern part of the lower Michigan peninsula, approximately halfway between Detroit and Chicago. The county is bisected by I-94 Freeway east to west and by U.S. 131 Expressway north to south. The city of Kalamazoo is the county seat. Kalamazoo and Portage are the main commercial, industrial, and educational centers of the county. The total area of the county is about 362,880 acres, or 567 square miles.

The climate is favorable for most crops. About 50 percent of the county is cultivated. The major crops are corn, soybeans, wheat, oats, and hay.

General nature of the county

On the pages that follow is general information on the climate of the county, the physiography, relief, and drainage, the settlement, the natural resources, and the farming.

Climate

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Kalamazoo 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 27.0 degrees F, and the average daily minimum temperature is 19.6 degrees. The lowest temperature on record, which occurred at Kalamazoo on February 10, 1885, is -25 degrees. In summer the average temperature is 71.4 degrees, and the average daily maximum temperature is 83.3 degrees. The highest recorded temperature, which occurred on July 13, 1936, is 109 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, 20.04 inches, or 58 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 17.0 inches. The heaviest 24-hour rainfall during the period of record was 5.2 inches at Kalamazoo on May 11 and 12, 1914. Thunderstorms occur on about 37 days each year, and most occur in June and July.

Average seasonal snowfall is 71.4 inches. The greatest snow depth at any one time during the period of record was 42 inches. On the average, 70 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 80 percent. The percentage of possible sunshine is 64 in summer and 33 in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11.7 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, East Lansing, Michigan.

Physiography, relief, and drainage

The surface features of Kalamazoo County formed through the complex action of glaciers, resulting in the formation of four distinct features—moraines, till plains, outwash plains, and ponded areas (fig. 1).

There are two main belts of moraines in the county. They are distinguished by hilly, uneven, knoblike hills and pothole depressions. One belt extends from the north county line in Cooper Township to the west county line in Texas Township. The other belt forms a ridge that begins in Charlestown Township, continues southwestward and then becomes indistinct just north of the village of Scotts. The soils in these belts are underlain by sand and gravel.

Till plains (fig. 2) are important as a dominant landscape feature only in the southeastern part of the county. They are dominantly undulating. The soils are mostly medium textured. Some have restricted internal drainage.

The ponded areas are concentrated mainly along the Kalamazoo River. Ponded areas also occur in Pavillon Township and in Alamo Township.

The outwash plains are the dominant landscape feature of the entire county. They are more level than any other part of the county. A variety of soils are associated with the outwash plains, but almost all have a high percentage of sand and gravel in the underlying material.

The elevation ranges from about 740 feet above sea level, where the river flows out of the county on the north, to about 1,040 feet above sea level in Oshtemo Township.

The Kalamazoo River flows through the county. It enters from the east about 4 miles south of the northern boundary. It flows westerly to the city of Kalamazoo and then turns north leaving the county along the northern boundary just west of the center of the boundary. The northern part of the county is in the Kalamazoo River basin. Most of the southern one-third of the county is in the St. Joseph River basin.

There are many scattered lakes throughout the county. The largest, Gull Lake, is in the northern part. There are no lakes in the till plain area in the southeastern part.

Settlement

Recorded history of Kalamazoo County began with explorations by the early French missionaries. These explorers were searching for a land route from Fort St. Joseph to Detroit when they crossed the present area of Kalamazoo County in the late 1600's. Their diaries tell of traveling through dense hardwood forests broken only by a few scattered grass meadows. The mention of these forest openings lends emphasis to the significance of the prairies in the history of Kalamazoo County. The villages of the Pottowattomie and Ottawa Indians were located on these prairies. The remains of at least two other distinct civilizations, however, record the presence of people who made their homes on these meadows before the Indians.

The first settlers in the county arrived in Prairie Ronde Township in 1828. By 1830, the population was large enough for Kalamazoo County to be approved as a legal congressional county. The city of Kalamazoo was selected as the county seat. Immigrants moved in from Holland and Greece during the 1900's.

Kalamazoo County had a population of 201,550 in 1970. It is served by four cities. Kalamazoo is the largest in population. Portage is the largest in size. There are five incorporated villages in the county.

Natural resources

Soil and water are the most important resources in the county. In most of the county there is an abundance of water. The underground formations of sand and gravel are important water-bearing sources for wells.

North of the city of Kalamazoo in areas adjacent to the Kalamazoo River there is a large development for the removal of sand and gravel for building purposes. There has been some exploration for gas and oil, but no producing wells have yet been developed.

Farming

Originally the vegetation of Kalamazoo County, for the most part, was a heavy growth of hardwood forest. Maple, elm, beech, hickory, and sycamore and some walnut and cherry were the main species. The prairie cover was a thick sod of tall bluestem and a few scattered burr oak. The prairie was cultivated. As the need for lumber increased, the forest land was cleared and plowed. The small part of the original forest that remains is confined to farm woodlots.

Cash grain farming is now prevalent in the county. Hogs, beef, and dairy farming are also important. A limited acreage is in commercial orchards, vineyards, and truck crops.

The main crops are corn, soybeans, wheat, oats, and hay. Onions, tomatoes, potatoes, and celery are the main vegetable crops. Grapes is the principal fruit crop.

According to the 1974 U.S. Department of Commerce, Census of Agriculture, (*9*) the average size farm is about 158 acres. In 1920, the average size farm was 98.7 acres.

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 (*6*).

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, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

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 map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Map unit descriptions

1. Schoolcraft

Nearly level and undulating, well drained soils that have a loamy subsoil; formed in glacial outwash

This map unit is on plains that were formerly prairies. The soils, therefore, have a darker colored surface layer than the soils in the surrounding areas.

This unit makes up about 6 percent of the county. It is about 80 percent Schoolcraft and similar soils and about 20 percent soils of minor content.

Schoolcraft soils are nearly level and undulating. The surface layer typically is very dark gray loam about 12 inches thick. The subsoil is dark yellowish brown and dark brown and is about 26 inches thick. The upper part is clay loam, and the lower part is sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown sand.

Minor in this unit are the well drained Dowagiac soils, the somewhat poorly drained Sleeth soils, and the very poorly drained Sebewa soils. Dowagiac and Schoolcraft soils are in similar landscape positions. Sleeth soils occupy slightly lower landscape positions and depressional areas. Sebewa soils occupy lowland areas and depressions.

Most of the unit is cultivated because of the high value of the soils for farming. Droughtiness is the main limitation.

These soils are well suited to cultivated crops. They are suited to most building site development and are well suited to septic tank absorption fields. Shrink-swell potential and low strength are moderate limitations. Limitations are severe for shallow excavations. Banks cut in excavations tend to cave.

2. Kalamazoo-Schoolcraft

Nearly level to rolling, well drained soils that have a loamy or a loamy and sandy subsoil; formed in glacial outwash

This map unit is on upland plains. It makes up about 29 percent of the county. It is about 50 percent Kalamazoo and similar soils, 20 percent Schoolcraft and similar soils, and 30 percent soils of minor extent. Kalamazoo and Schoolcraft soils occupy similar landscape positions.

Kalamazoo soils are nearly level to rolling. The surface layer is dark grayish brown loam about 11 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam, the middle parts are clay loam and sandy loam, and the lower part is loamy coarse sand and gravelly loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown gravelly sand.

Schoolcraft soils are nearly level and undulating. The surface layer is very dark gray loam about 12 inches thick. The subsoil is dark yellowish brown and dark brown and is about 26 inches thick. The upper part is clay loam, and the lower part is sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown sand.

Minor in this unit are the well drained Dowagiac and Oshtemo soils, the somewhat poorly drained Sleeth soils, and the very poorly drained Sebewa, Adrian, and Houghton soils. Dowagiac, Kalamazoo, and Schoolcraft soils occupy similar landscape positions. Oshtemo soils occupy the more sandy ridges. Sleeth and Sebewa soils occupy wet depressions. Adrian and Houghton soils occupy depressions that are filled to varying depths with organic material.

Most of the unit is cultivated because of the high value of the soils for farming. Some small areas are woodland. Droughtiness, erosion, and slopes are the main limitations in farming.

These soils are well suited to cultivated crops. They are suited to most building site development and well suited to septic tank absorption fields. The shrink-swell potential and low strength are moderate limitations. Limitations are severe for shallow excavations. Banks cut in excavations tend to cave.

3. Kalamazoo-Oshtemo

Nearly level to rolling, well drained soils that have a loamy and sandy subsoil; formed in glacial outwash and morainic deposits

This map unit makes up about 15 percent of the county. It is about 30 percent Kalamazoo and similar soils, about 30 percent Oshtemo and similar soils, and 40 percent soils of minor extent.

Kalamazoo and Oshtemo soils are nearly level to rolling. They occupy the same landscape positions.

The surface layer of the Kalamazoo soils is dark grayish brown loam about 11 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam, the middle parts are clay loam and sandy loam, and the lower part is loamy coarse sand and gravelly loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown gravelly sand.

The surface layer of the Oshtemo soils is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown sandy loam, the middle part is dark yellowish brown loamy sand, and the lower part is yellowish brown sand with bands of dark brown loamy sand.

Minor in this unit are the somewhat excessively drained Coloma soils, the well drained Spinks soils, the moderately well drained Bronson soils, the somewhat poorly drained Brady soils, and the very poorly drained Adrian, Gilford, and Houghton soils. Coloma soils are more sandy than those soils. They occupy narrow ridges. Spinks, Kalamazoo, and Oshtemo soils are in similar landscape positions, but the Spinks soils are more sandy. Bronson soils occupy slightly lower elevations. Brady and Gilford soils occupy low areas. Adrian and Houghton soils occupy depressions that are filled to varying depths with organic material.

This map unit is used about equally for urban development and cultivated crops. Droughtiness, erosion, and moderate slopes are the main limitations in farming and most other uses.

These soils are suited to farming. In most areas they are well suited to building site development, sanitary facilities, recreation, and woodland. In part of the unit limitations are moderate for dwellings, small commercial buildings, and local roads and streets. Limitations are severe for shallow excavations. Banks cut in excavations tend to cave.

4. Oshtemo-Coloma-Kalamazoo

Undulating to steep, well drained, or somewhat excessively drained soils that have a sandy subsoil or a loamy and sandy subsoil; formed in glacial outwash and sandy morainic deposits

This unit occupies hilly areas, flat plains, and rolling uplands. It makes up about 18 percent of the county. It is about 30 percent Oshtemo and similar soils, about 20 percent Coloma and similar soils, about 20 percent Kalamazoo and similar soils, and about 30 percent soils of minor extent.

Oshtemo soils are generally in the more hilly areas. Coloma soils are usually on hillsides and narrow ridges. Kalamazoo soils are generally on hilltops in the more level areas. Oshtemo and Kalamazoo soils are well drained, and Coloma soils are somewhat excessively drained.

Oshtemo soils are undulating to steep. The surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown sandy loam, the middle part is dark brown loamy sand, and the lower part is yellowish brown sand with bands of dark brown loamy sand.

Coloma soils are undulating or rolling. The surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is light yellowish brown and yellowish brown sand about 32 inches thick. The next layer to a depth of about 66 inches is yellowish brown sand with bands of brown loamy sand.

Kalamazoo soils are undulating or rolling. The surface layer is dark grayish brown loam about 11 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam, the middle parts are clay loam, and sandy loam, and the lower part is loamy coarse sand and gravelly loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown gravelly sand.

Minor in this unit are the moderately well drained Bronson soils, the somewhat poorly drained Brady and Sleeth soils, and the very poorly drained Adrian, Gilford, Houghton, and Sebewa soils. The Bronson, Brady, Gilford, Sebewa, and Sleeth soils occupy depressions and low-lying areas around lakes and streams. Adrian and Houghton soils occupy depressions that are filled to varying depths with organic material.

This map unit is mainly idle grassland and brush. Steep slopes, erosion, and droughtiness are the main limitations in farming and most other uses.

Because of the steepness of the slopes, these soils range from suited to poorly suited to farming, recreation, and most building site development. They are well suited to woodland. Limitations are severe for shallow excavations. Banks cut in excavations tend to cave.

5. Riddles-Sleeth

Nearly level to rolling, well drained or somewhat poorly drained soils that have a loamy subsoil; formed in glacial till and outwash

This unit (fig. 3) is on rolling uplands and nearly level plains. It makes up about 11 percent of the county. It is about 50 percent Riddles and similar soils, 25 percent Sleeth and similar soils, and 25 percent soils of minor extent.

Sleeth soils are in lower landscape positions than the Riddles soils. They are in nearly level areas adjacent to drainageways. Riddles soils are on the higher, rolling uplands.

Riddles soils are undulating or rolling. The surface layer is dark grayish brown loam about 11 inches thick. The subsurface layer is dark brown sandy loam about 4 inches thick. The subsoil is dark yellowish brown and is about 35 inches thick. The upper part is clay loam, and the lower part is sandy clay loam. The substratum to a depth of about 80 inches is yellowish brown sandy loam.

Sleeth soils are nearly level. The surface layer is dark yellowish brown loam about 10 inches thick. The mottled subsoil is about 30 inches thick. The upper part is light brownish gray sandy clay loam and clay loam, and the lower part is grayish brown sandy loam. The substratum to a depth of about 60 inches is dark gray gravelly sand.

Minor in this map unit are the very poorly drained Glendora, Sebewa, and Houghton soils. Sebewa soils occupy shallow depressions and areas along intermittent drainageways. Glendora soils occupy the alluvial areas along the perennial streams. Houghton soils occupy depressional areas that are filled with organic material.

This map unit is used mainly for cultivated crops. Some small areas are woodland. Erosion in the rolling areas and wetness in the low areas are the main limitations in farming and most other uses.

These soils are well suited to farming. They are suited or well suited to all other uses of the Riddles soils and suited or poorly suited to other uses of the Sleeth soils.

6. Oshtemo-Kalamazoo-Glendora

Nearly level and undulating, well drained or very poorly drained soils that have a sandy subsoil or a loamy and sandy subsoil; formed in glacial outwash and sandy alluvium

This unit is on nearly level plains and river terraces. It makes up about 7 percent of the county. It is about 30 percent Oshtemo and similar soils, 20 percent Kalamazoo and similar soils, 20 percent Glendora and similar soils, and about 30 percent soils of minor extent. Oshtemo and Kalamazoo soils occupy the same landscape positions.

Oshtemo soils are nearly level or undulating. The surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown sandy loam, the middle part is dark yellowish brown loamy sand, and the lower part is yellowish brown sand with dark brown bands of loamy sand.

Kalamazoo soils are nearly level or undulating. The surface layer is dark grayish brown loam about 11 inches thick. The subsoil is dark yellowish brown and dark brown is about 44 inches thick. The upper part is loam, the middle parts are clay loam and sandy loam, and the lower part is loamy coarse sand and gravelly loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown gravelly sand.

Glendora soils are nearly level. They are on flood plains. Typically, the surface layer is black sandy loam about 10 inches thick. The underlying material to a depth of about 60 inches is alternate layers of multicolored sand with thin layers of black loamy sand and muck.

Minor in the unit are the moderately well drained Bronson soils, the somewhat poorly drained Brady soils, and the very poorly drained Adrian, Gilford, and Houghton soils. Brady, Bronson, and Gilford soils occupy lower lying areas in the uplands. Adrian and Houghton soils are on the flood plain along the Kalamazoo River.

This map unit is urbanized along the roads. Most interior areas are idle grassland and brush. A few are farmed. Droughtiness is the main limitation in farming the upland soils. Wetness and flooding are the main limitations in the low areas.

In upland areas these soils are suited to cultivated crops, recreation, woodland, septic tank absorption fields, and most building site development. In the low areas they are well suited to wetland wildlife but are poorly suited to most other uses because of wetness and flooding. Limitations are severe for shallow excavations in the upland areas. Banks cut in excavations tend to cave.

7. Coloma-Spinks-Oshtemo

Nearly level to rolling, somewhat excessively drained or well drained soils that have a sandy subsoil or a loamy and sandy subsoil; formed in glacial outwash and sandy morainic deposits

These areas are nearly level plains and rolling uplands. This map unit occupies about 10 percent of the county. About 40 percent of the map unit is Coloma and similar soils, about 15 percent is Spinks and similar soils, about 15 percent is Oshtemo and similar soils, and 30 percent is soils of minor extent. Coloma, Spinks, and Oshtemo soils are in similar landscape positions.

The Coloma soils are dominantly nearly level or undulating. The surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is light yellowish brown and yellowish brown sand about 32 inches thick. The next layer to a depth of about 66 inches is yellowish brown sand with bands of brown loamy sand.

Spinks soils are dominantly in the more level areas. The surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is dark yellowish brown and yellowish brown loamy sand about 18 inches thick. The next layer to a depth of about 86 inches is yellowish brown sand with bands of dark yellowish brown loamy sand.

Oshtemo soils are undulating or rolling. The surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown sandy loam, the middle part is dark yellowish brown loamy sand, and the lower part is yellowish brown sand with bands of dark brown loamy sand.

Minor in this unit are the excessively drained Plainfield soils and the very poorly drained Adrian and Glendora soils. Plainfield, Coloma, Spinks, and Oshtemo soils occupy similar landscape positions. Glendora soils occupy flood plains along perennial streams. Adrian soils occupy depressions containing shallow deposits of organic material.

This map unit is dominantly cropland. Some is idle grassland and brush. Droughtiness and low fertility are the major limitations in farming.

These soils are suited or poorly suited to farming and recreation. They are suited to wildlife and woodland. They are well suited to septic tank absorption fields and to building site development in the more level areas and are suited in the rolling areas. Limitations are severe for shallow excavations. Banks cut in excavations tend to cave.

8. Thetford-Gilford-Granby

Nearly level, somewhat poorly drained to very poorly drained soils that have a sandy subsoil or a loamy and sandy subsoil; formed in glacial outwash

This unit occupies nearly level plains and old glacial stream valleys. It occupies about 4 percent of the county. It is about 30 percent Thetford and similar soils, about 30 percent Gilford and similar soils, about 20 percent Granby and similar soils, and 20 percent soils of minor extent.

Gilford and Granby soils occupy similar landscape positions. Thetford soils occupy slightly higher landscape positions. Gilford soils are very poorly drained, Granby soils are poorly drained, and Thetford soils are somewhat poorly drained soils.

Thetford soils are nearly level. The surface layer is dark brown loamy sand about 9 inches thick. The subsurface layer is yellowish brown loamy sand and very pale brown sand about 12 inches thick. The next layer, about 34 inches thick, is pale brown sand with bands of strong brown loamy sand. The subsoil, to a depth of about 66 inches, is yellowish brown loamy sand.

Gilford soils are nearly level. The surface layer is black sandy loam about 12 inches thick. The subsurface layer is dark gray sandy loam about 5 inches thick. The subsoil is 25 inches thick. The upper part is multicolored sandy loam, the middle part is gray mottled sandy loam, and the lower part is yellowish brown mottled loamy sand. The substratum to a depth of about 60 inches is grayish brown mottled sand.

Granby soils are nearly level. The surface layer is black loamy sand about 13 inches thick. The subsoil and underlying material, to a depth of about 60 inches, is multicolored sand.

Minor in this unit are the well drained Oshtemo and Kalamazoo soils, the somewhat poorly drained Brady soils, and the very poorly drained Adrian and Houghton soils. Oshtemo and Kalamazoo soils occupy the highest landscape positions. Brady and Thetford soils occupy similar landscape positions. Adrian and Houghton soils occupy depressions that are filled to varying depths with organic material.

Most of this map unit is idle grassland or brush. Wetness is the main limitation in farming and most other uses. Ponding is common in the lower areas.

These soils are suited to farming if drainage is feasible. They are poorly suited to woodland, recreation, septic tank absorption fields, and building site development.

Broad land use considerations

Deciding what land should be used for urban development is an important issue in Kalamazoo County. A considerable acreage is developed for urban uses in Comstock, Galesburg, Kalamazoo, Portage, Richland, and Vicksburg and around all of the lakes. About 70,000 acres of the county is urban or built-up land. The general soil map can help in planning the general outline for potential urban areas, but it cannot be used in selecting sites for specific urban structures. In general, the soils in the survey area have good potential for cultivated crops and also have good potential for urban development. Data on specific soils in this survey also can help in planning future land use patterns.

Areas where the soils are severely limited for urban development are moderately extensive (fig. 4). Large parts of map unit 8 and the Sleeth and Glendora soils of map units 5 and 6 have a high water table, which severely limits urban development. The steeper parts of map unit 4 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 use at lower cost. These areas include map units 1, 2, 3, and 7 and the well drained, nearly level to rolling parts of map units 4, 5, and 6.

Map units 1, 2, 3, and 5 have the best potential as farmland and should not be overlooked when broad land uses are considered.

Map units 1, 2, 3, and 5, which make up about 61 percent of the county, are well suited to farming. Dominant in these map units are the Kalamazoo, Oshtemo, Riddles, and Schoolcraft soils. Droughtiness and erosion are the major problems.

Map unit 8 has good potential for wetland wildlife. It is also suitable for nature study areas. The hilly or steep parts of map unit 4 have potential as sites for parks and recreation areas.

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 similar profiles 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 Schoolcraft series, for example, was named for the town of Schoolcraft in Kalamazoo 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, Oshtemo sandy loam, 6 to 12 percent slopes, is one of several phases within the Oshtemo 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. Spinks-Coloma loamy sands, 18 to 35 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. Houghton and Sebewa soils, ponded, 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, gravel, 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 nearly level, very poorly drained soil is in depressions and on lake plains. It is subject to frequent flooding. Areas are commonly irregular in shape and range from 5 to 100 acres.

Typically the upper 31 inches is black muck. The underlying material to a depth of about 60 inches is dark gray sand.

Included with this soil in mapping are small areas of very poorly drained Edwards, Gilford, and Houghton soils and poorly drained Granby soils. These included soils make up 10 to 15 percent of the map unit. Edwards and Houghton soils are organic. They are in landscape positions similar to those of the Adrian soil. Edwards soils are 16 to 50 inches of organic material over marl, and Houghton soils are more than 51 inches of organic material. Gilford and Granby are mineral soils in slightly higher areas.

Permeability is moderately slow to moderately rapid. Surface runoff is very slow or ponded. The available water capacity is high. The seasonal high water table is within a depth of 1 foot from November to May.

Many areas are cultivated. Some are idle. The potential is fair for cultivated crops, hay, and pasture. It is poor for woodland, recreational uses, and building site development.

This soil is suited to corn, soybeans, and some special crops. Wetness and soil blowing are the major problems. Ditch and tile drainage is needed. Windbreaks, cover crops, and controlled drainage help to control excessive soil blowing.

The use of this soil for pasture or hay is also effective in controlling erosion. Wetness is the major limitation. Ditch drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, and deferred grazing help to keep the pasture and soil in good condition.

This soil is poorly suited to trees. In a few areas it supports poor stands of native trees. Wetness and low strength are the major limitations. The equipment limitation, windthrow, and seedling mortality are severe. Removing obstructions from natural drainageways improves drainage.

This soil has severe problems for recreation because of the flooding. If drained, it is soft and dusty. It is well suited to development of wetland wildlife habitat.

Building site development is not practical on this soil. The high water table, the flooding, and the instability of the soil are the most serious problems.

The capability subclass is 4w. The Michigan soil management group is M/4c.

BdA—Brady sandy loam, 0 to 3 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on lowlands and in depressions. Areas are commonly irregular in shape and range from 10 to 50 acres.

Typically the surface layer is very dark grayish brown sandy loam about 12 inches thick. The subsoil is about 44 inches thick. The upper part is multicolored sandy loam, and the lower part is multicolored loamy sand. The substratum to a depth of about 60 inches is grayish brown sand.

Included with this soil in mapping are small areas of moderately well drained Bronson soils. These included soils make up about 10 percent of the map unit. They are in slightly higher landscape positions than the Brady soil.

Permeability is moderately rapid. Surface runoff is slow. The available water capacity is moderate. The seasonal high water table is 1 foot to 3 feet below the surface from November to May.

Most areas are in pasture or are idle. The potential is fair for crops, hay, and pasture. It is good to fair for woodland, fair to poor for recreation, and poor for building site development.

This soil is suited to corn, soybeans, and small grain. Wetness and droughtiness are the main limitations. Ditches and tile drainage are needed. Returning crop residues to the soil or regularly adding other organic material improves fertility and maintains soil structure.

This soil is well suited to pasture or hay. Ditch drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is poorly suited to building site development and sanitary facilities. The major problems are wetness, seepage, and frost action. Sanitary facilities should be connected to commercial sewers if available. Because the seasonal water table is high, buildings should be constructed without basements. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 3w. The Michigan soil management group is 4b.

BrA—Bronson sandy loam, 0 to 3 percent slopes. This nearly level and undulating, moderately well drained soil is in flat areas and slight depressions. Areas are commonly irregular in shape and range from 10 to 80 acres.

Typically the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown loamy sand about 8 inches thick. The mottled subsoil is about 31 inches thick. The upper part is dark yellowish brown sandy loam, the next part is strong brown sandy loam, and the lower part is yellowish brown loamy sand. The substratum to a depth of about 66 inches is yellowish brown and pale brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Brady soils and small areas of the well drained Oshtemo soils. These included soils make up about 10 to 15 percent of the map unit. Oshtemo soils are in slightly higher landscape positions than this Bronson soil. Brady soils are in slightly lower positions.

Permeability is moderately rapid. Surface runoff is slow. The available water capacity is moderate. The seasonal high water table is 2 to 3 1/2 feet below the surface from November to May.

Most of the acreage is cropland. The potential is fair for cropland, woodland, and recreation. It is fair or poor for building site development.

This soil is suited to corn, soybeans, and small grain. Soil blowing and droughtiness are the major problems. Minimum tillage and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for pasture or hay is effective in controlling erosion. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to some building site development but is poorly suited to sanitary facilities. The major problems are wetness, frost action, and the instability of the soil when excavated. Sanitary facilities should be connected to commercial sewers and treatment facilities if available. Because the seasonal water table is high, foot drains are needed around foundations. Frost action is the major problem for roads and streets. Artificial drainage is needed. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 3w. The Michigan soil management group is 4a.

CoB—Coloma loamy sand, 0 to 6 percent slopes. This nearly level and undulating, somewhat excessively drained soil is on uplands and small ridges. Areas are commonly irregular in shape and range from 10 to 120 acres.

Typically the surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is light yellowish brown and yellowish brown sand about 32 inches thick. The next layer to a depth of about 66 inches is yellowish brown sand with bands of brown loamy sand.

Included with this soil in mapping are small areas of the well drained Oshtemo soils and the somewhat poorly drained Thetford soils. The Oshtemo soils make up about 5 to 10 percent of the map unit. They are in landscape positions similar to those of the Coloma soil, but they are less droughty. Thetford soils make up 2 to 5 percent of the unit. They are in depressions.

Permeability is rapid. Surface runoff is slow or medium. The available water capacity is low.

Most of the acreage is cultivated. The potential is poor for crops, hay, and pasture. It is poor or fair for woodland. The potential is fair for recreation and good for building site development.

This soil is poorly suited to corn, soybeans, and small grain. Droughtiness and soil blowing are the major problems. Minimum tillage and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is poorly suited to hay and pasture. Droughtiness is the major limitation. The use of this soil for hay or pasture is effective in controlling erosion. Proper stocking, pasture rotation, and timely deferment of grazing are essential to keep the pasture in good condition.

This soil is suited to recreational uses. The major limitations are droughtiness and the sandy texture. Maintaining a plant cover is difficult in camp areas and picnic areas and on playgrounds and paths and trails.

This soil is well suited to most building site development and to sanitary facilities. The major limitations are the rapid permeability and the instability of the the soil when excavated. Banks cut in excavations tend to cave. Shoring the banks reduces this problem. Contamination of ground water from septic tank absorption fields is a concern.

The capability subclass is 4s. The Michigan soil management group is 5a.

CoC—Coloma loamy sand, 6 to 12 percent slopes. This rolling, somewhat excessively drained soil is on upland ridges and sides of knolls. Areas are commonly irregular in shape or long and narrow. They range from 10 to 200 acres.

Typically the surface layer is dark brown loamy sand about 7 inches thick. The subsurface layer is light yellowish brown and yellowish brown sand about 44 inches thick. The next layer to a depth of about 66 inches is yellowish brown sand with bands of dark yellowish brown loamy sand.

Included with this soil in mapping are small areas of well drained Oshtemo and Spinks soils. These included soils make up l0 to l5 percent of the map unit. They are in landscape positions similar to those of the Coloma soil.

Permeability is rapid. Surface runoff is medium. The available water capacity is low.

Most areas are either idle or wooded. The potential is poor for crops, hay, pasture, and recreation. It is poor to fair for woodland and fair for building site development.

This soil has severe problems for crops because of the slope, the erosion, and the droughtiness.

This soil is poorly suited to hay and pasture. Droughtiness is the major limitation. The use of this soil for hay or pasture is effective in controlling erosion. Proper stocking, pasture rotation, and timely deferment of grazing are essential to keep the pasture in good condition.

This soil is suited to most recreation. The slope, the droughtiness, and the sandy texture are limitations for camp areas, picnic areas, and playgrounds. Maintaining a plant cover is difficult. Sand is exposed if the soil is leveled. Because of the sand, paths and trails are difficult to maintain.

This soil is fairly well suited to most building site development and to sanitary facilities. The major limitations are the slope, the rapid permeability, and the instability of the soil when excavated. Contamination of ground water from septic tank absorption fields is a concern. The included level areas should be used when available to minimize the hazard of hillside seepage from the drain field. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 6s. The Michigan soil management group is 5a.

CoD—Coloma loamy sand, 12 to 18 percent slopes. This hilly, somewhat excessively drained soil is on upland ridges and slopes. Areas are commonly irregular in shape or long and narrow. They range from 10 to 100 acres.

Typically the surface layer is dark brown loamy sand about 6 inches thick. The subsurface layer is light yellowish brown and yellowish brown sand about 35 inches thick. The next layer to a depth of about 66 inches is yellowish brown sand with bands of dark yellowish brown loamy sand.

Included with this soil in mapping are small areas of the well drained Oshtemo and Spinks soils. These included soils make up about 10 to 15 percent of the map unit. The Oshtemo soils are in less sloping areas than the Coloma soil. The Spinks soils are in landscape positions similar to those of the Coloma soil. Oshtemo and Spinks soils are less droughty.

Permeability is rapid. Surface runoff is medium. The available water capacity is low.

Most areas are wooded or idle. The potential is poor for crops, hay, pasture, and recreation. It is fair or poor for woodland. It is poor for building site development.

The soil has severe problems for crops, pasture, and hay because of the steep slope, the erosion, and the droughtiness.

This soil is poorly suited to building site development and sanitary facilities. The major limitation is the steep slope. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 7s. The Michigan soil management group is 5a.

DoA—Dowagiac loam, 0 to 3 percent slopes. This nearly level and undulating, well drained soil is in level areas and on low knolls. Areas are commonly irregular in shape and range from 10 to 200 acres.

Typically the surface layer is very dark brown loam about 9 inches thick. The subsurface layer is dark grayish brown loam about 2 inches thick. The subsoil is about 39 inches thick. In sequence downward is 5 inches of dark brown loam, 13 inches of dark yellowish brown clay loam, 9 inches of dark yellowish brown sandy loam, and 12 inches of yellowish brown sand. The substratum to a depth of about 60 inches is brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils. These included soils make up 3 to 5 percent of the map unit. They are in depressions and along intermittent drains.

Permeability is moderate. Surface runoff is slow. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is good for crops, hay, pasture, recreation, and building site development.

This soil is well suited to corn, soybeans, and small grain. Midsummer droughtiness is the major limitation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is well suited to pasture or hay. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to most building site development and to sanitary facilities. The major problems are the seepage and the instability of the soil when excavated. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem. Frost action and low strength are moderate problems for local roads and streets. The use of suitable base material in the construction of local roads and streets can help to overcome the low strength.

The capability subclass is 2s. The Michigan soil management group is 3/5a.

Ed—Edwards muck. This nearly level, very poorly drained soil is in depressions and old lakebeds. It is subject to frequent flooding. Areas commonly are irregular in shape and range from 5 to 200 acres.

Typically the upper 25 inches is black and very dark brown muck. The underlying material to a depth of about 60 inches is light gray marl.

Included with this soil in mapping are small areas of very poorly drained Houghton soils. These included soils make up about 10 to 15 percent of the map unit. Houghton soils are 51 inches or more of organic material. They are in landscape positions similar to those of the Edwards soil.

Permeability is moderately slow to moderately rapid in the organic material. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is within a depth of 1/2 foot from September to June.

Most of the acreage is cultivated. The potential is good for crops. It is fair for hay and pasture. It is poor for woodland, recreation, and building site development.

This soil is suited to corn and soybeans. Wetness and soil blowing are the major problems. Ditch and tile drainage is needed. Winter cover crops and controlled drainage help to reduce soil loss.

The use of this soil for pasture and hay is effective in controlling erosion. Wetness is the major limitation. Ditch and tile drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods will help to keep the pasture and soil in good condition.

Building site development and sanitary facilities are not practical on this soil. The major problems are flooding, wetness, low strength, and high frost action. In most places the unstable material is so thick that removing it and replacing it with fill material is not economical.

The capability subclass is 4w. The Michigan soil management group is M/mc.

Gd—Gilford sandy loam. This nearly level, very poorly drained soil is in low flat areas. It is subject to frequent flooding. Areas are commonly irregular in shape and range from 10 to 100 acres.

Typically the surface layer is black sandy loam about 12 inches thick. The subsurface layer is dark gray sandy loam about 5 inches thick. The subsoil is about 25 inches thick. The upper part is multicolored sandy loam, the next part is gray mottled sandy loam, and the lower part is yellowish brown mottled loamy sand. The substratum to a depth of about 60 inches is grayish brown mottled sand. In places the surface layer is organic material 1 to 4 inches thick.

Included with this soil in mapping are small areas of the very poorly drained Adrian soils and the somewhat poorly drained Brady soils. These included soils make up 5 to 10 percent of the map unit. Adrian soils are in depressions filled with organic material that is 16 to 50 inches thick over sand. Brady soils are at slightly higher elevations.

Permeability is moderately rapid. Surface runoff is very slow. The available water capacity is moderate. The seasonal high water table is within a depth of 1 foot from December to May.

Most areas are idle. The potential is fair for cultivated crops. It is good for hay and pasture. It is poor for woodland, recreation, and building site development.

This soil is suited to corn, soybeans, and small grain. Wetness is the major limitation. Ditch and tile drainage is needed. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is well suited to hay and pasture. Wetness is the major limitation. Ditch and tile drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, deferred grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is poorly suited to building site development and sanitary facilities. The major problems are wetness, seepage, frost action, and frequent flooding in winter. Building sites should be located on some of the better drained included soils if possible.

The capability subclass is 2w. The Michigan soil management group is 4c.

Gn—Glendora sandy loam. This nearly level, very poorly drained soil is on sandy lowlands along rivers and streams. It is subject to frequent flooding. Areas are commonly long and narrow and range from 10 to more than 100 acres.

Typically the surface layer is black sandy loam about 10 inches thick. The underlying material to a depth of 60 inches is alternate layers of multicolored sand with thin layers of black loamy sand and muck.

Included with this soil in mapping are areas of Adrian, Houghton, and Sebewa soils. These included soils make up 10 to 15 percent of this map unit. The very poorly drained Adrian and Houghton soils are organic. They are in landscape positions similar to those of the Glendora soil. Adrian soils are 16 to 50 inches of muck over sand. Houghton soils are more than 51 inches of organic material. The poorly drained and very poorly drained Sebewa soils have more clay in the profile than the Glendora soil.

Permeability is rapid. Surface runoff is very slow or ponded. The available water capacity is low. The seasonal high water table is within a depth of 1 foot for most of the year.

Most areas are idle. The potential is poor for cropland, hayland, woodland, recreation, and building site development. It is fair for pasture.

This soil is poorly suited to cultivated crops. Wetness and flooding are the major limitations. In most areas there is not sufficient fall in the land to make either ditch or tile drainage effective.

This soil is suited to grassland pasture. Wetness and flooding are the major problems. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is poorly suited to recreation because of the wetness and the flooding. It is well suited to development of wetland wildlife habitat.

This soil is poorly suited to building site development and sanitary facilities. Because of the wetness, the flooding, and the inadequate drainage outlets, this soil should not be considered in building site development.

The capability subclass is 7w. The Michigan soil management group is L-4c.

Gy—Granby loamy sand. This nearly level, poorly drained soil is in depressional areas. It is subject to frequent flooding. Areas are commonly irregular in shape and range from 20 to 200 acres.

Typically the surface layer is black loamy sand about 13 inches thick. The subsoil and the underlying material to a depth of about 60 inches is multicolored sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Thetford soils. These included soils make up about 5 to 15 percent of the unit. Thetford soils are at slightly higher elevations than this Granby soil.

Permeability is rapid. Surface runoff is very slow. The available water capacity is low. The seasonal high water table is within a depth of 1 foot from November to June.

Most areas are idle. The potential is fair for crops, hay, and pasture. It is poor for recreation, woodland, and building site development.

The soil is suited to corn, soybeans, and small grain. Wetness and soil blowing are the major problems. Ditch and tile drainage is needed. If the soil is drained, droughtiness is an additional limitation. Stripcropping, minimum tillage, and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for pasture or hay is effective in controlling erosion. Wetness is the major limitation. Ditch and tile drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is poorly suited to trees. Wetness is a severe limitation. Removing obstructions from natural waterways improves drainage.

This soil is generally not suited to building site development and sanitary facilities. The major problems are wetness, seepage, and short periods of flooding in spring.

The capability subclass is 3w. The Michigan soil management group is 5c.

Hn—Houghton muck. This nearly level, very poorly drained soil is in depressions. It is subject to frequent flooding. Areas are commonly irregular in shape and range from 5 to 200 acres.

Typically the upper 10 inches is black muck. The underlying layers to a depth of about 60 inches are black and very dark brown muck.

Included with this soil in mapping are small areas of the very poorly drained Adrian, Edwards, Sebewa, and Gilford soils. These included soils make up 12 to 20 percent of the map unit. Adrian and Edwards soils are organic. They are in landscape positions similar to those of the Houghton soil. Adrian soils are 16 to 50 inches of muck over sand. Edwards soils are 16 to 50 inches of muck over marl. Gilford and Sebewa are mineral soils. Gilford soils are sandy. Sebewa soils have more clay in the subsoil than Gilford soils. All are at slightly higher elevations than the Houghton soil.

Permeability is moderately slow to moderately rapid. Surface runoff is very slow or ponded. The available water capacity is high. The seasonal high water table is within a depth of 1 foot from September to June.

Most areas are either cultivated or wooded. The potential is good for cultivated crops. It is fair for hay and pasture and poor for recreation, woodland, and building site development.

This soil is suited to corn, soybeans, and small grain. Wetness and soil blowing are the major problems. Ditch and tile drainage is needed. Windbreaks, cover crops, and controlled drainage help to prevent excessive soil loss.

The use of this land for hay or pasture is effective in controlling erosion. Wetness is the major limitation. Ditch and tile drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is poorly suited to recreational facilities. It is wet, it frequently is flooded, and it contains an excessive amount of humus, which make development of recreational facilities impractical. It is well suited to development of wetland wildlife habitat.

This soil is poorly suited to building site development and sanitary facilities because of wetness, flooding, high frost action, and low strength.

The capability subclass is 3w. The Michigan soil management group is Mc.

Hs—Houghton and Sebewa soils, ponded. These nearly level, very poorly drained soils are in flat depressed areas. They are subject to frequent flooding. Areas are commonly irregular in shape and range from 5 to 150 acres. Some are entirely Houghton soils. Some are entirely Sebewa soils. Others consist of both soils.

Typically the surface layer of the Houghton soil is black muck about 10 inches thick. The underlying layers to a depth of about 60 inches are black and very dark brown muck.

Typically the surface layer of the Sebewa soil is black loam about 11 inches thick. The mottled subsoil is very dark gray and gray clay loam about 12 inches thick. The substratum to a depth of about 60 inches is gray and grayish brown loamy sand.

Included with these soils in mapping are areas of the very poorly drained Adrian, Edwards, Glendora, and Gilford soils and the poorly drained Granby soils. All of these included soils are in landscape positions similar to those of the Houghton and Sebewa soils. Adrian soils are 16 to 50 inches of muck over sand. Edwards soils are 16 to 50 inches of muck over marl. Gilford, Glendora, and Granby soils are more sandy than Sebewa soils. Glendora soils are on flood plains along perennial streams.

Most areas support water tolerant plants and trees. The major problems are the water table at or near the surface and the long periods of flooding. Most areas are used as wetland wildlife habitat.

The capability subclass is 8w. The Michigan soil management group is Mc-3/5c.

KaA—Kalamazoo loam, 0 to 2 percent slopes. This nearly level, well drained soil occurs as flat areas that are commonly irregular in shape and range from 20 to 300 acres.

Typically the surface layer is dark grayish brown loam about 11 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam and clay loam, the next part is sandy loam, and the lower part is loamy coarse sand and gravelly loamy sand. The substratum to a depth of about 60 inches is dark yellowish brown gravelly sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils. Sleeth soils make up 3 to 5 percent of the map unit. They are in depressions and along intermittent drainageways.

Permeability is moderate. Surface runoff is slow. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is good for cropland, hayland, pastureland, woodland, recreation, and building site development.

This soil is well suited to corn, soybeans, and small grain. Midsummer droughtiness is the major limitation. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is well suited to hay and pasture. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to most building site development and to sanitary facilities (fig. 4). Banks cut in shallow excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 2s. The Michigan soil management group is 3/5a.

KaB—Kalamazoo loam, 2 to 6 percent slopes. This undulating, well drained soil is on uplands. Areas are commonly irregular in shape and range from 10 to 300 acres.

Typically the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam and clay loam, the next part is sandy loam, and the lower part is loamy coarse sand. The substratum to a depth of about 64 inches is dark yellowish brown gravelly sand.

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

Permeability is moderate. Surface runoff is medium. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is good for cropland, hayland, pastureland, woodland, recreation, and building site development.

This soil is well suited to corn, soybeans, and small grain. Midsummer droughtiness and erosion are the major problems. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is well suited to hay and pasture. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to most building site development and to sanitary facilities. The major problem is the caving in of banks cut in excavations. Shoring the walls partly overcomes this problem.

The capability subclass is 2e. The Michigan soil management group is 3/5a.

KaC—Kalamazoo loam, 6 to 12 percent slopes. This rolling, well drained soil is on uplands. Areas are commonly irregular in shape and range from 10 to 180 acres.

Typically the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam, the next part is clay loam, and the lower part is loamy coarse sand. The substratum to a depth of 60 inches is yellowish brown gravelly sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils. These included soils make up less than 5 percent of the map unit. They are in depressions and along intermittent drainageways.

Permeability is moderate. Surface runoff is medium or rapid. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is fair for crops, recreation, and building site development. It is good for hayland, pastureland, and woodland.

This soil is suited to corn, soybeans, and small grain. Erosion and midsummer droughtiness are the major problems. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure and control erosion.

This soil is well suited to hay and pasture. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to most building site development and to sanitary facilities. The major problems are the slope and the caving in of cutbanks. Care must be taken in installing septic tank drain fields to prevent hillside seeps. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 3e. The Michigan soil management group is 3/5a.

OsB—Oshtemo sandy loam, 1 to 6 percent slopes. This nearly level and undulating, well drained soil is on sandy upland plains. Areas are commonly irregular in shape and range from 10 to 180 acres.

Typically the surface layer is dark brown sandy loam about 9 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown sandy loam, the next part is dark yellowish brown loamy sand, and the lower part is yellowish brown sand with bands of dark brown loamy sand.

Included with this soil in mapping are small areas of the moderately well drained Bronson soils and the somewhat excessively drained Coloma soils. These included soils make up about 10 to 15 percent of the map unit. Bronson soils are in slight depressions and along intermittent drains. Coloma soils are in landscape positions similar to those of the Oshtemo soil, but they are more sandy and more droughty.

Permeability is moderately rapid. Surface runoff is slow or medium. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is fair for crops, hay, and pasture. It is good for woodland, recreation, and building site development.

This soil is suited to corn, soybeans, and small grain. Erosion and midsummer droughtiness are the major problems. Minimum tillage and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility.

The use of this soil for pasture or hay is effective in controlling erosion. Droughtiness is the major limitation. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is well suited to most building site development and to sanitary facilities. There is a severe problem for shallow excavations. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 3s. The Michigan soil management group is 3a.

OsC—Oshtemo sandy loam, 6 to 12 percent slopes. This rolling, well drained soil is on uplands. Areas are commonly irregular in shape and range from 10 to 110 acres.

Typically the surface layer is dark brown sandy loam about 7 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is dark brown and is about 29 inches thick. The upper part is loamy sand, and the lower part is sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown sand. In some areas the subsoil is slightly heavier than is typical.

Included with this soil in mapping are small areas of the somewhat excessively drained Coloma soils. These included soils make up about 10 percent of the map unit. They occupy landscape positions similar to those of the Oshtemo soil.

Permeability is moderately rapid. Surface runoff is medium. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is fair for crops, hay, pasture, recreation, and building site development. It is good for woodland.

This soil is suited to corn, soybeans, and small grain. Erosion and midsummer droughtiness are the major problems. Minimum tillage and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility.

The use of this soil for pasture or hay is effective in controlling erosion. Droughtiness is the major limitation. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to building site development and sanitary facilities. The major limitation is the slope. Limitations are severe for small commercial buildings. They are severe for shallow excavations. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem. Limitations are moderate for dwellings with basements.

The capability subclass is 3e. The Michigan soil management group is 3a.

OsD—Oshtemo sandy loam, 12 to 18 percent slopes. This hilly, well drained soil is on sandy uplands and ridges. Areas are commonly irregular in shape and range from 10 to 70 acres.

Typically the surface layer is dark brown sandy loam about 7 inches thick. The subsurface layer is dark yellowish brown sandy loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part is dark brown loamy sand, and the lower part is dark yellowish brown sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown sand.

Included with this soil in mapping are small areas of the somewhat excessively drained Coloma soils and the excessively drained Plainfield soils. These included soils make up about 15 percent of the map unit. They are in landscape positions similar to those of the Oshtemo soil. Coloma and Plainfield soils are more sandy and more droughty than the Oshtemo soil.

Permeability is moderately rapid. Surface runoff is rapid. The available water capacity is moderate.

Most areas are idle and are in weeds and brush. The potential is fair for hay and pasture. It is good for woodland, fair to poor for crops and building site development, and fair for recreation.

This soil has severe problems for corn, soybeans, and small grain. Steep slopes and erosion are the major problems. The use of no till or minimum tillage helps to prevent excessive soil loss.

The use of this soil for hay and pasture is effective in controlling erosion. Slope and erosion are the major problems. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is poorly suited to building site development. The steep slopes are the major limitation. Care must be taken in establishing septic tank filter fields to prevent hillside seepage. Banks cut in excavations tend to cave. Shoring the banks helps to control this problem.

The capability subclass is 4e. The Michigan soil management group is 3a.

OsE—Oshtemo sandy loam, 18 to 35 percent slopes. This steep, well drained soil is on sandy uplands and ridges. Areas are commonly irregular in shape and range from 5 to 40 acres.

Typically the surface layer is dark brown sandy loam about 7 inches thick. The subsoil is about 29 inches thick. The upper part is dark yellowish brown loamy sand, and the lower part is dark brown sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown sand.

Included with this soil in mapping are areas of the somewhat excessively drained Coloma soils and the excessively drained Plainfield soils. These included soils make up about 10 to 15 percent of the map unit. Coloma and Plainfield soils are more sandy and more droughty than the Oshtemo soil.

Permeability is moderately rapid. Surface runoff is rapid. The available water capacity is moderate.

Most areas are idle and are in weeds and brush. The potential is poor for crops and hay. It is fair for pasture and good for woodland. It is poor for recreation and building site development.

This soil has severe problems for corn, soybeans, and small grain. The steep slopes and erosion are the major problems.

The use of this soil for hay and pasture is effective in controlling erosion. The steep slopes and erosion are the major problems. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is generally not suitable for building site development and sanitary facilities.

The capability subclass is 6e. The Michigan soil management group is 3a.

Pb—Pits, gravel. Pits are open excavations from which the soil and the underlying material have been removed, exposing material that supports little or no plant cover. Pits vary considerably in size and shape. They range from 5 to 300 acres and are 5 feet or more deep.

Some pits have standing water at varying depths.

Soil properties, such as the permeability, the available water capacity, and the reaction, are too variable to be rated.

Onsite investigation is needed to determine the potential of these areas for wildlife habitat development and recreational use.

No interpretative groups.

PfB—Plainfield loamy sand, 0 to 6 percent slopes. This nearly level and undulating, excessively drained soil is on uplands and small ridges. Areas are commonly irregular in shape and range from 10 to 50 acres.

Typically the surface layer is dark grayish brown loamy sand about 10 inches thick. The subsoil is dark yellowish brown sand about 28 inches thick. The substratum to a depth of 60 inches is yellowish brown sand.

Included in this soil in mapping are small areas of the well drained Spinks soils and the somewhat poorly drained Thetford soils. These included soils make up about 10 to 15 percent of the map unit. Spinks soils are in landscape positions similar to those of the Plainfield soil but are less droughty. Thetford soils are in depressions and along intermittent drainageways.

Permeability is rapid. Surface runoff is slow. The available water capacity is low.

Most areas are idle and are brushy or wooded. The potential is poor for crops, hay, and pasture. It is fair for woodland and fair or poor for recreation. It is good for building site development.

This soil is poorly suited to corn, soybeans, and small grain. Droughtiness and low fertility are the major limitations. If adequate water is available, these limitations can be partly overcome by irrigation.

This soil is poorly suited to hay and pastureland. Droughtiness and low fertility are the major limitations. Proper stocking, timely deferment of grazing, and pasture rotation help to keep the pasture and soil in good condition.

This soil is suited to most building site development and sanitary facilities. The major problems are the seepage, the instability of the soil when excavated, and the droughtiness. Suitable fill and topsoil are needed for lawn development. Banks cut in excavations tend to cave. Shoring the banks partly reduces this problem.

Effluent from septic tank filter fields may pollute ground water because of the rapid permeability of the soil.

The capability subclass is 4s. The Michigan soil management group is 5a.

RdB—Riddles loam, 2 to 6 percent slopes. This undulating, well drained soil is on loamy uplands. Areas are commonly irregular in shape and range from 10 to 300 acres.

Typically the surface layer is dark grayish brown loam about 11 inches thick. The subsurface layer is dark brown sandy loam about 4 inches thick. The dark yellowish brown subsoil is about 35 inches thick. The upper part is clay loam, and the lower part is sandy clay loam. The substratum to a depth of about 80 inches is yellowish brown sandy loam.

Included with this soil in mapping are small areas of the well drained Kalamazoo and Oshtemo soils and the somewhat poorly drained Sleeth soils. These included soils make up about 5 to 10 percent of the map unit. The Sleeth soils are in lower landscape positions than the Riddles soil and in depressions. The Kalamazoo and Oshtemo soils are in landscape positions similar to those of the Riddles soil. They are underlain by sand.

Permeability is moderate. Surface runoff is slow. The available water capacity is high.

Most of the acreage is cultivated. The potential is good for cropland, hayland, pastureland, woodland, recreation, and building site development.

This soil is well suited to corn, soybeans, and small grain. Slope is the major limitation. Minimum tillage, winter cover crops, and grassed waterways (fig. 5) help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for hay or pasture is effective in controlling erosion. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to building site development and sanitary facilities. Low strength, permeability, and shrink swell in the subsoil are moderate limitations. The shrink swell limitation can be partly overcome by constructing buildings without basements and by backfilling around foundations. Suitable base material is needed in constructing local roads and streets.

The capability subclass is 2e. The Michigan soil management group is 2.5a.

RdC—Riddles loam, 6 to 12 percent slopes. This rolling, well drained soil is on loamy uplands. Areas are commonly irregular in shape and range from 10 to 40 acres.

Typically the surface layer is dark grayish brown loam about 11 inches thick. The subsurface layer is dark brown sandy loam about 4 inches thick. The dark yellowish brown subsoil is about 35 inches thick. The upper part is clay loam, and the lower part is sandy clay loam. The substratum to a depth of about 70 inches is yellowish brown sandy loam.

Included with this soil in mapping are small areas of the well drained Kalamazoo and Oshtemo soils and the somewhat poorly drained Sleeth soils. These included soils make up about 5 to 10 percent of the map unit. The Sleeth soils are in depressions and at the foot of slopes. Kalamazoo and Oshtemo soils are in landscape positions similar to those of the Riddles soil. They are underlain by sand.

Permeability is moderate. Surface runoff is medium. The available water capacity is high.

Most of the acreage is cultivated. The potential is fair for crops, recreation, and building site development. It is good for hay, pasture, and woodland.

This soil is suited to corn, soybeans, and small grain. Slope is the major limitation. Minimum tillage and winter cover crops help to control excessive soil loss. In some locations the topography is simple and contour stripcropping can reduce soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for hay or pasture is effective in controlling erosion. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to most building site development and to sanitary facilities. The major limitations are slope, permeability, low strength, and shrink swell in the subsoil. The shrink-swell limitation can be controlled by constructing buildings without basements, backfilling around foundations with suitable material, and providing drainage around foundations. Suitable base material is needed in constructing local roads and streets. Land shaping can help to solve some of the problems related to the slope.

The capability subclass is 3e. The Michigan soil management group is 2.5a.

SaA—Schoolcraft loam, 0 to 2 percent slopes. This nearly level, well drained soil is on flat plains. Areas are commonly irregular in shape and range from 10 to 400 acres.

Typically the surface layer is very dark gray loam about 12 inches thick. The subsoil is dark yellowish brown and dark brown and is about 26 inches thick. The upper part is clay loam, and the lower part is sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils. These included soils make up 3 to 5 percent of the map unit. They are in depressed areas.

Permeability is moderate. Surface runoff is slow. The available water capacity is moderate.

Most of the acreage is cultivated. The potential is good for crops, hay, pasture, recreation, and building site development.

This soil is well suited to corn, soybeans, and small grain. Midsummer droughtiness and soil blowing are the major problems. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material maintains good soil structure.

The use of this soil for hay or pasture is effective in controlling erosion. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to building site development and sanitary facilities. Banks cut in shallow excavations tend to cave. Shoring the banks can partly overcome this problem.

The capability subclass is 2s. The Michigan soil management group is 3/5a-m.

SaB—Schoolcraft loam, 2 to 6 percent slopes. This undulating, well drained soil is on uplands. Areas are commonly irregular in shape and range from 10 to 200 acres.

Typically the surface layer is very dark gray loam about 12 inches thick. The subsoil is dark yellowish brown and dark brown and is about 26 inches thick. The upper part is clay loam, and the lower part is sandy loam. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils. These included soils make up 3 to 5 percent of the map unit. They are in depressions.

Permeability is moderate. Surface runoff is slow or medium. The available water capacity is moderate.

Most areas are cultivated. The potential is good for crops, hay, pasture, recreation, and building site development.

This soil is well suited to corn, soybeans, and small grain. The slope, midsummer droughtiness, and erosion are the major problems. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for hay or pasture is effective in controlling erosion. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to building site development and sanitary facilities. Banks cut in shallow excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 2e. The Michigan soil management group is 3/5a-m.

Sb—Sebewa loam. This nearly level, very poorly drained soil is in low areas (fig. 6). It is subject to frequent flooding. Areas are commonly irregular in shape and range from 10 to 300 acres.

Typically the surface layer is black loam about 11 inches thick. The subsoil is gray and very dark gray mottled clay loam about 12 inches thick. The substratum to a depth of about 60 inches is dominantly gray and grayish brown loamy sand.

Included with this Sebewa soil in mapping are small areas of the very poorly drained Adrian and Gilford soils. These included soils make up about 10 to 15 percent of the map unit. Adrian soils are 16 to 50 inches of organic material over sand. They are in depressions. Gilford soils are in landscape positions similar to those of the Sebewa soil. They are more sandy than the Sebewa soil.

Permeability is moderate. Surface runoff is very slow. The available water capacity is moderate. The seasonal high water table is within a depth of 1 foot from September to May.

Most areas are idle. The potential is good for crops, hay, and pasture. It is fair for woodland. It is poor for recreation and building site development.

This soil is well suited to corn, soybeans, and small grain. Wetness is the main limitation. Ditch and tile drainage is needed. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is well suited to hay and pasture. Wetness is the main limitation. Ditch and tile drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are severe because of wetness. Removing obstructions from natural drainage improves drainage.

This soil is poorly suited to building site development and sanitary facilities. The major problems are wetness and frequent flooding in winter and spring.

The capability subclass is 2w. The Michigan soil management group is 3/5c.

SeA—Sleeth loam, 0 to 3 percent slopes. This nearly level and undulating, somewhat poorly drained soil is on lowland plains and in upland depressions. Areas are commonly irregular in shape and range from 10 to 300 acres.

Typically the surface layer is dark yellowish brown loam about 10 inches thick. The subsoil is mottled and is about 36 inches thick. The upper part is light brownish gray sandy clay loam and clay loam, and the lower part is grayish brown sandy loam. The substratum to a depth of about 60 inches is dark gray gravelly sand.

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

Permeability is moderate. Surface runoff is slow. The available water capacity is moderate. The seasonal high water table is 1 foot to 3 feet below the surface from January to April.

Most of the acreage is cultivated. The potential is good for cropland, hayland, pastureland, and woodland. It is fair for recreation and poor for building site development.

This soil is well suited to corn, soybeans, and small grain. Wetness is the major limitation. Ditch and tile drainage is needed. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

This soil is well suited to hay and pasture. Wetness is the major limitation. Ditch and tile drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is poorly suited to building site development and sanitary facilities. The major limitations are wetness and the instability of the soil when excavated. Limitations are severe for septic tank absorption fields because of the seasonal high water table. Sanitary facilities should be connected to commercial sewers if available. Banks cut in excavations tend to cave. Shoring the banks can partly overcome this problem.

The capability subclass is 2w. The Michigan soil management group is 2.5b.

SpB—Spinks loamy sand, 0 to 6 percent slopes. This nearly level and undulating, well drained soil is on sandy uplands. Areas are commonly irregular in shape and range from 10 to 100 acres.

Typically the surface layer is dark brown loamy sand about 10 inches thick. The subsurface layer is dark yellowish brown and yellowish brown loamy sand about 18 inches thick. The next layer to a depth of about 60 inches is yellowish brown sand with bands of dark yellowish brown loamy sand. In some soils the total thickness of the bands is less than 6 inches.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils and the somewhat poorly drained Thetford soils. These included soils make up about 5 to 10 percent of the map unit. Plainfield soils are in landscape positions similar to those of the Spinks soil. They are more droughty than Spinks soil. Thetford soils are in depressions.

Permeability is rapid. Surface runoff is slow. The available water capacity is low.

Most of the acreage is cultivated. The potential is fair for crops, hay, pasture, and recreation. It is good for woodland and building site development.

This soil is suited to corn, soybeans, and small grain. Soil blowing and droughtiness are the major problems. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for hay or pasture is effective in controlling erosion. Droughtiness is the major limitation. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is well suited to most building site development and to sanitary facilities. The rapid permeability, the instability of the soil when excavated, and droughtiness are the major limitations. Shallow wells can be polluted by effluent from the septic systems. Suitable fill and topsoil are needed for lawn development. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 3s. The Michigan soil management group is 4a.

SpC—Spinks loamy sand, 6 to 12 percent slopes. This rolling, well drained soil is on sandy uplands and ridges. Areas are commonly irregular in shape and range from 10 to 90 acres.

Typically the surface layer is dark brown loamy sand about 8 inches thick. The subsurface layer is dark yellowish brown loamy sand about 18 inches thick. The next layer to a depth of about 60 inches is yellowish brown sand with dark yellowish brown loamy sand bands.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils. These included soils make up about 10 percent of the map unit. They are in landscape positions similar to those of the Spinks soils. Plainfield soils are more droughty than the Spinks soils.

Permeability is rapid. Surface runoff is medium. The available water capacity is low.

Most of the acreage is cultivated. The potential is fair for crops, hay, pasture, recreation, and building site development. It is good for woodland.

This soil is suited to corn, soybeans, and small grain. Erosion and droughtiness are the major problems. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to maintain soil structure.

The use of this soil for hay or pasture is effective in controlling erosion. Droughtiness is the major limitation. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is suited to most building site development and to sanitary facilities. The slope, the instability of the soil when excavated, the rapid permeability, and the droughtiness are the major limitations. Shallow wells may be polluted by effluent from the septic systems. Suitable topsoil and fill are needed for lawn development. Banks cut in excavations tend to cave. Shoring the banks can partly overcome this problem. The slope limitation can be reduced by land shaping and by constructing roads and streets on the contour.

The capability subclass is 3e. The Michigan soil management group is 4a.

SpD—Spinks loamy sand, 12 to 18 percent slopes. This hilly, well drained soil is on hillsides and ridges. Areas are commonly long and narrow and range from 10 to 60 acres.

Typically the surface layer is dark brown loamy sand about 6 inches thick. The subsurface layer is dark yellowish brown loamy sand about 3 inches thick. The next layer is dominantly yellowish brown sand about 38 inches thick. It has bands of loamy sand. The substratum to a depth of about 60 inches is yellowish brown sand.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils. These included soils make up about 15 percent or less of the map unit. They are in landscape positions similar to those of the Spinks soil.

Permeability is rapid. Surface runoff is medium. The available water capacity is low.

Most areas are idle and are in weeds and brush. The potential is poor for cropland. It is fair for hay, pasture, recreation, and building site development. It is good for woodland.

This soil has severe problems for corn, soybeans, and small grain. The steep slopes, the erosion, and the droughtiness are the major problems. No tillage or minimum tillage and winter cover crops help to control soil loss.

The use of this soil for hay or pasture is effective in controlling erosion. Erosion and droughtiness are the major problems. Proper stocking, pasture rotation, and timely deferment of grazing help to keep the pasture and soil in good condition.

This soil is poorly suited to building site development and sanitary facilities. The slope, the instability of the soil when excavated, the rapid permeability, and the droughtiness are the major limitations. Suitable fill and topsoil are needed for lawn development. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem. Land shaping is needed. Roads and streets should be constructed on the contour.

The capability subclass is 4e. The Michigan soil management group is 4a.

StE—Spinks-Coloma loamy sands, 18 to 35 percent slopes. These steep, well drained and somewhat excessively drained soils are on sandy ridges and escarpments. Areas are commonly long and narrow and range from 5 to 60 acres. The Spinks soil makes up about 35 to 45 percent of the map unit, and the Coloma soil about 35 to 45 percent. The Spinks soil is mostly in the less sloping parts of the unit. The Coloma soil is in the steeper parts. The two soils are so intricately mixed that it is not practical to separate them in mapping.

Typically the Spinks soil has a surface layer of dark brown loamy sand about 5 inches thick. The subsurface layer is dark yellowish brown loamy sand about 6 inches thick. The next layer to a depth of about 86 inches is dominantly yellowish brown sand with bands of loamy sand.

Typically the Coloma soil has a surface layer of dark brown sand about 5 inches thick. The subsurface layer is light yellowish brown and yellowish brown loamy sand about 28 inches thick. The next layer to a depth of about 66 inches is brownish yellow sand with bands of dark yellowish brown loamy sand.

Included with these soils in mapping are areas of the excessively drained Plainfield soils. Plainfield soils are in landscape positions similar to those of the Spinks and Coloma soils. Also included are small areas of the well drained Oshtemo soils. The Oshtemo soils are in landscape positions similar to those of the Spinks and Coloma soils. They also occur in the less sloping areas. These included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Surface runoff is rapid. The available water capacity is low.

Most areas are idle and are in weeds and brush. The potential is poor for crops, hay, recreation, and building site development. It is fair for pasture and woodland.

The soils are poorly suited to crops, hay, or pasture. The steep slopes are the major limitations.

These soils are poorly suited to recreation. The steep slopes are the major limitation. Maintaining paths and trails is difficult.

These soils are generally not suitable for building site development and sanitary facilities. Limitations are severe.

The capability subclass is 6e. The Michigan soil management groups are 4a-5a.

ThA—Thetford loamy sand, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on lowlands and in depressions. Areas are commonly irregular in shape and range from 10 to 100 acres.

Typically the surface layer is dark brown loamy sand about 9 inches thick. The subsurface layer is yellowish brown loamy sand and very pale brown sand about 12 inches thick. The next layer, about 34 inches thick, is pale brown sand with bands of strong brown loamy sand. The subsoil to a depth of about 66 inches is yellowish brown loamy sand.

Included with this soil in mapping are small areas of the moderately well drained Bronson soils and well drained Spinks soils. These included soils make up about 5 to 10 percent of the map unit. Both Bronson and Spinks soils are in higher landscape positions than those of the Thetford soils. The Bronson soils have more clay in the profile. The Spinks soils have bands at a shallower depth.

Permeability is moderately rapid. Surface runoff is slow. The available water capacity is low. The seasonal high water table is within a depth of 1 foot to 2 feet from February to May.

Most of the acreage is pastured or is idle and brushy. A small acreage is cultivated. The potential is fair for cropland, hayland, pastureland, woodland, and recreation. It is poor for building site development.

This soil is suited to corn, soybeans, and small grain. Wetness, droughtiness, and soil blowing are the major problems. Drainage is needed. Minimum tillage and winter cover crops help to control soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and maintains soil structure.

The use of this soil for pasture and hay is effective in controlling erosion. Wetness is the major limitation. Ditch drainage is needed. Livestock should be fenced away from the ditches to help control bank erosion. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

The soil is poorly suited to building site development and sanitary facilities. The major problems are the wetness, the instability of the soil when excavated, and the seepage. Sanitary facilities should be connected to commercial sewers if available. Septic tank absorption fields can pollute the ground water because of the rapid permeability of the soil. Suitable fill and topsoil are needed for lawn development. Banks cut in excavations tend to cave. Shoring the banks partly overcomes this problem.

The capability subclass is 3w. The Michigan soil management group is 4b.

Ua—Udipsamments, level to steep. This map unit consists of level to steep, moderately well drained or well drained soils that have been disturbed. Areas are commonly irregular in shape and range from 5 to 30 acres.

This unit includes sanitary landfills, flood plains, and lowlands that have been filled with various types of natural and manmade debris. The fill material is 1 foot to several feet thick and commonly is covered with sandy or loamy material.

Permeability and the available water capacity are variable. Runoff depends on the slope.

Some areas are suited to building site development, some are developed into parks, and others are idle. Onsite investigation is needed to determine the potential of this unit for specified uses.

No interpretative groups.

Ub—Urban land. This map unit consists of areas so obscured by urban work and structures that identification of the soil is not possible.

No interpretative groups.

Ug—Urban land-Glendora complex. This map unit consists of nearly level areas of Urban land and a very poorly drained soil. It occurs along streams and is subject to frequent flooding. Areas commonly range from 20 to 150 acres. Urban land makes up 40 to 60 percent of the map unit and the Glendora soil 20 to 40 percent. The Urban land areas and Glendora soils are so intricately mixed, or so small in size, that it is not practical to separate them in mapping.

In the areas of Urban land the soil is so obscured by urban work or structures that identification is not feasible.

Typically the Glendora soil has a surface layer of black sandy loam about 10 inches thick. The underlying material to a depth of about 60 inches is alternate layers of multicolored sand with thick layers of black loamy sand and muck.

Included with this unit in mapping and making up 10 to 20 percent of the acreage are small areas of very poorly drained Adrian, Houghton, and Sebewa soils. All are in landscape positions similar to those of the Glendora soil. Adrian and Houghton soils are organic. Sebewa soils have a clay loam subsoil.

The Glendora soil has rapid permeability, slow runoff, and low available water capacity. In undrained areas, the seasonal high water table is within 1 foot of the surface during November to June.

Most areas are idle. Some are brushy. Some are under urban development. The potential is poor for cropland, woodland, recreation, and building site development. It is good for development of wetland wildlife habitat.

This map unit is well suited as wetland wildlife habitat.

This unit is generally not suited to building site development and sanitary facilities. Site development is difficult because of the high water table and the flooding. Lowering the water table is difficult because the unit is along a perennial stream.

No interpretative groups.

UkB—Urban land-Kalamazoo complex, 0 to 6 percent slopes. This map unit consists of Urban land and a level and undulating, well drained soil on uplands. Areas are commonly irregular in shape and range from 80 to 800 acres. Urban land makes up 60 to 70 percent of the map unit, and the Kalamazoo soil 30 to 40 percent. The urban areas and Kalamazoo soils are so intricately mixed, or so small in size, that it is not practical to separate them in mapping.

In the areas of Urban land the soil is so obscured by urban works and structures that identification is not feasible.

Typically the Kalamazoo soil has a surface layer of dark grayish brown loam about 11 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is clay loam and loam, the next part is sandy loam, and the lower part is loamy coarse sand. The substratum to a depth of about 60 inches is dark yellowish brown gravelly sand.

Included with this unit in mapping are small areas of the somewhat poorly drained Sleeth soils in depressions. Included also are areas of the moderately well drained Bronson soils and the somewhat excessively drained Coloma soils. Bronson soils are in flat areas near streams and lakes. Coloma soils are on narrow ridges. They are more sandy than the Kalamazoo soils.

Permeability is moderate in the Kalamazoo soil. The available water capacity is moderate. Surface runoff is slow or medium.

Most areas are under urban development or are idle grassland. Small areas are cropped. The potential is good for building site development. In open areas it is good for recreation.

The Kalamazoo soil is suited to building site development and sanitary facilities. Walls cut in excavations, however, tend to cave. Shoring the walls overcomes this problem.

No interpretative groups.

UkC—Urban land-Kalamazoo complex, 6 to 12 percent slopes. This map unit consists of Urban land and rolling, well drained soil on uplands. Areas are commonly irregular in shape and range from 10 to 160 acres. Urban land makes up 50 to 60 percent of the map unit, and the Kalamazoo soil 40 to 50 percent. These soils and miscellaneous land types are so intricately mixed that it is not practical to separate them in mapping.

In the areas of Urban land the soil is so obscured by urban development that identification is not feasible.

Typically the Kalamazoo soil has a surface layer of dark grayish brown loam about 9 inches thick. The subsoil is dark yellowish brown and dark brown and is about 44 inches thick. The upper part is loam, the next part is clay loam, and the lower part is loamy coarse sand. The substratum to a depth of about 60 inches is yellowish brown gravelly sand.

Included with this unit in mapping are small areas of the somewhat poorly drained Sleeth soils in depressions and areas of the somewhat excessively drained Coloma soils. The Coloma soils are on narrow ridges. They are more sandy than the Kalamazoo soil. These included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in the Kalamazoo soil. Surface runoff is medium or rapid. The available water capacity is moderate.

Most areas are under urban development or are idle grassland. The potential is fair for building site development. In open areas, it is low for recreation.

The Kalamazoo soil is suited to most building site development and to sanitary facilities. The major problems are the slope and the caving of cutbanks. Care must be taken in installing septic system drain fields to prevent hillside seeps. Limitations are moderate for dwellings because of the slope. Limitations are severe for commercial buildings. Larger level areas are needed.

No interpretative groups.

UoD—Urban land-Oshtemo complex, 12 to 25 percent slopes. This map unit consists of Urban land and a hilly, well drained soil on upland areas mostly bordering stream flood plains or terraces. Areas are commonly long and narrow and range from 10 to 300 acres. Urban land makes up 50 to 65 percent of the map unit, and the Oshtemo soil 20 to 30 percent. The areas of Urban land and Oshtemo soil are so intricately mixed that it is not practical to separate them in mapping.

In the areas of Urban land the soil is so obscured by urban development that identification is not feasible.

Typically the Oshtemo soil has a surface layer of dark brown sandy loam about 8 inches thick. The subsurface layer is yellowish brown sandy loam about 10 inches thick. The subsoil is about 50 inches thick. The upper part is dark brown sandy loam, the next part is dark yellowish brown loamy sand, and the lower part is banded dark brown loamy sand and yellowish brown sand.

Included with this unit in mapping are small areas of the somewhat excessively drained Coloma soils and the excessively drained Plainfield soils. These included soils are in landscape positions similar to those of the Oshtemo soil. They make up 15 to 20 percent of the map unit.

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

Most areas are equally divided among woodland, idle land, and urban development. The potential is poor for recreation and building site development.

These soils are poorly suited to building site development and sanitary facilities. The steepness of the slope and the instability of the soil when excavated are the major limitations. Care must be taken to prevent hillside seepage of the effluent in establishing septic tank filter fields. Banks cut in excavations tend to cave. Shoring the banks can partly overcome this problem.

No interpretative groups.

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 (*5*). 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 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

Deane W. Meredith, district conservationist, Soil Conservation Service, assisted in preparing this section.

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.

Approximately 127,000 acres was cropped in the county, according to the 1974 U.S. Census of Agriculture. Of this total about 97,000 acres was cropland harvest, and about 12,000 acres was pasture. All other cropland totaled 18,000 acres.

The potential is good for increased food production. Much of the cropland is idle throughout the county, particularly around the cities. These acreages could be used to produce food and fiber.

The acreage in crops and pasture is decreasing as more and more land is used for urban development. In 1967, about 53,000 acres in the county was built-up land. This figure has been steadily increasing. In I974, about 51 percent of the land was in nonfarm use, according to the U.S. Census of Agriculture. This soil survey can help in making land use decisions that will influence the future role of farming. See "Broad land use consideration."

Soil erosion is the major hazard on about half the cropland in Kalamazoo County. If the slope is more than 2 percent, water erosion is a hazard.

Loss of the surface layer through erosion is damaging for two reasons. First, the productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. This is especially true of soils that tend to be droughty, such as Kalamazoo and Oshtemo soils. Second, 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. Erosion also reduces the capacity of the streams to handle floodwater.

Erosion control provides protective cover, reduces runoff, and increases 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 productivity of the soil. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land, provide nitrogen, and improve tilth for the following crops.

Slopes are so short and irregular that contour tillage and terracing is not practical on the sloping Kalamazoo and Oshtemo soils. On these soils, cropping sytems that provide substantial plant cover are needed to control erosion unless tillage is kept to a minimum. Minimizing tillage and leaving crop residue on the surface increase infiltration and reduce the hazards of runoff and erosion. Conservation tillage can be adapted to most soils in the survey area but is more difficult to use successfully on eroded soils. No till is effective in reducing erosion on sloping land and is suited to most soils in the county.

Terraces and diversions reduce the length of the slope and reduce runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. Riddle soils are more suitable for terraces than other soils. Contouring and contour stripcropping are also best adapted to soils with smooth uniform slopes.

Soil blowing is a hazard on the sandy Coloma and Plainfield soils and on the muck soils—Houghton, Edwards, and Adrian soils. Soil blowing can damage these soils in a few hours if the wind is strong and the soils are dry and bare of vegetation or surface mulch. Maintaining a plant cover, a surface mulch, or a rough surface through tillage minimizes the hazard of soil blowing. Windbreaks of adapted shrubs, such as willow or spirea, are effective on the muck soils.

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

Soil drainage is the major management problem on about one-tenth of the acreage used for crops and pasture in the county. Some soils are naturally so wet that production of crops common to the area is generally not possible unless those soils are artificially drained. Examples are the poorly and very poorly drained Gilford, Granby, and Sebewa soils and the very poorly drained Houghton, Edwards, and Adrian soils.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged in most years. Examples are the Brady, Sleeth, and Thetford soils.

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 and very poorly drained soils used for row crops. Drains have to be more closely spaced in the moderately slowly permeable soils. Finding adequate outlets for tile drainage systems is difficult in many parts of the county.

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 of organic soils. Information on the drainage design for each kind of soil is available in the local office of the Soil Conservation Service.

Field crops suited to the soils and climate of the area are corn, sorghum, soybeans, wheat, and oats. Special crops grown in the area are vegetables, small fruits, tree fruits, and nursery plants. Most of the vegetables are grown on organic soils in Comstock Township. A small acreage throughout the county is used for sweet corn, tomatoes, peppers, and other vegetables. In addition, some grapes are grown in the western part of the county. There are a few apple orchards scattered throughout the county.

If adequately drained, the muck soils are well suited to a wide range of vegetable crops. Most of the well drained soils in the area are suitable for orchards and nursery plants. Soils in low positions, where frost is frequent and air drainage is poor, generally are poorly suited to early vegetables, small fruits, and orchards.

Latest information and suggestions for growing special crops can be obtained from the 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 (*3*); 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 (*7*) 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 map unit description is the capability subclass and the Michigan soil management group. For 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"(*4*).

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, 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 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. Mapping unit symbols for soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates insignificant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the following order: x, w, t, d, c, s, f, and r.

In table 7 the soils are also 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.

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, 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, open ditches, and cemeteries. 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, 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. 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, and shrink-swell potential are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, 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, and susceptibility to flooding. Stones and boulders 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 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 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 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 or 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 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; hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; alkalinity; 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; 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, 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 bluestem, goldenrod, beggarweed, wheatgrass, and grama.

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, poplar, 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, fir, cedar, 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, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, and wildrice 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 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 wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, 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 beaver.

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. 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 Alfisol.

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 Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

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 Hapludalfs (*Hapl*, meaning simple horizons, plus *udalf*, the suborder of Alfisols that have an udic 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 *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Hapludalfs.

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 fine-loamy, mixed, mesic, Typic Hapludalfs.

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 mapping 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 in depressions. These soils formed in organic material 16 to 50 inches thick over sand. Slope is 0 to 2 percent.

Adrian soils are similar to Edwards and Houghton soils and are adjacent to Edwards, Gilford, Glendora, Granby, and Houghton soils. Edwards and Houghton soils are organic. The very poorly drained Edwards soils are 16 to 50 inches deep over marl. The very poorly drained Houghton soils are more than 50 inches deep. The very poorly drained Gilford and Glendora soils and the poorly drained Granby soils formed in sandy material. Adrian, Houghton, and Edwards soils are in similar landscape positions. Gilford and Granby soils are in slightly higher sandy areas. Glendora soils are on flood plains.

Typical pedon of Adrian muck, 1,980 feet north and 600 feet west of the southeast corner sec. 10, T. 1 S., R. 12 W.

Oa1—0 to 13 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fiber; strong medium subangular blocky structure; friable; many roots; slightly acid; gradual smooth boundary.

Oa2—13 to 25 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fiber; weak medium subangular blocky structure; common roots; slightly acid; gradual smooth boundary.

Oa3—25 to 31 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fiber; weak coarse subangular blocky structure; slightly acid; clear smooth boundary.

IIC—31 to 60 inches; dark gray (10YR 4/1) sand; single grained; loose; mildly alkaline.

Depth to the sandy IIC horizon is 16 to 50 inches. The organic material is derived mainly from herbaceous plants. The solum is up to 10 percent woody material.

The lower layers of organic material are up to about 40 percent silt loam or sand. In some pedons they contain some shells.

The IIC horizon has a hue of 10YR, 7.5YR, or 2.5Y, value of 3 or 4, and chroma of 4 or less. It is sand, gravelly sand, or loamy sand.

Brady series

The Brady series consists of somewhat poorly drained, moderately rapidly permeable soils on outwash plains and in depressions. These soils formed in sandy sediments. Slope is 0 to 3 percent. The Brady soils in Kalamazoo County have a lighter colored surface layer than is typical of the Brady series. This difference, however, does not alter their use and management.

Brady soils are similar to Bronson and Gilford soils and are adjacent to Bronson, Gilford, and Oshtemo soils. The moderately well drained Bronson soils and the well drained Oshtemo soils are in slightly higher landscape positions than Brady soils. The very poorly drained Gilford soils are in depressions and along streams.

Typical pedon of Brady sandy loam, 0 to 30 percent slopes, 525 feet south and 585 feet west of the center of sec. I4, T.1 S., R. I2 W.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) sandy loam; light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; few fine roots; about 1 percent pebbles; medium acid; abrupt smooth boundary.

B21t—12 to 18 inches; mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) sandy loam; moderate coarse subangular blocky structure; friable; few fine roots; clay bridging of sand grains; about 1 percent pebbles; slightly acid; clear wavy boundary.

B22t—18 to 24 inches; mottled brown (10YR 5/3), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/6) sandy loam; massive; friable; clay bridging of sand grains; about 1 percent pebbles; slightly acid; gradual wavy boundary.

B31—24 to 34 inches; brown (10YR 5/3) loamy sand; common coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; very friable; about 1 percent pebbles; slightly acid; abrupt smooth boundary.

IIB32—34 to 43 inches; dark brown (7.5YR 4/4) loamy sand; many coarse prominent light gray (10YR 7/2) mottles; weak medium subangular blocky structure; friable; about 15 percent pebbles; medium acid; abrupt smooth boundary.

IIB33—43 to 56 inches; brown (10YR 5/3) loamy sand; massive; very friable; about 5 percent pebbles; slightly acid; gradual wavy boundary.

IIC—56 to 68 inches; grayish brown (10YR 5/2) sand; single grained; loose; about 5 percent pebbles; neutral.

Solum thickness ranges from 40 to 70 inches but is typically 48 to 60 inches. Reaction is slightly acid to strongly acid. The pebble content ranges from 0 to 20 percent throughout the profile.

The A horizon has value of 3 or 4 and chroma of 1 or 2. It is typically sandy loam, but the range includes loamy sand. In noncultivated areas the soil has a 1- to 3-inch A2 horizon of sandy loam or loamy sand.

The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It is typically sandy loam but includes thin bands of loamy sand or clay loam.

The IIC horizon has chroma of 1 to 3.

Bronson series

The Bronson series consists of moderately well drained, moderately rapidly permeable soils on outwash plains and in depressions. These soils formed in sandy sediments. Slope is 0 to 3 percent.

Bronson soils are similar to and adjacent to Brady and Oshtemo soils. The somewhat poorly drained Brady soils are in depressions. The well drained Oshtemo soils are in slightly higher landscape positions.

Typical pedon of Bronson sandy loam, 0 to 3 percent slopes, 1,510 feet south and 175 feet west of the northeast corner sec. 10, T. 4 S., R. 10 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium granular structure; friable; common fine roots; neutral; clear smooth boundary.

A2—9 to 17 inches; yellowish brown (10YR 5/6) loamy sand; few distinct strong brown (7.5YR 5/8) mottles; weak medium granular structure; very friable; few fine roots; dark grayish brown (10YR 4/2) Ap material in wormholes and root channels; neutral; clear wavy boundary.

B21t—17 to 25 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct yellowish red (5YR 5/8) and common fine distinct gray (10YR 5/1) mottles; weak medium subangular blocky structure; friable; clay bridging; dark grayish brown (10YR 4/2) Ap material in wormholes and root channels; about 1 percent pebbles; neutral; gradual wavy boundary.

B22t—25 to 33 inches; strong brown (7.5YR 5/6) sandy loam; few fine distinct light gray (10YR 7/1) mottles; weak medium subangular blocky structure; very friable; clay bridging; about 1 percent pebbles; strongly acid; gradual wavy boundary.

B3—33 to 48 inches; yellowish brown (10YR 5/4) loamy sand; few medium distinct gray (10YR 6/1) mottles; massive; very friable; about 1 percent pebbles; strongly acid; gradual wavy boundary.

C1—48 to 53 inches; yellowish brown (10YR 5/4) sand; common medium distinct dark yellowish brown (10YR 3/6) mottles; single grained; loose; about 1 percent pebbles; strongly acid; gradual wavy boundary.

C2—53 to 66 inches; pale brown (10YR 6/3) sand; single grained; loose; about 1 percent pebbles; medium acid.

Pebble content is 0 to 5 percent throughout the profile. The A2 horizon is loamy sand or sandy loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. In some pedons it is sandy clay loam.

Coloma series

The Coloma series consists of somewhat excessively drained, rapidly permeable soils on outwash plains and moraines. These soils formed in sandy deposits. Slope ranges from 0 to 35 percent.

Coloma soils are similar to Spinks soils and are adjacent to Oshtemo, Plainfield, and Spinks soils. All of these soils are in similar landscape positions. The well drained Oshtemo and Spinks soils have more clay in the profile than Coloma soils and have a higher available water capacity. The excessively drained Plainfield soils do not have loamy sand lamellae.

Typical pedon of Coloma loamy sand, 0 to 6 percent slopes, 1,000 feet north and 1,000 feet west of the southeast corner sec. 20, T. 1 S., R. 12 W.

A1—0 to 10 inches; dark brown (10YR 4/3) loamy sand; weak fine granular structure; very friable; common roots; 1 percent pebbles; slightly acid; clear smooth boundary.

A21—10 to 26 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; few roots; 1 percent pebbles; slightly acid; gradual wavy boundary.

A22—26 to 42 inches; yellowish brown (10YR 5/4) sand; single grained; loose; slightly acid; gradual wavy boundary.

A&B—42 to 66 inches; yellowish brown (10YR 5/4) sand; single grained (A2); loose; lamellae and bands of brown (7.5YR 4/4) loamy sand (B2t); massive; friable; slightly acid.

The pebble content ranges from 0 to 10 percent throughout the profile.

The A horizon has value of 3 to 6 and chroma of 2 to 6. In wooded areas the soil has a very dark grayish brown (10YR 3/2) loamy sand A1 horizon 2 to 3 inches thick and a dark yellowish brown (10YR 4/4) A12 horizon 3 to 5 inches thick.

Lamallae have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. They are at depths of 40 inches or more. They are loamy sand or sandy loam 1/8 to 1 inch thick. Total thickness is less than 6 inches.

Dowagiac series

The Dowagiac series consists of well drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils are on outwash plains. They formed in loamy over sandy material. Slope is 0 to 3 percent.

Dowagiac soils are similar to Kalamazoo and Schoolcraft soils. They are adjacent to Kalamazoo, Oshtemo, Sleeth, and Schoolcraft soils. The well drained Dowagiac, Kalamazoo, and Schoolcraft soils are in similar landscape positions. The surface layer is lighter colored in the Kalamazoo soils than in the Dowagiac soils and is thicker in the Schoolcraft soils. The well drained Oshtemo soils are in adjacent sloping areas. The somewhat poorly drained Sleeth soils are in depressions and along intermittent drains.

Typical pedon of Dowagiac loam, 0 to 3 percent slopes, 1,100 feet east and 20 feet north of the center of sec. 2, T. 4 S., R. 12 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam; weak medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A2—9 to 11 inches; dark grayish brown (10YR 4/2) loam; weak thin platy structure; friable; many fine roots; slightly acid; gradual wavy boundary.

B1—11 to 16 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; many fine roots; slightly acid; gradual wavy boundary.

B21t—16 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common roots; fine discontinuous dark reddish brown (5YR 2/2, 2/3) thin clay films on faces of peds; medium acid; clear smooth boundary.

B22t—29 to 38 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; thin clay films on faces of peds and bridging of sand grains; strongly acid; gradual wavy boundary.

IIB3—38 to 50 inches; yellowish brown (10YR 5/6) sand; single grained; loose; medium acid; abrupt irregular boundary.

IIC—50 to 60 inches; brown (10YR 5/3) sand; single grained; loose; neutral.

Depth of the solum ranges from 45 to 60 inches. The pebble content ranges from 0 to 30 percent.

The Ap horizon has a value of 2 or 3 and chroma of 1 or 2. It is typically loam, but the range includes sandy loam.

The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. The clay content of the B2 horizon ranges from 18 to 35 percent.

The C horizon has value of 4 to 6 and chroma of 3 to 6. It is sand, gravelly sand, or gravel and sand. The pebble content ranges from 0 to 30 percent.

Edwards series

The Edwards series consists of very poorly drained, moderately slowly to moderately rapidly permeable soils in depressions. These soils formed in organic material 16 to 50 inches thick over marl. Slope is 0 to 2 percent.

Edwards soils are similar to Adrian soils. They are adjacent to Adrian, Gilford, Glendora, Granby, and Houghton soils. The very poorly drained Adrian and Houghton soils are organic. They are in landscape positions similar to those of Edwards soils. Adrian soils are 16 to 50 inches deep over sand. Houghton soils are organic to a depth of 51 inches or more. The very poorly drained Gilford and Glendora soils and poorly drained Granby soils formed in sandy material. Gilford and Granby soils are in slightly higher sandy areas than Edwards soils. Glendora soils are on flood plains along perennial streams.

Typical pedon of Edwards muck, 275 feet north and 400 feet west of the center of sec. 25, T.4 S., R. 10 W.

Oa1—0 to 9 inches; black (10YR 2/1) broken face and rubbed sapric material; less than 5 percent fiber, a trace rubbed; weak fine granular structure; neutral; clear smooth boundary.

Oa2—9 to 17 inches; black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed sapric material; less than 5 percent fiber, a trace rubbed; strong coarse platy structure; neutral; clear smooth boundary.

Oa3—17 to 26 inches; very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed sapric material; about 15 percent fiber, less than 5 percent rubbed; massive; mildly alkaline; clear smooth boundary.

Lca—26 to 60 inches; light gray (10YR 6/1) marl; massive; friable; violent effervescence; moderately alkaline.

Depth to the Lca horizon ranges from 16 to 50 inches. The organic material is derived mainly from herbaceous plants. The profile is up to 10 percent woody material.

In some pedons the subsurface layer contains fibric material, but the total thickness of this material is less than 5 inches. In some pedons snail shells and a thin layer of coprogenous earth occur directly above the marl.

The Lca horizon has value of 5 to 7 and chroma of 1 or 2.

Gilford series

The Gilford series consists of very poorly drained, moderately rapidly permeable soils that occupy outwash plains and glacial lakebeds. These soils formed in sandy sediments. Slope is 0 to 2 percent.

Gilford soils are adjacent to Adrian, Brady, Bronson, and Granby soils. The very poorly drained Adrian soils are organic and are 16 to 50 inches deep over sand. They formed in depressions. The somewhat poorly drained Brady soils and the moderately well drained Bronson soils are in slightly higher landscape positions than Gilford soils. The poorly drained Granby soils are in landscape positions similar to those of Gilford soils, but they are sandy and are more droughty.

Typical pedon of Gilford sandy loam, 1,320 feet south and 640 feet east of the center of sec. 31, T. 1 S., R. 12 W.

Ap—0 to 12 inches; black (10YR 2/1) sandy loam; very dark gray (10YR 3/1) dry; few faint dark yellowish brown (10YR 3/4) mottles; weak fine granular structure; many fine and medium roots; neutral; clear smooth boundary.

A12—12 to 17 inches; very dark gray (10YR 3/1) sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; neutral; clear wavy boundary.

B21g—17 to 21 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/4, 5/6), and dark grayish brown (10YR 4/2) sandy loam; massive; very friable; few fine roots; about 1 percent pebbles; neutral; gradual wavy boundary.

B22g—21 to 31 inches; gray (2.5Y 6/0) sandy loam; common fine prominent yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine roots; slightly acid; gradual wavy boundary.

B3—31 to 42 inches; yellowish brown (10YR 5/4) loamy sand; few fine faint yellowish brown (10YR 5/8) mottles; massive; very friable; neutral; gradual wavy boundary.

IIC—42 to 60 inches; grayish brown (10YR 5/2) sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grained; about 5 percent pebbles; mildly alkaline.

Solum thickness ranges from 20 to 44 inches. The pebble content is 0 to 10 percent. Thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly sandy loam, but the range includes loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 0 to 6. It is mottled. In some pedons the B2g horizon is 1 to 3 inches of loam or clay loam.

The C horizon has value of 5 or 6 and chroma of 2 to 4.

Glendora series

The Glendora series consists of very poorly drained, rapidly permeable soils on flood plains along perennial rivers and streams. These soils formed in sandy alluvium. Slope is 0 to 2 percent.

Glendora soils are similar to Gilford and Granby soils. They are adjacent to Adrian, Granby, and Gilford, Houghton, and Sebewa soils. The very poorly drained Adrian and Houghton soils are organic. They occupy depressions. Adrian soils are 16 to 50 inches of muck over sand, and Houghton soils are more than 51 inches of muck. The very poorly drained Gilford soils and the poorly drained Granby soils are sandy and are less stratified than Glendora soils. They are in slightly higher landscape positions. The very poorly drained Sebewa soils have more clay than Glendora soils and are in slightly higher landscape positions.

Typical pedon of Glendora sandy loam, 1,200 feet north and 50 feet west of the southeast corner sec. 20, T. 4 S., R. 9 W.

A1—0 to 10 inches; black (10YR 2/1) sandy loam; weak fine granular structure; friable; many roots; neutral; clear wavy boundary.

C1—10 to 21 inches; light brownish gray (10YR 6/2) sand; black (10YR 2/1) loamy sand and organic bands 1/8 to 1 inch thick; single grained; loose; common roots; neutral; gradual wavy boundary.

C2—21 to 42 inches; pale brown (10YR 6/3) and dark yellowish brown (10YR 4/4) sand; black (10YR 2/1) organic bands less than 1/4 inch thick; single grained; loose; common roots; neutral; gradual wavy boundary.

C3—42 to 60 inches; brown (10YR 5/3) sand; black (10YR 2/1) organic bands 1/8 to 1/2 inch thick; single grained; loose; neutral.

Layers of this soil are highly variable in sequence and thickness within a horizontal distance of a few feet.

Granby series

The Granby series consists of poorly drained, rapidly permeable soils in glacial lakebeds. These soils formed in sandy sediments. Slope is 0 to 2 percent. The Granby soils in Kalamazoo County have an irregular decrease in organic carbon and are more acid in the C horizon than is typical of the Granby series. This difference, however, does not alter use and management of the soils.

Granby soils are similar to Gilford soils. They are adjacent to Adrian, Gilford, Houghton, and Thetford soils. The very poorly drained Adrian and Houghton soils are in depressions filled with organic matter. Houghton soils are more than 51 inches of muck, and Adrian soils are 16 to 50 inches of muck over sand. The very poorly drained Gilford soils are in landscape positions similar to those of Granby soils, but they have a finer textured solum. The somewhat poorly drained Thetford soils are at slightly higher elevations.

Typical pedon of Granby loamy sand, 650 feet north and 600 feet west of the southeast corner sec. 20, T. 1 S., R. 9 W.

A1—0 to 13 inches; black (10YR 2/1) loamy sand; dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many roots; slightly acid; clear smooth boundary.

B1—13 to 16 inches; pale brown (10YR 6/3) sand; single grained; loose; about 1 percent pebbles; neutral; gradual wavy boundary.

B2g—16 to 30 inches; light brownish gray (10YR 6/2) sand; single grained; loose; about 3 percent pebbles; neutral; gradual wavy boundary.

B3g—30 to 36 inches; dark grayish brown (10YR 4/2) sand; single grained; loose; neutral; gradual wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) sand; few medium faint yellowish brown (10YR 5/6) mottles; single grained; loose; strongly acid.

Thickness of the solum ranges from 28 to 42 inches. The pebble content ranges from 0 to 5 percent throughout.

The A horizon has chroma of 2 or less.

The B horizon has value of 4 to 6 and chroma of 2 or 3. In some pedons this horizon contains thin discontinuous bands of coarse sand. Total thickness of the bands is 3 or 4 inches.

The C horizon has value of 5 to 7 and chroma of 2 or 3.

Houghton series

The Houghton series consists of very poorly drained, moderately slowly to moderately rapidly permeable soils in depressions. These soils formed in organic material more than 51 inches thick. Slope is 0 to 2 percent.

Houghton soils are similar to Adrian and Edwards soils. They are adjacent to Adrian, Edwards, Gilford, Glendora, Granby, and Sebewa soils. The very poorly drained Adrian and Edwards soils are in landscape positions similar to those of Houghton soils. Adrian soils are underlain by sand at depths of 16 to 50 inches, and Edwards soils are underlain by marl at similar depths. The very poorly drained Gilford and Glendora soils and the poorly drained Granby soils formed in sand. Gilford and Granby soils are at slightly higher elevations than Houghton soils. Glendora soils are on flood plains along perennial streams. The very poorly drained Sebewa soils are on slightly higher knolls than Houghton soils and are heavier textured.

Typical pedon of Houghton muck, 1,000 feet south and 250 feet west of the northeast corner sec. 25, T. 4 S., R. 10 W.

Oa1—0 to 10 inches; black (10YR 2/1) broken face and rubbed sapric material; about 5 percent fiber, a trace rubbed; weak coarse subangular blocky structure; neutral; gradual wavy boundary.

Oa2—10 to 21 inches; black (10YR 2/1) broken face and rubbed sapric material; about 5 percent fiber, a trace rubbed; massive; mildly alkaline; gradual wavy boundary.

Oa3—21 to 56 inches; black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed sapric material; about 10 percent fiber, less than 5 percent rubbed; massive; mildly alkaline; clear smooth boundary.

Oa4—56 to 66 inches; very dark brown (10YR 2/2) broken face and rubbed sapric material; about 25 percent fiber, less than 5 percent rubbed; massive; mildly alkaline.

The content of woody fragments ranges from 0 to 10 percent. The organic layers have hue of 10YR, 7.5YR, or 5YR, value of 2 or 3, and chroma of 0 to 3. Total thickness of the hemic and fibric material is less than 5 inches.

Kalamazoo series

The Kalamazoo series consists of well drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils are on outwash plains and moraines. They formed in loamy over sandy material. Slope ranges from 0 to 12 percent.

Kalamazoo soils are similar to Dowagiac and Schoolcraft soils. They are adjacent to Dowagiac, Oshtemo, Sebewa, Sleeth, and Schoolcraft soils. The well drained Dowagiac and Schoolcraft soils are in landscape positions similar to those of Kalamazoo soils. The well drained Oshtemo soils are in sandy sloping areas. The very poorly drained Sebewa soils and the somewhat poorly drained Sleeth soils are on lowlands and in depressions.

Typical pedon of Kalamazoo loam, 0 to 2 percent slopes, 635 feet north and 115 feet east of the southwest corner sec. 28, T. 3 S., R. 10 W.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) loam; light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

B1—11 to 16 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; common fine roots; dark grayish brown (10YR 4/2) material in pores and wormholes; neutral; gradual wavy boundary.

B21t—16 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; few fine roots; 1 percent pebbles; neutral; gradual wavy boundary.

B22t—20 to 30 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous dark yellowish brown (10YR 3/4) clay films on faces of peds; few fine roots; 1 percent pebbles; neutral; gradual wavy boundary.

B23t—30 to 38 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; thin continuous dark yellowish brown clay films on faces of peds; 5 percent pebbles; medium acid; gradual wavy boundary.

IIB31—38 to 42 inches; dark yellowish brown (10YR 4/6) loamy coarse sand; massive; friable; 10 percent pebbles; medium acid; gradual wavy boundary.

IIB32—42 to 55 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; massive; friable; 20 percent pebbles; neutral; gradual wavy boundary.

IIC—55 to 60 inches; dark yellowish brown (10YR 4/4) gravelly sand; single grained; loose; 20 percent pebbles; slight effervescence; mildly alkaline.

The depth to calcareous material ranges from 41 to 70 inches. The pebble content in the solum ranges from 0 to 30 percent.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. It is typically loam, but the range includes sandy loam.

The B horizon has hue of 10YR or 7.5YR, value of 3 to 6, and chroma of 3 to 5. The clay content of the B21t and B22t horizons ranges from 18 to 35 percent.

The C horizon has value of 4 to 6 and chroma of 3 to 6. It is sand, gravelly sand, or gravel and sand. The pebble content ranges from 0 to 60 percent.

Oshtemo series

The Oshtemo series (fig. 7) consists of well drained, moderately rapidly permeable soils on outwash plains and moraines. These soils formed in sandy material. Slope ranges from 0 to 35 percent.

Oshtemo soils are similar to Spinks soils and are adjacent to Bronson, Coloma, Kalamazoo, and Spinks soils. The moderately well drained Bronson soils are at slightly lower elevations than the Oshtemo soils. The somewhat excessively drained Coloma soils and the well drained Oshtemo, Kalamazoo, and Spinks soils are in similar landscape positions. Kalamazoo soils have more clay in the profile than Oshtemo soils and are less droughty. Coloma and Spinks soils are more sandy and more droughty than Oshtemo soils.

Typical pedon of Oshtemo sandy loam, 1 to 6 percent slopes, 2,150 feet north and 50 feet west of the southeast corner sec. 16, T. 1 S., R. 12 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam; light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common fine roots; neutral; clear smooth boundary.

A2—9 to 19 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse platy structure; friable; dark brown (10YR 3/3) Ap material in root channels and wormholes; about 2 percent pebbles; slightly acid; gradual wavy boundary.

B21t—19 to 29 inches; dark brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; clay bridging between sand grains; few fine roots; about 2 percent pebbles; slightly acid; gradual wavy boundary.

B31—29 to 42 inches; dark yellowish brown (10YR 4/6) loamy sand; massive; friable; few fine roots; about 2 percent pebbles; neutral; gradual wavy boundary.

B32—42 to 69 inches; yellowish dark brown (10YR 5/6) sand; single grained; loose; about 2 percent pebbles; slightly acid; dark brown (7.5YR 4/4) loamy sand bands; massive; very friable; neutral; gradual wavy boundary.

The solum is dominantly 50 to 70 inches thick but ranges from 45 to 75 inches. The pebble content in the pedon ranges from 0 to 30 percent. In some areas there are a few cobbles and stones.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3.

The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam and gravelly sandy loam. The B3 horizon has value of 4 to 6 and chroma of 3 to 6. It is loamy sand or sand with bands of sandy loam or loamy sand 1/2 to 3 inches thick.

Plainfield series

The Plainfield series consists of excessively drained, rapidly permeable soils on outwash plains and moraines. These soils formed in sandy material. Slope ranges from 0 to 6 percent.

Plainfield soils are similar to Coloma soils. They are adjacent to Coloma, Oshtemo, Granby, Thetford, and Spinks soils. The somewhat excessively drained Coloma soils and the well drained Oshtemo and Spinks soils are in landscape positions similar to those of Plainfield soils. They have more clay in the profile than Plainfield soils and are less droughty. The poorly drained Granby soils and the somewhat poorly drained Thetford soils are in shallow depressions.

Typical pedon of Plainfield loamy sand, 0 to 6 percent slopes, 325 feet south and 650 feet west of the northeast corner sec. 3, T. 2 S., R. 9 W.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) loamy sand; weak fine granular structure; very friable; common fine roots; about 1 percent pebbles; medium acid; clear smooth boundary.
B2—10 to 38 inches; dark yellowish brown (10YR 4/4) sand; single grained; loose; about 5 percent pebbles; slightly acid; gradual wavy boundary.
C—38 to 66 inches; yellowish brown (10YR 5/6) sand; single grained; loose; about 3 percent pebbles; strongly acid.

The A horizon has value of 3 or 4 and chroma of 2 to 4. It is dominantly loamy sand, but the range includes sand.

The B horizon has value of 4 to 6 and chroma of 4 to 8. The pebble content ranges from 0 to about 10 percent.

Riddles series

The Riddles series consists of well drained, moderately permeable soils on till plains. These soils formed in loamy till. Slope ranges from 2 to 12 percent.

Riddles soils are similar to Kalamazoo soils. They are adjacent to Kalamazoo and Sleeth soils. The somewhat poorly drained Sleeth soils are in lower landscape position than Riddles soils. The well drained Kalamazoo soils are in landscape positions similar to those of Riddles soils but are underlain by sand and gravel.

Typical pedon of Riddles loam, 2 to 6 percent slopes, 650 feet south and 50 feet west of the northeast corner sec. 22, T. 4 S., R. 9 W.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.
A2—11 to 15 inches; dark brown (10YR 4/3) sandy loam; moderate thick platy structure; friable; few fine roots; very dark grayish brown (10YR 3/2) Ap material in wormholes and root channels; about 1 percent pebbles; neutral; gradual wavy boundary.
B2t—15 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate coarse subangular blocky structure; friable; few fine roots; dark brown (7.5YR 4/4) clay films on most ped faces; 5 percent pebbles and cobbles; neutral; gradual wavy boundary.
B22t—25 to 50 inches; dark yellowish brown (10YR 4/6) sandy clay loam; weak coarse subangular blocky structure; friable; dark yellowish brown (10YR 3/6) clay films on some ped faces; about 2 percent pebbles; neutral; gradual wavy boundary.
C—50 to 80 inches; yellowish brown (10YR 5/4) sandy loam; massive; friable; mildly alkaline.

The solum is 45 to 70 inches thick. The content of pebbles and cobbles throughout the solum ranges from 0 to 10 percent.

The Ap horizon has value of 3 or 4. It is dominantly loam, but range includes sandy loam.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, and value and chroma of 4 to 6. It is clay loam, sandy clay loam, loam, or sandy loam. It is medium acid to neutral.

In some pedons the C horizon contains pockets of loamy sand.

Schoolcraft series

The Schoolcraft series consists of well drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils are on outwash plains. They formed in loamy material over sand and gravel. Slope ranges from 0 to 6 percent.

Schoolcraft soils are similar to Dowagiac and Kalamazoo soils. They are adjacent to Dowagiac, Kalamazoo, Oshtemo, and Sleeth soils. The well drained Dowagiac and Kalamazoo soils are in landscape positions similar to those of Schoolcraft soils. The surface layer is thinner in Dowagiac soils than in Schoolcraft soils and is lighter colored in Kalamazoo soils. The well drained Oshtemo soils occupy more sandy sloping areas than Schoolcraft soils. The somewhat poorly drained Sleeth soils are in depressions and along intermittent drainageways.

Typical pedon of Schoolcraft loam, 0 to 2 percent slopes, 1,200 feet east of the southwest corner sec. 11, T. 4 S., R. 12 W.

Ap—0 to 12 inches; very dark gray (10YR 3/1) loam; dark grayish brown (10YR 4/2) dry; weak medium granular structure; friable; many fine roots; neutral; abrupt smooth boundary.
B21t—12 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; common fine roots; thin clay films on surfaces of peds and in pores; slightly acid; gradual wavy boundary.
B22t—20 to 29 inches; dark brown (7.5YR 4/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; thin clay films in pores and on some vertical and horizontal surfaces of peds; slightly acid; gradual smooth boundary.
B23t—29 to 38 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine subangular blocky structure; friable; thin clay films on surface of peds and bridging of sand grains; slightly acid; gradual smooth boundary.
IIC1—38 to 49 inches; dark yellowish brown (10YR 4/6) sand; single grained; loose; about 5 percent pebbles; slightly acid; gradual smooth boundary.
IIC2—49 to 60 inches; yellowish brown (10YR 5/6) sand; single grained; loose; slightly acid.

Solum thickness ranges from 25 to 50 inches. The pebble content ranges from 0 to 10 percent.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loam 12 to 17 inches thick, but the range includes sandy loam.

The B horizon has value of 3 to 5 and chroma of 2 to 4. Texture includes clay loam, loam, sandy clay loam, and sandy loam.

The C horizon has value of 4 to 6 and chroma of 3 to 6. It is sand or gravelly sand or a mixture of the two.

Sebewa series

The Sebewa series consists of 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 and lake plains. They formed in loamy material over sand and gravel. Slope ranges from 0 to 2 percent.

Sebewa soils are adjacent to Adrian, Kalamazoo, and Sleeth soils. The very poorly drained Adrian soils are in depressions. The organic material is 16 to 50 inches deep over sand. The well drained Kalamazoo and the somewhat poorly drained Sleeth soils are in slightly higher landscape positions around the Sebewa soils.

Typical pedon of Sebewa loam, 950 feet north and 1,200 feet east of the center of sec. 8, T. 3 S., R. 10 W.

A1—0 to 11 inches; black (10YR 2/1) loam; very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; many fine and medium roots; neutral; clear smooth boundary.

B21tg—11 to 15 inches; very dark gray (10YR 3/1) clay loam; few fine distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; firm; many fine roots; very dark gray (7.5YR 3/0) clay films on most ped faces; black (10YR 2/1) organic stains; neutral; gradual wavy boundary.

B22tg—15 to 23 inches; gray (10YR 5/1) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; common fine roots and few medium roots; about 1 percent pebbles; neutral; gradual clear boundary.

IIC1g—23 to 25 inches; gray (5Y 5/1) loamy coarse sand; massive; friable; few medium roots; about 2 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

IIC2g—25 to 34 inches; gray (5Y 6/1) loamy sand; few fine prominent brownish yellow (10YR 6/6) mottles; weak coarse subangular blocky structure; very friable; few medium roots; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC3g—34 to 60 inches; grayish brown (2.5Y 5/2) loamy sand; few fine prominent brownish yellow (10YR 6/6) mottles; massive; very friable; about 2 percent pebbles; strong effervescence; moderately alkaline.

The depth to calcareous material ranges from 22 to 38 inches. The pebble content ranges from 0 to 10 percent.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loam 10 to 16 inches thick, but the range includes silt loam and sandy loam.

The B horizon has value of 5 to 7 and chroma of 0 to 2. It is sandy loam, sandy clay loam, or clay loam.

The IIC horizon has value of 5 or 6 and chroma of 1 or 2. It is sand, stratified sand and gravel, or loamy sand.

Sleeth series

The Sleeth series consists of somewhat poorly drained, moderately permeable soils on outwash plains. These soils formed in loamy material over sand and gravel. Slope is 0 to 2 percent.

Sleeth soils are similar to Sebewa soils and are adjacent to Kalamazoo and Sebewa soils. The well drained Kalamazoo soils are in higher landscape positions than Sleeth soils. The very poorly drained Sebewa soils are in lower landscape positions.

Typical pedon of Sleeth loam, 0 to 3 percent slopes, 2,300 feet north and 100 feet west of the center of sec. 22, T. 3 S., R. 10 W.

Ap—0 to 10 inches; dark yellowish brown (10YR 4/4) loam; few medium distinct light gray (10YR 7/1) and few fine faint yellowish brown (10YR 5/8) mottles; weak fine granular structure; friable; neutral; clear smooth boundary.

B1g—10 to 13 inches; light brownish gray (10YR 6/2) clay loam; many medium prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; firm; very dark gray (10YR 3/1) material in root channels; about 1 percent pebbles; neutral; gradual smooth boundary.

B21tg—13 to 29 inches; light brownish gray (10YR 6/2) sandy clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; clay films on the face of peds; about 1 percent pebbles; neutral; gradual wavy boundary.

B22tg—29 to 39 inches; mixed light brownish gray (10YR 6/2) and yellowish red (5YR 5/8) clay loam; moderate medium subangular blocky structure; firm; light yellowish brown (10YR 6/4) clay films on face of peds; neutral; gradual wavy boundary.

B3g—39 to 46 inches; grayish brown (2.5Y 5/2) sandy loam; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; about 10 percent pebbles; neutral; gradual wavy boundary.

IIC—46 to 66 inches; dark gray (10YR 4/1) gravelly sand; loose; about 20 percent pebbles; mildly alkaline.

The solum is 40 to 50 inches thick.

The Ap horizon has value of 4 to 6 and chroma of 1 to 4. It is dominantly loam, but the range includes sandy loam. Some pedons have an A2 horizon 1 to 3 inches thick.

The B horizon is sandy loam, sandy clay loam, loam, or clay loam. The pebble content is 0 to 20 percent. In most pedons the B2 horizon contains thin to medium clay films.

The C horizon has hue of 4 to 6 and value of 1 or 2. It is sand or sand and gravel.

Spinks series

The Spinks series consists of well drained, rapidly permeable soils on outwash plains and moraines. These soils formed in sandy sediments. Slope ranges from 0 to 35 percent.

Spinks soils are similar to Coloma soils, and are adjacent to Coloma, Oshtemo, and Plainfield soils. All of these soils occupy similar landscape positions. The somewhat excessively drained Coloma soils contain bands of loamy sand. Total thickness of the bands is less than 6 inches. Plainfield soils lack clay accumulations. The well drained Oshtemo soils have a continuous argillic horizon above 20 inches.

Typical pedon of Spinks loamy sand, 0 to 6 percent slopes, 1,125 feet north and 950 feet east of the southwest corner sec. 19, T. 3 S., R. 11 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) loamy sand; weak fine granular structure; very friable; common roots; about 1 percent pebbles; slightly acid; clear smooth boundary.

A21—10 to 16 inches; dark yellowish brown (10YR 4/4) loamy sand; weak coarse subangular blocky structure; friable; few roots; about 1 percent pebbles; slightly acid; gradual wavy boundary.

A22—16 to 28 inches; yellowish brown (10YR 5/6) loamy sand; weak coarse subangular blocky structure; very friable; few roots; about 3 percent pebbles; neutral; gradual wavy boundary.

A&B—28 to 86 inches; yellowish brown (10YR 5/6) sand (A2) single grained; loose; bands of dark yellowish brown (10YR 4/6) loamy sand (Bt); massive; very friable; about 1 percent pebbles; neutral; gradual wavy boundary.

The solum ranges from medium acid to neutral. The pebble content ranges from 0 to 10 percent throughout the pedon.

The A horizon has value of 3 to 5 and chroma of 3 or 4.

The B horizon has value and chroma of 4 to 6. The lamellae are loamy sand or sandy loam. They are 1/8 inch to 3 inches thick and have a cumulative thickness of more than 6 inches. They extend for many feet in some pedons.

Thetford series

The Thetford series consists of somewhat poorly drained, moderately rapidly permeable soils on outwash plains and in depressions. These soils formed in sandy sediments. Slope is 0 to 2 percent. The Thetford soils in Kalamazoo County are more acid throughout than is typical for the Thetford series, but this difference does not alter their use or management.

Thetford soils are similar to Brady soils and are adjacent to Brady, Coloma, Gilford, and Granby soils. The somewhat poorly drained Brady soils are in slightly higher landscape positions than Thetford soils. The somewhat excessively drained Coloma soils also are in higher landscape positions. The very poorly drained Gilford and the poorly drained Granby soils are in lower, wetter areas.

Typical pedon of Thetford loamy sand, 0 to 2 percent slopes, 50 feet north and 640 feet west of the center of sec. 6, T. 1 S., R. 12 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many roots; medium acid; clear smooth boundary.

A21—9 to 13 inches; yellowish brown (10YR 5/4) loamy sand; few medium distinct yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; very friable; common roots; strongly acid; gradual wavy boundary.

A22—13 to 21 inches; very pale brown (10YR 7/4) sand; few medium distinct yellowish brown (10YR 5/8) and common medium faint grayish brown (10YR 5/2) mottles; single grained; loose; strongly acid; clear wavy boundary.

A&B—21 to 55 inches; pale brown (10YR 6/3) sand (A2); few medium faint brownish yellow (10YR 6/8) and common medium faint grayish brown (10YR 5/2) mottles; loose; strong brown (7.5YR 5/8) loamy sand bands (Bt); bands are 1/4 to 1 1/2 inches thick; very friable; about 1 percent pebbles; strongly acid; gradual wavy boundary.

B2t—55 to 66 inches; yellowish brown (10YR 5/6) loamy sand; few fine faint dark yellowish brown (10YR 4/4) and few medium faint yellowish brown (10YR 5/4) mottles; massive; very friable; about 1 percent pebbles; very strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The pebble content ranges from 0 to 5 percent throughout the pedon.

The A horizon has value of 3 or 4 and chroma of 1 to 3. It is typically sand, but the range includes loamy sand.

The B horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 8.

The A&B horizon extends deeper than 66 inches in some pedons.

Formation of the soils

The paragraphs that follow describe the factors of soil formation, 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 the processes of soil formation have acted on the parent material.

Climate and plant and animal life are the active factors 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 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 the 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 soil 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 Kalamazoo 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 Kalamazoo County was deposited as glacial till, outwash 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 Kalamazoo County is calcareous. Its texture is sandy loam or loam. Riddles soils, for example, formed in glacial till. They typically are medium textured and have moderately well developed structure.

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 Kalamazoo soils, for example, formed in deposits of outwash material in Kalamazoo County.

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. The alluvium deposited along a swift stream is coarser textured than that along a slow, sluggish stream. An example of an alluvial soil is the Glendora soil.

Organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions in the outwash plains and the 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 Kalamazoo 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 nitrogren to the soil. The kind of organic material on and in 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 Kalamazoo County was mainly deciduous forest. Differences in natural soil drainage and minor changes in parent material affected the compositon of the forest species.

In general, the well drained upland soils, such as Kalamazoo and Oshtemo soils, were mainly covered with maple, oak, and hickory. The Plainfield soils were covered with scrub oak. The wet soils were covered mainly with soft maple, elm, and ash. Gilford and Sebewa 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 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 Kalamazoo County, presumably similar to that in which the soils formed, is cool and humid. The soils in Kalamazoo county differ from those formed in a dry, warm climate or in a moist, hot 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 Kalamazoo County result from the differences in climate.

Relief

Relief, or topography, has a marked influence on the soils of Kalamazoo County through its influence on natural drainage, erosion, plant cover, and soil temperature. Slopes range from 0 to 35 percent. Natural soil drainage ranges from excessively 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 most rapid 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. Kalamazoo soils are examples of well drained, well aerated soils. Sebewa 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 difference in length of time that the parent material has been in place is commonly reflected in the degree of development of the soil profile. Some soils develop rapidly. Others develop slowly.

The soils in Kalamazoo County range from young to mature. The glacial deposits from which many of the soils in Kalamazoo 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 Glendora soil, formed in alluvial material, is an example of a young soil. The Kalamazoo soil is an example of a mature soil. The effect of more time on leaching of lime from this soil is evident.

Processes of soil formation

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 Kalamazoo 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 Kalamazoo County more than one of these processes has 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 Kalamazoo County, the surface layer ranges from high to low in organic matter content. Sebewa soils, for example, are high in content of organic matter in the surface layer. Coloma soils are low.

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 50 inches, whereas Sebewa soils are leached to a depth of only 25 inches. Differences in the depth of leaching is a result of time as a soil-forming factor.

The reduction and transfer of iron, a process called gleying, is evident in the somewhat poorly drained, poorly drained, and very poorly drained soils. The gray color in the subsoil indicates the reduction and loss of iron. Sebewa soils are an example of gleying and the reduction processes.

In some soils the 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 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 ped surfaces. 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. Riddles soil is an example of a soil that has 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.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

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.

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.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse 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.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping 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 earthmoving equipment. The soil sloughs easily.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

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.

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.*

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

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.

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 capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

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.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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 land form of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

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 bases 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 of subsurface tunnels or pipelike cavities in the soil.

Pitting. Formation of pits as a result of the melting of ground ice after the removal of plant cover.

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.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

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

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.

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).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that 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.

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.

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, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

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 decompositon 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

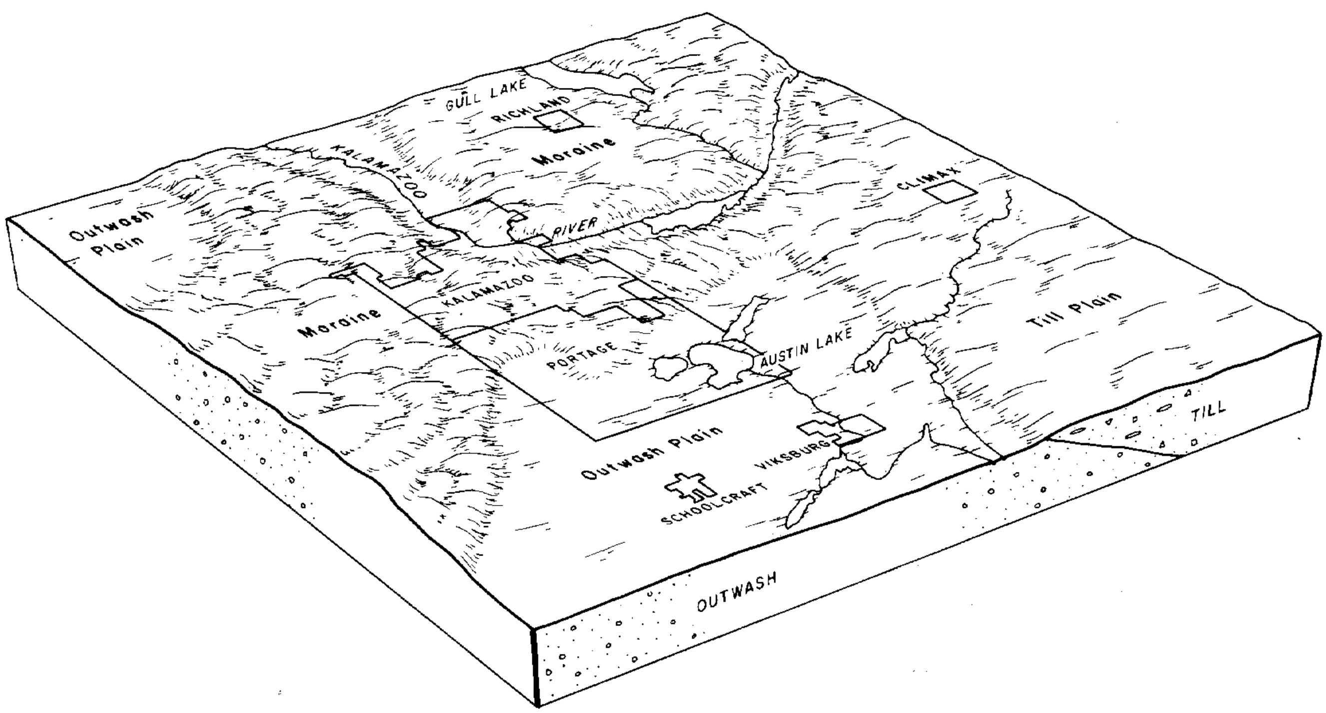

Figure 1.—Major glacial and drainage features of Kalamazoo County.

Figure 2.—Typical rolling topography of the till plains.

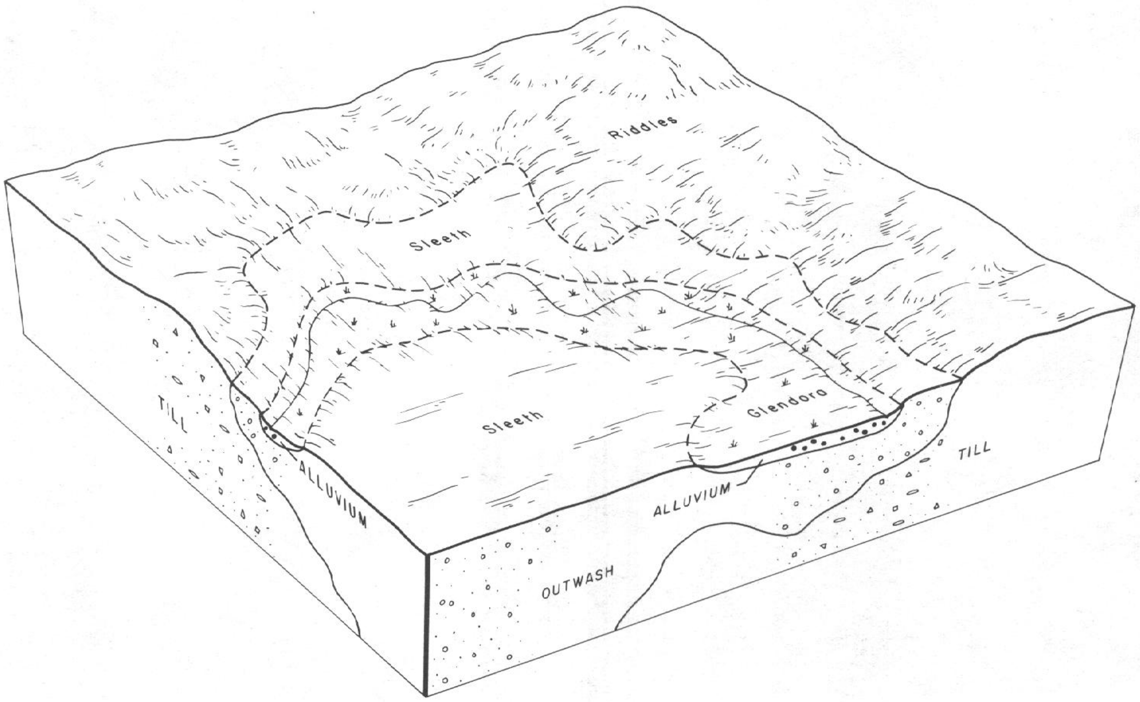

Figure 3.—Pattern of soils in Riddles-Sleeth map unit.

Figure 4.—Urban encroachment on farmland. The soil is Kalamazoo loam.

Figure 5.—Grassed waterway in Riddles loam.

Figure 6.—Area of Sebewa soils. Kalamazoo loam is in the foreground and the background.

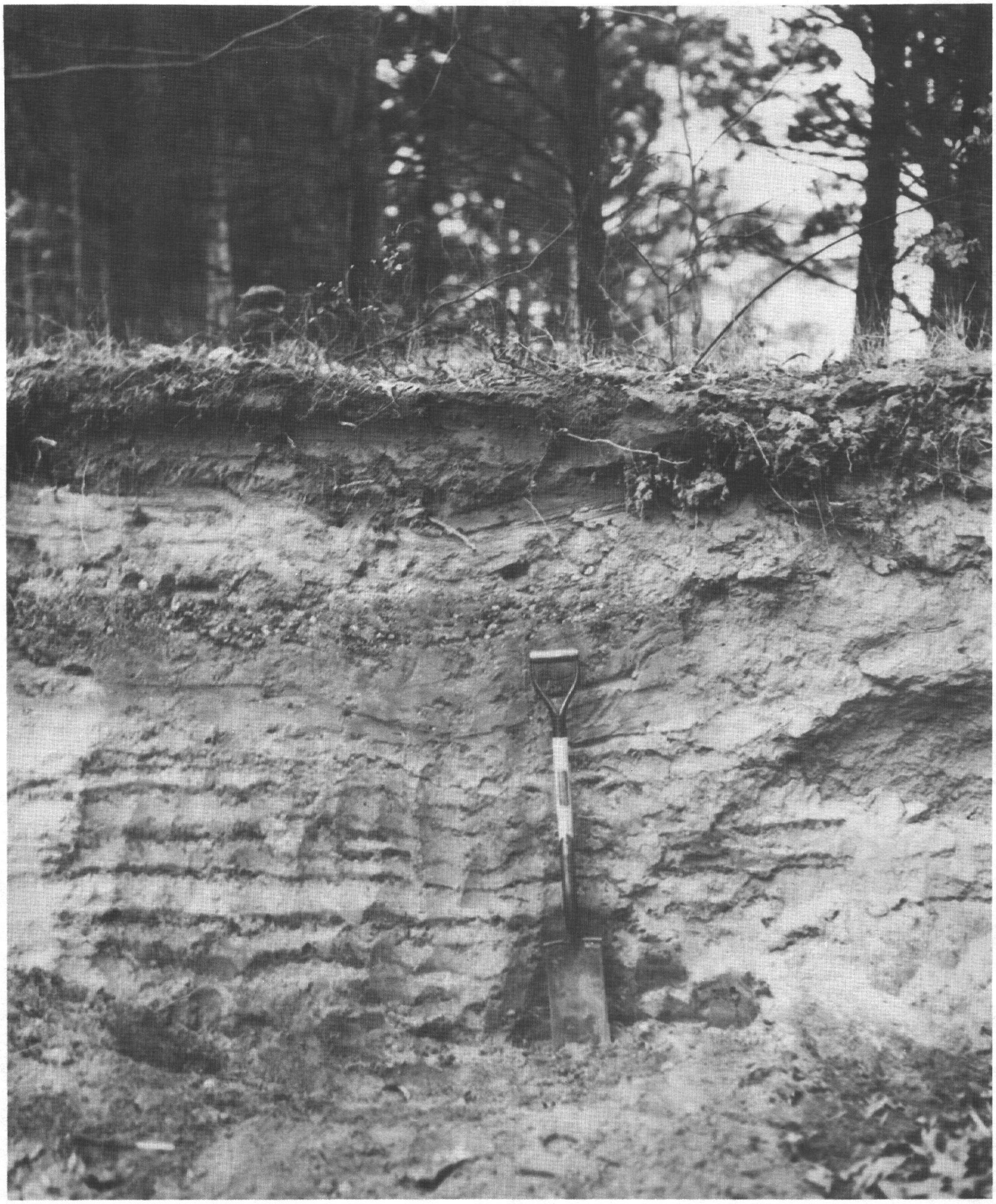

Figure 7.—Typical profile of Oshtemo sandy loam. The lower banding is evident in most pedons.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

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	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	32.2	17.4	24.8	56	-9	0	2.10	1.20	2.90	6	17.8
February---	35.3	19.0	27.1	57	-6	0	1.83	.95	2.61	5	14.3
March------	44.9	26.3	35.6	74	05	15	2.48	1.59	3.29	7	11.0
April------	60.1	37.5	48.8	82	18	111	3.77	2.41	5.00	8	2.9
May--------	71.8	47.4	59.6	89	29	324	3.36	2.09	4.51	7	T
June-------	81.3	57.5	69.4	95	40	589	3.49	2.10	4.73	7	0
July-------	84.8	61.2	73.0	96	47	721	3.56	2.14	4.83	6	0
August-----	83.8	59.8	71.8	96	43	684	2.80	1.29	4.10	5	0
September--	76.1	52.7	64.4	93	33	443	3.06	1.65	4.30	6	T
October----	65.2	43.1	54.2	85	24	195	2.74	1.19	4.06	5	.9
November---	47.8	32.4	40.1	72	8	27	2.67	1.77	3.50	7	9.3
December---	35.9	22.3	29.1	61	-1	0	2.53	1.30	3.60	7	15.2
Year-----	59.9	39.7	49.8	98	-10	3,009	34.40	29.71	38.92	76	71.4

[1]Recorded in the period 1947-76 at Kalamazoo, Michigan.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1930-74 at Kalamazoo, Michigan]

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Spring:			
1 year in 10 later than--	April 24	May 4	May 17
2 years in 10 later than--	April 19	April 29	May 12
5 years in 10 later than--	April 9	April 20	May 3
Fall:			
1 year in 10 earlier than--	October 24	October 12	September 24
2 years in 10 earlier than--	October 30	October 17	September 29
5 years in 10 earlier than--	November 10	October 27	October 10

TABLE 3.--GROWING SEASON LENGTH

[Recorded in the period 1930-74 at Kalamazoo]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	190	171	138
8 years in 10	198	177	145
5 years in 10	215	189	159
2 years in 10	231	201	173
1 year in 10	239	207	180

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Adrian muck	5,240	1.4
BdA	Brady sandy loam, 0 to 3 percent slopes	3,020	0.8
BrA	Bronson sandy loam, 0 to 3 percent slopes	875	0.2
CoB	Coloma loamy sand, 0 to 6 percent slopes	9,495	2.6
CoC	Coloma loamy sand, 6 to 12 percent slopes	7,910	2.2
CoD	Coloma loamy sand, 12 to 18 percent slopes	6,390	1.8
DoA	Dowagiac loam, 0 to 3 percent slopes	3,680	1.0
Ed	Edwards muck	1,255	0.3
Gd	Gilford sandy loam	4,610	1.3
Gn	Glendora sandy loam	5,435	1.5
Gy	Granby loamy sand	965	0.3
Hn	Houghton muck	15,520	4.3
Hs	Houghton and Sebewa soils, ponded	9,125	2.5
KaA	Kalamazoo loam, 0 to 2 percent slopes	19,850	5.5
KaB	Kalamazoo loam, 2 to 6 percent slopes	61,135	16.9
KaC	Kalamazoo loam, 6 to 12 percent slopes	17,455	4.8
OsB	Oshtemo sandy loam, 1 to 6 percent slopes	30,095	8.3
OsC	Oshtemo sandy loam, 6 to 12 percent slopes	14,715	4.1
OsD	Oshtemo sandy loam, 12 to 18 percent slopes	12,550	3.5
OsE	Oshtemo sandy loam, 18 to 35 percent slopes	11,675	3.2
Pb	Pits, gravel	1,070	0.3
PfB	Plainfield loamy sand, 0 to 6 percent slopes	1,170	0.3
RdB	Riddles loam, 2 to 6 percent slopes	18,280	5.0
RdC	Riddles loam, 6 to 12 percent slopes	2,270	0.6
SaA	Schoolcraft loam, 0 to 2 percent slopes	12,060	3.3
SaB	Schoolcraft loam, 2 to 6 percent slopes	6,450	1.8
Sb	Sebewa loam	9,640	2.7
SeA	Sleeth loam, 0 to 3 percent slopes	16,470	4.5
SpB	Spinks loamy sand, 0 to 6 percent slopes	10,155	2.8
SpC	Spinks loamy sand, 6 to 12 percent slopes	8,145	2.2
SpD	Spinks loamy sand, 12 to 18 percent slopes	2,875	0.8
StE	Spinks-Coloma loamy sands, 18 to 35 percent slopes	3,095	0.9
ThA	Thetford loamy sand, 0 to 2 percent slopes	1,795	0.5
Ua	Udipsamments, level to steep	420	0.1
Ub	Urban land	7,570	2.1
Ug	Urban land-Glendora complex	1,490	0.4
UkB	Urban land-Kalamazoo complex, 0 to 6 percent slopes	8,140	2.2
UkC	Urban land-Kalamazoo complex, 6 to 12 percent slopes	2,930	0.8
UoD	Urban land-Oshtemo complex, 12 to 25 percent slopes	3,505	1.0
	Water	4,355	1.2
	Total	362,880	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Corn silage	Winter wheat	Oats	Soybeans	Grass-legume hay	Grass hay
	Bu	Ton	Bu	Bu	Bu	Ton	Ton
Ad----- Adrian	75	10	---	---	23	---	2.4
BdA----- Brady	80	12	35	60	30	3.0	---
BrA----- Bronson	75	13	35	60	28	3.0	---
CoB----- Coloma	55	9	---	55	---	2.5	---
CoC----- Coloma	---	---	---	---	---	1.5	---
CoD----- Coloma	---	---	---	---	---	---	---
DoA----- Dowagiac	100	17	45	80	30	3.5	---
Ed----- Edwards	90	15	---	---	34	---	3.0
Gd----- Gilford	90	15	54	70	35	4.0	---
Gn----- Glendora	---	---	---	---	---	---	---
Gy----- Granby	75	10	25	55	30	---	---
Hn----- Houghton	100	18	---	---	34	3.0	2.8
Hs----- Houghton and Sebewa	---	---	---	---	---	---	---
KaA----- Kalamazoo	95	16	45	75	30	3.8	---
KaB----- Kalamazoo	90	15	45	75	30	3.6	---
KaC----- Kalamazoo	80	14	40	70	27	3.2	---
OsB----- Oshtemo	80	13	30	60	30	2.5	---
OsC----- Oshtemo	75	12	30	55	26	2.5	---
OsD----- Oshtemo	65	11	27	50	15	2.2	---
OsE----- Oshtemo	---	---	---	---	---	1.5	---
Pb*. Pits							

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Winter wheat	Oats	Soybeans	Grass-legume hay	Grass hay
	Bu	Ton	Bu	Bu	Bu	Ton	Ton
PfB----------------------- Plainfield	45	6	---	45	---	2.5	---
RdB----------------------- Riddles	105	17	46	---	40	3.8	---
RdC----------------------- Riddles	100	16	42	---	37	3.4	---
SaA----------------------- Schoolcraft	90	15	---	80	30	4.0	---
SaB----------------------- Schoolcraft	85	14	---	80	28	3.8	---
Sb------------------------ Sebewa	105	17	50	90	36	4.6	---
SeA----------------------- Sleeth	110	17	48	---	42	4.0	---
SpB----------------------- Spinks	65	9	30	60	20	3.0	---
SpC----------------------- Spinks	57	8	30	55	18	2.4	---
SpD----------------------- Spinks	---	---	24	50	---	1.8	---
StE----------------------- Spinks-Coloma	---	---	---	---	---	---	---
ThA----------------------- Thetford	80	12	35	60	30	3.0	---
Ua*. Udipsamments							
Ub*. Urban land							
Ug------------------------ Urban land-Glendora	---	---	---	---	---	---	---
UkB----------------------- Urban land-Kalamazoo	---	---	---	---	---	---	---
UkC----------------------- Urban land-Kalamazoo	---	---	---	---	---	---	---
UoD----------------------- Urban land-Oshtemo	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics 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)
		Acres	Acres	Acres
I	---	---	---	---
II	152,175	85,865	30,720	35,590
III	105,010	42,585	22,175	40,250
IV	32,585	15,425	6,495	10,665
V	---	---	---	---
VI	22,680	14,770	---	7,910
VII	11,825	---	5,435	6,390
VIII	9,125	---	9,125	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
Ad----------------- Adrian	3w	Slight	Severe	Severe	Severe	Red maple----------- Silver maple-------- White ash----------- Quaking aspen------- Tamarack------------ Green ash-----------	56 82 56 60 45 56	
BdA---------------- Brady	3o	Slight	Slight	Slight	Slight	Red maple----------- White ash----------- Quaking aspen------- Silver maple-------- Bitternut hickory--- Swamp white oak----- American basswood---	56 56 60 82 --- --- 56	White spruce, northern white-cedar, eastern white pine, Norway spruce, Austrian pine, American sycamore, red maple.
BrA---------------- Bronson	2o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------- Sugar maple--------- American beech------ American basswood--- Shagbark hickory---- Black walnut--------	66 66 61 --- --- --- ---	Eastern white pine, red pine, white spruce, jack pine, eastern cottonwood, black walnut, black cherry.
CoB, CoC----------- Coloma	2s	Slight	Slight	Severe	Slight	Northern pin oak---- Jack pine----------- Black oak----------- White oak----------- Red pine------------ Eastern white pine--	65 --- --- --- --- ---	Red pine, eastern white pine, jack pine.
CoD---------------- Coloma	2s	Moderate	Moderate	Severe	Slight	Northern pin oak---- Jack pine----------- Black oak----------- White oak----------- Red pine------------ Eastern white pine--	65 --- --- --- --- ---	Red pine, eastern white pine, jack pine.
DoA---------------- Dowagiac	2o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----------- White ash----------- Black walnut-------- Black cherry-------- Yellow-poplar------- Sugar maple--------- American basswood---	65 --- 61 --- --- --- 61 61	Black walnut, yellow-poplar, sugar maple, northern red oak, eastern white pine, red pine, white spruce.
Ed----------------- Edwards	3w	Slight	Severe	Severe	Severe	Red maple----------- White ash----------- Green ash----------- Black cherry-------- Swamp white oak----- Silver maple-------- Northern white-cedar Black ash-----------	56 56 56 --- --- 76 27 ---	
Gd----------------- Gilford	5w	Slight	Severe	Severe	Moderate	Silver maple-------- American basswood--- Pin oak------------- Red maple----------- White ash----------- Swamp white oak----- Bur oak-------------	60 --- --- --- --- --- ---	Eastern white pine, silver maple, Austrian pine, Norway spruce, white spruce, European larch, eastern cottonwood.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Gn----------------- Glendora	5w	Slight	Severe	Moderate	Severe	Red maple-----------	40	Eastern cottonwood,
						Swamp white oak-----	---	eastern white pine,
						Quaking aspen-------	45	white spruce.
						Black ash-----------	---	
						Silver maple--------	65	
						Pin oak-------------	---	
						Eastern cottonwood--	---	
Gy----------------- Granby	5w	Slight	Severe	Severe	Severe	Red maple-----------	40	Eastern white pine,
						Silver maple--------	65	Norway spruce,
						American basswood---	40	white spruce,
						Pin oak-------------	---	European larch.
						Quaking aspen-------	45	
						Eastern cottonwood--	75	
						White ash-----------	40	
Hn----------------- Houghton	3w	Slight	Severe	Severe	Severe	Red maple-----------	56	
						Silver maple--------	82	
						White ash-----------	56	
						Quaking aspen-------	60	
						Tamarack------------	45	
						Green ash-----------	---	
						Northern white-cedar	27	
						Swamp white oak-----	---	
Hs*:								
Houghton.								
Sebewa.								
KaA, KaB, KaC------ Kalamazoo	2o	Slight	Slight	Slight	Slight	Northern red oak----	65	Black walnut,
						White ash-----------	65	yellow-poplar,
						Black walnut--------	65	eastern white pine,
						Yellow-poplar-------	65	white spruce,
						White oak-----------	---	Norway spruce,
						Black cherry--------	---	red pine,
						American basswood---	65	Austrian pine,
						Sugar maple---------	61	white ash.
OsB, OsC, OsD------ Oshtemo	2o	Slight	Slight	Slight	Slight	Northern red oak----	66	Eastern white pine,
						White oak-----------	---	red pine,
						American basswood---	66	white spruce,
						Sugar maple---------	61	jack pine.
OsE---------------- Oshtemo	2r	Moderate	Moderate	Slight	Slight	Northern red oak----	66	Eastern white pine,
						White oak-----------	---	red pine,
						American basswood---	66	white spruce,
						Sugar maple---------	61	jack pine.
PfB---------------- Plainfield	2s	Slight	Slight	Severe	Slight	Red pine------------	60	Red pine,
						Eastern white pine--	---	eastern white pine,
						Jack pine-----------	---	jack pine.
						Northern pin oak----	---	
RdB---------------- Riddles	2o	Slight	Slight	Slight	Slight	Northern red oak----	65	Black walnut,
						Red maple-----------	65	eastern cottonwood,
						White ash-----------	65	red pine,
						Green ash-----------	65	white spruce.
						Black walnut--------	---	
						Yellow-poplar-------	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
SaA, SaB: Schoolcraft	2o	Slight	Slight	Slight	Slight	Northern red oak	65	Black walnut, yellow-poplar, whitebark pine, white spruce, Norway spruce, red pine, Austrian pine, white ash.
						White ash	65	
						Black walnut	65	
						Yellow-poplar	65	
						White oak	---	
						Black cherry	---	
						American basswood	65	
						Sugar maple	61	
Sb: Sebewa	2w	Slight	Severe	Moderate	Moderate	Red maple	66	White spruce, eastern white pine, northern white-cedar, Norway spruce, white ash, red maple.
						White ash	66	
						American basswood	---	
						Swamp white oak	---	
						Pin oak	66	
						Northern red oak	66	
SeA: Sleeth	3o	Slight	Slight	Slight	Slight	Pin oak	85	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Yellow-poplar	85	
						White oak	75	
SpB, SpC, SpD: Spinks	2s	Slight	Slight	Moderate	Slight	Northern red oak	66	Red pine, eastern white pine, jack pine, black cherry.
						White oak	66	
						Shagbark hickory	66	
						Black oak	66	
						Black cherry	66	
StE*:								
Spinks	2s	Moderate	Moderate	Moderate	Slight	Northern red oak	66	Red pine, eastern white pine, jack pine, black cherry.
						White oak	66	
						Shagbark hickory	66	
						Black oak	66	
						Black cherry	66	
Coloma	2s	Moderate	Moderate	Severe	Slight	Northern pin oak	65	Red pine, eastern white pine, jack pine.
						Jack pine	---	
						Black oak	---	
						White oak	---	
						Red pine	---	
						Eastern white pine	---	
ThA: Thetford	3s	Slight	Slight	Moderate	Slight	Red maple	56	White spruce, Norway spruce, eastern white pine.
						White ash	56	
						Quaking aspen	60	
						Eastern cottonwood	91	
						Sugar maple	53	
						Northern red oak	56	
						Swamp white oak	---	
						Bitternut hickory	---	
Ug*: Urban land.								
Glendora	5w	Slight	Severe	Moderate	Severe	Red maple	40	Eastern cottonwood, eastern white pine, white spruce.
						Swamp white oak	---	
						Quaking aspen	45	
						Black ash	---	
						Silver maple	65	
						Pin oak	---	
						Eastern cottonwood	---	
UkB*, UkC*: Urban land.								

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
UkB*, UkC*:								
Kalamazoo----------	2o	Slight	Slight	Slight	Slight	Northern red oak---- White ash----------- Black walnut-------- Yellow-poplar------- White oak----------- Black cherry-------- American basswood--- Sugar maple---------	65 65 65 65 --- --- 65 61	Black walnut, yellow-poplar, eastern white pine, white spruce, Norway spruce, red pine, Austrian pine, white ash.
UoD*:								
Urban land.								
Oshtemo-----------	2r	Moderate	Moderate	Slight	Slight	Northern red oak---- White oak----------- American basswood--- Sugar maple---------	66 --- 66 61	Eastern white pine, red pine, white spruce, jack pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ad: Adrian	---	Silky dogwood, white spruce.	Austrian pine	Northern white-cedar, Carolina poplar, Norway spruce, eastern white pine.	---
BdA: Brady	---	Silky dogwood, whitebelle honeysuckle, Tatarian honeysuckle.	White spruce, northern white-cedar, eastern white pine, blue spruce, European larch.	Norway spruce, red pine.	Carolina poplar, green ash.
BrA: Bronson	---	Amur privet, late lilac, Tatarian honeysuckle, autumn-olive.	White spruce	Eastern white pine, red pine.	Carolina poplar.
CoB, CoC, CoD: Coloma	Manyflower cotoneaster.	Lilac	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	---
DoA: Dowagiac	---	Late lilac, Amur privet, autumn-olive.	Northern white-cedar, red pine, white spruce.	Eastern white pine, Norway spruce.	---
Ed: Edwards	---	Amur privet, redosier dogwood, silky dogwood.	Austrian pine, nannyberry viburnum, eastern white pine.	Northern white-cedar, Norway spruce.	Carolina poplar, green ash.
Gd: Gilford	---	Austrian pine, white spruce, shadblow serviceberry, silky dogwood, hawthorn.	Eastern white pine, Norway spruce, green ash, northern white-cedar, black spruce.	---	Carolina poplar.
Gn: Glendora	---	Amur privet, silky dogwood, Siberian crabapple.	Northern white-cedar, black spruce, green ash.	---	Carolina poplar, eastern white pine.
Gy: Granby	---	Silky dogwood, Amur privet, white spruce, Austrian pine.	Eastern white pine, northern white-cedar, Norway spruce, tamarack.	---	---
Hn: Houghton	Vanhoutte spirea	Silky dogwood, Amur privet, white spruce, redosier dogwood.	Eastern white pine, tamarack, Austrian pine.	Northern white-cedar, Norway spruce.	Carolina poplar.
Hs*:					
Houghton.					
Sebewa.					

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
KaA, KaB, KaC------ Kalamazoo	---	Late lilac, Amur privet, Tatarian honeysuckle.	Red pine, white spruce.	Eastern white pine, Norway spruce.	Carolina poplar.
OsB, OsC, OsD, OsE--------------- Oshtemo	Vanhoutte spirea, silky dogwood.	Autumn-olive, Tatarian honeysuckle, white spruce.	---	Eastern white pine, red pine, jack pine, Scotch pine.	Carolina poplar.
Pb*. Pits					
PfB--------------- Plainfield	Manyflower cotoneaster.	Lilac-------------	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	---
RdB, RdC---------- Riddles	---	Autumn-olive------	Northern white-cedar, red pine, white spruce.	Norway spruce, Scotch pine.	---
SaA, SaB---------- Schoolcraft	---	Late lilac, Amur privet, Tatarian honeysuckle.	Red pine, white spruce.	Whitebark pine, Norway spruce.	Carolina poplar.
Sb---------------- Sebewa	---	White spruce, silky dogwood, Amur privet, Austrian pine.	Eastern white pine, northern white-cedar.	---	Carolina poplar.
SeA--------------- Sleeth	Cutleaf staghorn sumac.	Blackhaw, arrowwood, cornelian cherry dogwood, rose-of-sharon, Amur honeysuckle, American cranberrybush, autumn-olive.	White spruce------	American basswood, Norway spruce.	Eastern white pine.
SpB, SpC, SpD----- Spinks	Vanhoutte spirea	White spruce, Tatarian honeysuckle, Amur privet, autumn-olive.	Eastern redcedar	Eastern white pine, red pine.	---
StE*: Spinks-----------	Vanhoutte spirea	White spruce, Tatarian honeysuckle, Amur privet, autumn-olive.	Eastern redcedar	Eastern white pine, red pine.	---
Coloma-----------	Manyflower cotoneaster.	Lilac-------------	Norway spruce, Siberian peashrub.	Eastern white pine, red pine, jack pine.	---
ThA--------------- Thetford	---	Silky dogwood, Tatarian honeysuckle.	White spruce, eastern white pine, northern white-cedar, Austrian pine.	Norway spruce, red pine.	Carolina poplar.
Ua*. Udipsamments					

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
Ub*. Urban land					
Ug*: Urban land.					
Glendora	---	Amur privet, silky dogwood, Siberian crabapple.	Northern white-cedar, black spruce, green ash.	---	Carolina poplar, eastern white pine.
UkB*, UkC*: Urban land.					
Kalamazoo	---	Late lilac, Amur privet, Tatarian honeysuckle.	Red pine, white spruce.	Eastern white pine, Norway spruce.	Carolina poplar.
UoD*: Urban land.					
Oshtemo	Vanhoutte spirea, silky dogwood.	Autumn-olive, Tatarian honeysuckle, white spruce.	---	Eastern white pine, red pine, jack pine, Scotch pine.	Carolina poplar.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

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.
BdA---------------- Brady	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, wetness.	Moderate: wetness.
BrA---------------- Bronson	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
CoB---------------- Coloma	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: too sandy.
CoC---------------- Coloma	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: too sandy, slope.
CoD---------------- Coloma	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
DoA---------------- Dowagiac	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action, low strength.	Slight.
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.
Gd----------------- Gilford	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, floods.	Severe: wetness, floods.
Gn----------------- Glendora	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Gy----------------- Granby	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
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.
Hs*:						
Houghton---------	Severe: excess humus, wetness, floods.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: low strength, wetness, floods.	Severe: excess humus, wetness, floods.
Sebewa-----------	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
KaA---------------- Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: 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
KaB----------------- Kalamazoo	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: slope, shrink-swell.	Moderate: low strength.	Slight.
KaC----------------- Kalamazoo	Severe: cutbanks cave.	Moderate: slope, shrink-swell.	Moderate: slope.	Severe: slope.	Moderate: low strength.	Moderate: slope.
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.
OsD, OsE----------- Oshtemo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Pb*. Pits						
PfB----------------- Plainfield	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: too sandy.
RdB----------------- Riddles	Slight---------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Moderate: low strength.	Slight.
RdC----------------- Riddles	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Moderate: low strength.	Moderate: slope.
SaA----------------- Schoolcraft	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: low strength.	Slight.
SaB----------------- Schoolcraft	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight---------	Moderate: slope, shrink-swell.	Moderate: low strength.	Slight.
Sb------------------ Sebewa	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
SeA----------------- Sleeth	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
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.
SpD----------------- Spinks	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
StE*: Spinks------------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Coloma------------	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

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
ThA----------------- Thetford	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, too sandy.
Ua*. Udipsamments						
Ub*. Urban land						
Ug*: Urban land.						
Glendora----------	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
UkB*: Urban land.						
Kalamazoo---------	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight----------	Moderate: shrink-swell.	Moderate: low strength.	Slight.
UkC*: Urban land.						
Kalamazoo---------	Severe: cutbanks cave.	Moderate: slope, shrink-swell.	Moderate: slope.	Severe: slope.	Moderate: low strength.	Moderate: slope.
UoD*: Urban land.						
Oshtemo-----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

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.
BdA----------------- Brady	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
BrA----------------- Bronson	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness, seepage.	Severe: seepage, wetness.	Fair: wetness.
CoB----------------- Coloma	Slight------------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
CoC----------------- Coloma	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
CoD----------------- Coloma	Severe: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: slope, seepage.	Poor: slope.
DoA----------------- Dowagiac	Slight------------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage.
Ed------------------ Edwards	Severe: floods, wetness, percs slowly.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness, excess humus.
Gd------------------ Gilford	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness.
Gn------------------ Glendora	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: too sandy, wetness, seepage.
Gy------------------ Granby	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy, seepage.
Hn------------------ Houghton	Severe: wetness, floods, percs slowly.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
Hs*:					
Houghton-----------	Severe: floods, wetness.	Severe: floods, excess humus, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: wetness, hard to pack.
Sebewa-------------	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, small stones, seepage.

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
KaA, KaB: Kalamazoo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones, too clayey.
KaC: Kalamazoo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope, small stones, too clayey.
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.
OsD, OsE: Oshtemo	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage, slope.	Poor: slope.
Pb*. Pits					
PfB: Plainfield	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
RdB: Riddles	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
RdC: Riddles	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
SaA, SaB: Schoolcraft	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Sb: Sebewa	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness, small stones, seepage.
SeA: Sleeth	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
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.
SpD: Spinks	Severe: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage, slope.	Poor: too sandy, seepage, slope.
StE*: Spinks	Severe: slope.	Severe: seepage, slope.	Severe: too sandy, seepage, slope.	Severe: seepage, slope.	Poor: too sandy, seepage, 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
StE*:					
Coloma	Severe: slope.	Severe: slope, seepage.	Severe: slope, seepage.	Severe: slope, seepage.	Poor: slope.
ThA Thetford	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
Ua*. Udipsamments					
Ub*. Urban land					
Ug*: Urban land.					
Glendora	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: too sandy, wetness, seepage.
UkB*: Urban land.					
Kalamazoo	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones, too clayey.
UkC*: Urban land.					
Kalamazoo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope, small stones, too clayey.
UoD*: Urban land.					
Oshtemo	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage, slope.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the 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.
BdA: Brady	Poor: wetness.	Good	Good	Good.
BrA: Bronson	Fair: wetness.	Good	Good	Good.
CoB: Coloma	Good	Good	Unsuited: excess fines.	Fair: too sandy.
CoC: Coloma	Good	Good	Unsuited: excess fines.	Fair: slope, too sandy.
CoD: Coloma	Fair: slope.	Good	Unsuited: excess fines.	Poor: slope.
DoA: Dowagiac	Good	Good	Good	Good.
Ed: Edwards	Poor: low strength, wetness.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
Gd: Gilford	Poor: wetness.	Good	Unsuited: excess fines.	Poor: wetness.
Gn: Glendora	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
Gy: Granby	Poor: wetness.	Good	Unsuited: excess fines.	Poor: wetness.
Hn: Houghton	Poor: wetness, low strength.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
Hs*:				
Houghton	Poor: low strength, wetness.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: excess humus, wetness.
Sebewa	Poor: wetness.	Good	Good	Poor: wetness.
KaA, KaB: Kalamazoo	Good	Good	Good	Fair: thin layer, small stones.
KaC: Kalamazoo	Good	Good	Good	Fair: slope, thin layer, small stones.
OsB: Oshtemo	Good	Good	Good	Fair: small stones.
OsC: Oshtemo	Good	Good	Good	Fair: slope, small stones.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OsD, OsE------------- Oshtemo	Fair: slope.	Good	Good	Poor: slope.
Pb*. Pits				
PfB------------------ Plainfield	Good	Good	Unsuited: excess fines.	Fair: too sandy.
RdB------------------ Riddles	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
RdC------------------ Riddles	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
SaA, SaB------------- Schoolcraft	Good	Good	Unsuited: excess fines.	Fair: thin layer.
Sb------------------- Sebewa	Poor: wetness.	Good	Good	Poor: wetness.
SeA------------------ Sleeth	Poor: low strength, wetness.	Good	Good	Fair: thin layer.
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.
SpD------------------ Spinks	Fair: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope.
StE*:				
Spinks---------------	Poor: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope.
Coloma---------------	Poor: slope.	Good	Unsuited: excess fines.	Poor: slope.
ThA------------------ Thetford	Poor: wetness.	Good	Unsuited: excess fines.	Fair: too sandy.
Ua*. Udipsamments				
Ub*. Urban land				
Ug*: Urban land.				
Glendora-------------	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
UkB*: Urban land.				
Kalamazoo------------	Good	Good	Good	Fair: thin layer, small stones.
UkC*: Urban land.				

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
UkC*:				
Kalamazoo	Good	Good	Good	Fair: slope, thin layer, small stones.
UoD*:				
Urban land.				
Oshtemo	Fair: slope.	Good	Good	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the 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.
BdA---------------- Brady	Seepage--------	Seepage, wetness.	Frost action---	Wetness, fast intake, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.
BrA---------------- Bronson	Seepage--------	Seepage--------	Frost action---	Soil blowing, wetness.	Too sandy, soil blowing, wetness.	Favorable.
CoB---------------- Coloma	Seepage--------	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
CoC---------------- Coloma	Seepage, slope.	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty, slope.
CoD---------------- Coloma	Seepage, slope.	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing, slope.	Droughty, slope.
DoA---------------- Dowagiac	Seepage--------	Seepage--------	Not needed-----	Favorable------	Not needed-----	Favorable.
Ed----------------- Edwards	Seepage--------	Excess humus, wetness.	Frost action, floods, excess humus.	Floods, soil blowing, wetness.	Not needed-----	Wetness.
Gd----------------- Gilford	Seepage--------	Seepage, wetness.	Floods, frost action.	Wetness, soil blowing.	Not needed-----	Wetness.
Gn----------------- Glendora	Seepage--------	Seepage, piping, wetness.	Floods---------	Wetness, droughty, soil blowing.	Not needed-----	Wetness, droughty.
Gy----------------- Granby	Seepage--------	Seepage, wetness.	Floods---------	Wetness, droughty, fast intake.	Not needed-----	Wetness, droughty.
Hn----------------- Houghton	Seepage--------	Excess humus, wetness.	Frost action, excess humus, floods.	Soil blowing, wetness, floods.	Not needed-----	Wetness.
Hs*:						
Houghton----------	Seepage--------	Excess humus, wetness.	Floods, excess humus, frost action.	Wetness, floods.	Not needed-----	Wetness.
Sebewa------------	Seepage--------	Seepage, wetness.	Frost action, floods.	Wetness, floods.	Not needed-----	Wetness.
KaA, KaB---------- Kalamazoo	Seepage--------	Thin layer-----	Not needed-----	Favorable------	Too sandy------	Favorable.
KaC---------------- Kalamazoo	Slope, seepage.	Thin layer-----	Not needed-----	Slope----------	Too sandy------	Slope.
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.

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
OsD, OsE: Oshtemo	Slope, seepage.	Seepage	Not needed	Slope, soil blowing.	Slope, too sandy, soil blowing.	Slope.
Pb*. Pits						
PfB: Plainfield	Seepage	Seepage	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
RdB: Riddles	Seepage	Favorable	Not needed	Favorable	Favorable	Favorable.
RdC: Riddles	Slope, seepage.	Favorable	Not needed	Slope	Favorable	Slope.
SaA, SaB: Schoolcraft	Seepage	Seepage	Not needed	Favorable	Too sandy	Favorable.
Sb: Sebewa	Seepage	Seepage, wetness.	Frost action, floods.	Wetness, floods.	Not needed	Wetness.
SeA: Sleeth	Seepage	Wetness	Frost action	Wetness	Not needed	Wetness.
SpB: Spinks	Seepage	Seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
SpC: Spinks	Seepage, slope.	Seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Slope, droughty.
SpD: Spinks	Seepage, slope.	Seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
StE*: Spinks	Seepage, slope.	Seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Coloma	Seepage, slope.	Seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing, slope.	Droughty, slope.
ThA: Thetford	Seepage	Piping, seepage, wetness.	Favorable	Wetness, fast intake, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.
Ua*. Udipsamments						
Ub*. Urban land						
Ug*: Urban land.						
Glendora	Seepage	Seepage, piping, wetness.	Floods	Wetness, droughty, soil blowing.	Not needed	Wetness, droughty.
UkB*: Urban land.						
Kalamazoo	Seepage	Thin layer	Not needed	Favorable	Too sandy	Favorable.

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
UkC*:						
Urban land.						
Kalamazoo	Slope, seepage.	Thin layer	Not needed	Slope	Too sandy	Slope.
UoD*:						
Urban land.						
Oshtemo	Slope, seepage.	Seepage	Not needed	Slope, soil blowing.	Slope, too sandy, soil blowing.	Slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
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.
BdA: Brady	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
BrA: Bronson	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
CoB: Coloma	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
CoC: Coloma	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
CoD: Coloma	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
DoA: Dowagiac	Slight	Slight	Slight	Slight	Slight.
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.
Gd: Gilford	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
Gn: Glendora	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
Gy: Granby	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
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.
Hs*:					
Houghton	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.
Sebewa	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
KaA: Kalamazoo	Slight	Slight	Moderate: small stones.	Slight	Slight.
KaB: Kalamazoo	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.

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
KaC------------------- Kalamazoo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: slope.
OsB------------------- Oshtemo	Slight----------	Slight----------	Moderate: slope, small stones.	Slight------------	Slight.
OsC------------------- Oshtemo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: slope.
OsD, OsE-------------- Oshtemo	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Pb*. Pits					
PfB------------------- Plainfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
RdB------------------- Riddles	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
RdC------------------- Riddles	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: slope.
SaA------------------- Schoolcraft	Slight----------	Slight----------	Slight----------	Slight------------	Slight.
SaB------------------- Schoolcraft	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
Sb-------------------- Sebewa	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
SeA------------------- Sleeth	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
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.
SpD------------------- Spinks	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.
StE*:					
Spinks---------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Coloma---------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ThA------------------- Thetford	Severe: wetness.	Moderate: too sandy, wetness.	Severe: wetness.	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.
Ua*. Udipsamments					
Ub*. Urban land					

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
Ug*:					
Urban land.					
Glendora	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
UkB*:					
Urban land.					
Kalamazoo	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
UkC*:					
Urban land.					
Kalamazoo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
UoD*:					
Urban land.					
Oshtemo	Severe: slope.	Severe: slope.	Severe: slope.	Slight	Severe: slope.

* See description of the map unit for composition and behavior characteristics 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 that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
Ad: Adrian	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
BdA: Brady	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
BrA: Bronson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Very poor.
CoB: Coloma	Fair	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
CoC, CoD: Coloma	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
DoA: Dowagiac	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Ed: Edwards	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gd: Gilford	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Gn: Glendora	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Gy: Granby	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Hn: Houghton	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Hs*:										
Houghton	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Sebewa	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
KaA, KaB: Kalamazoo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
KaC: Kalamazoo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
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.
OsD, OsE: Oshtemo	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Pb*. Pits										
PfB: Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
RdB: Riddles	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
RdC----------------- Riddles	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
SaA, SaB----------- Schoolcraft	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Sb----------------- Sebewa	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
SeA---------------- Sleeth	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
SpB---------------- Spinks	Poor	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
SpC, SpD----------- Spinks	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
StE*:										
Spinks------------	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Coloma------------	Very poor.	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
ThA---------------- Thetford	Poor	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
Ua*. Udipsamments										
Ub*. Urban land										
Ug*: Urban land.										
Glendora----------	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
UkB*: Urban land.										
Kalamazoo---------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
UkC*: Urban land.										
Kalamazoo---------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
UoD*: Urban land.										
Oshtemo-----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ad----------------- Adrian	0-31	Sapric material	Pt	A-8	---	---	---	---	---	---	---
	31-60	Sand, loamy sand, fine sand.	SP, SM	A-2, A-3, A-1	0	80-100	60-100	35-75	0-30	---	NP
BdA---------------- Brady	0-12	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	95-100	75-100	60-70	25-40	<25	NP-7
	12-24	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
	24-56	Loamy sand, sandy loam.	SM	A-2	0-5	95-100	75-95	55-70	15-35	---	NP
	56-68	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
BrA---------------- Bronson	0-17	Sandy loam, loamy sand.	SM, SM-SC	A-2, A-4	0-5	95-100	90-100	65-75	20-40	<25	NP-5
	17-33	Sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	95-100	60-95	60-85	25-45	<30	NP-15
	33-48	Loamy sand, gravelly loamy sand.	SM, SP-SM	A-2	0-5	85-95	60-95	55-70	10-15	---	NP
	48-66	Sand and gravel	SP, GP, SP-SM, GP-GM	A-1, A-2, A-3	0-10	40-90	35-85	20-60	0-10	---	NP
CoB, CoC, CoD------ Coloma	0-10	Loamy sand-----	SM	A-2	0-5	85-100	85-100	50-75	15-30	---	NP
	10-66	Sand, fine sand, loamy sand.	SP, SM, SP-SM	A-2, A-3	0-5	80-100	80-100	50-85	2-25	---	NP
DoA---------------- Dowagiac	0-16	Loam------------	ML, CL-ML	A-4	0	95-100	95-100	80-100	60-90	20-35	2-9
	16-29	Clay loam-------	CL, SC	A-6, A-4	0	95-100	70-95	70-90	45-75	25-38	9-18
	29-38	Sandy loam, coarse sandy loam, gravelly coarse sandy loam.	SM, SM-SC	A-2-4, A-1-B	0	80-100	60-85	40-60	15-30	12-23	2-7
	38-60	Sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	50-80	25-75	10-55	0-10	---	NP
Ed----------------- Edwards	0-26	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	26-60	Marl------------	---	---	0	100	95-100	80-90	60-80	---	---
Gd----------------- Gilford	0-17	Sandy loam------	SC, SM-SC	A-4, A-2-4	0	95-100	90-100	60-70	30-40	20-30	4-10
	17-31	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
	31-60	Loamy sand, sand	SM, SP, SP-SM	A-3, A-1-B, A-2-4	0	90-100	85-100	18-60	3-20	---	NP
Gn----------------- Glendora	0-10	Sandy loam------	SP-SM, SM	A-3, A-2, A-4, A-1	0-5	95-100	90-100	45-95	5-40	<20	NP-4
	10-60	Stratified sand to loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-B	0-5	95-100	90-100	45-85	0-35	---	NP
Gy----------------- Granby	0-13	Loamy sand------	SM	A-2	0	100	100	50-75	15-30	---	NP
	13-36	Sand, fine sand, loamy sand.	SP, SP-SM, SM	A-3, A-2	0	100	95-100	50-75	0-20	---	NP
	36-60	Sand, fine sand	SP	A-3	0	100	95-100	50-70	0-5	---	NP

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	
Hn------------------ Houghton	0-66	Sapric material	Pt	A-8	0	---	---	---	---	---	---
Hs*:											
Houghton------------	0-60	Sapric material	Pt	A-8	0	---	---	---	---	---	---
Sebewa--------------	0-11	Loam------------	CL, CL-ML	A-4, A-6	0	95-100	80-100	75-95	50-90	22-35	6-12
	11-23	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
	23-60	Sand and gravel	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	---	NP
KaA, KaB, KaC------ Kalamazoo	0-16	Loam------------	ML, CL-ML, CL	A-4	0-5	95-100	80-100	80-90	55-70	<25	NP-10
	16-38	Clay loam, sandy loam, gravelly sandy loam.	SC, CL	A-4, A-6	0-5	95-100	70-95	65-95	35-80	20-38	9-20
	38-55	Loamy coarse sand, loamy sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-1-B	0-5	95-100	60-95	40-60	10-25	---	NP
	55-60	Sand, gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	60-80	25-75	10-55	0-10	---	NP
OsB, OsC, OsD, OsE- Oshtemo	0-19	Sandy loam------	SM, SM-SC	A-2, A-4	0	95-100	60-95	60-70	25-40	15-25	2-7
	19-29	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
	29-42	Loamy sand------	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	42-69	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
Pb*. Pits											
PfB----------------- Plainfield	0-10	Loamy sand------	SM	A-2, A-4	0	100	100	55-95	15-40	---	NP
	10-60	Sand------------	SP	A-3, A-1, A-2	0	75-100	75-100	45-70	1-4	---	NP
RdB, RdC------------ Riddles	0-15	Loam, sandy loam	CL	A-4, A-6	0	95-100	85-95	80-90	60-75	20-35	8-15
	15-25	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	90-100	80-95	75-90	35-75	25-40	10-20
	25-50	Clay loam, sandy clay loam.	CL	A-6, A-7	0	90-100	80-95	75-95	65-75	35-50	15-30
	50-80	Sandy loam------	SM, SC	A-4, A-6, A-2	0-3	85-95	80-90	50-90	30-50	15-30	2-15
SaA, SaB------------ Schoolcraft	0-12	Loam------------	ML, CL-ML	A-4	0	95-100	90-100	80-90	60-70	20-35	2-9
	12-29	Clay loam, loam, sandy clay loam.	CL, SC	A-4, A-6	0	85-100	70-100	70-95	35-75	25-38	9-18
	29-38	Sandy loam------	SM, SM-SC	A-1, A-2	0	80-100	70-95	35-60	15-30	12-23	NP-7
	38-60	Sand, gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0	75-100	70-95	35-65	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		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Sb---------------- Sebewa	0-11	Loam------------	CL, CL-ML	A-4, A-6	0	95-100	80-100	75-95	50-90	22-35	6-12
	11-23	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
	23-60	Sand and gravel	SP, SP-SM, GP, GP-GM	A-1	0-5	40-75	35-70	20-40	0-10	---	NP
SeA---------------- Sleeth	0-10	Loam------------	CL, ML, CL-ML	A-4, A-6	0	100	90-100	75-95	50-85	20-35	3-15
	10-39	Clay loam, silty clay loam, sandy clay loam.	CL	A-6	0	85-95	85-95	80-90	65-75	30-40	15-25
	39-46	Gravelly clay loam, sandy loam, gravelly loam.	CL	A-6	0-3	65-95	60-85	55-70	50-70	30-40	15-25
	46-66	Stratified sand to gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	---	NP
SpB, SpC, SpD------ Spinks	0-10	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	10-28	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-25	---	NP
	28-86	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
StE*:											
Spinks------------	0-10	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-30	---	NP
	10-28	Loamy sand------	SM	A-2-4	0	100	80-100	50-90	15-25	---	NP
	28-86	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2-4	0	100	80-100	60-90	10-30	---	NP
Coloma------------	0-42	Loamy sand------	SM	A-2	0-5	85-100	85-100	50-75	15-30	---	NP
	42-66	Sand, fine sand	SP, SM, SP-SM	A-2, A-3	0-5	80-100	80-100	50-85	2-25	---	NP
ThA---------------- Thetford	0-13	Loamy sand------	SM	A-2, A-4	0	95-100	90-100	70-85	20-45	<20	NP-4
	13-55	Loamy sand, sand.	SM	A-2, A-4	0	95-100	90-100	60-80	20-40	<20	NP-4
	55-66	Very fine sand, fine sand, loamy sand.	SM, SP, SP-SM	A-2, A-4, A-3	0	95-100	70-100	50-85	0-45	<20	NP-4
Ua*. Udipsamments											
Ub*. Urban land											
Ug*: Urban land.											
Glendora----------	0-10	Sandy loam------	SP-SM, SM	A-3, A-2, A-4, A-1	0-5	95-100	90-100	45-95	5-40	<20	NP-4
	10-60	Stratified sand to loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-B	0-5	95-100	90-100	45-85	0-35	---	NP
UkB*, UkC*: Urban land.											

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	
UkB*, UkC*: Kalamazoo----------	0-16	Loam-------------	ML, CL-ML, CL	A-4	0-5	95-100	80-100	80-90	55-70	<25	NP-10
	16-38	Clay loam, sandy loam, gravelly sandy loam.	SC, CL	A-4, A-6	0-5	95-100	70-95	65-95	35-80	20-38	9-20
	38-55	Loamy coarse sand, loamy sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-1-B	0-5	95-100	60-95	40-60	10-25	---	NP
	55-60	Sand, gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-5	60-80	25-75	10-55	0-10	---	NP
UoD*: Urban land.											
Oshtemo------------	0-19	Sandy loam-------	SM, SM-SC	A-2, A-4	0	95-100	60-95	60-70	25-40	15-25	2-7
	19-29	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
	29-42	Loamy sand-------	SM, SP-SM	A-2	0	85-95	60-95	55-70	10-15	---	NP
	42-69	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

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <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/cm^3	In/hr	In/in	pH					Pct
Ad--------------	0-31	---	0.30-0.55	0.2-6.0	0.35-0.45	5.1-7.8	-------------	---	---	3	55-75
Adrian	31-60	---	1.40-1.75	6.0-20	0.03-0.08	6.1-8.4	Low----------	---			
BdA-------------	0-12	2-15	1.25-1.41	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.20	5	3	1-4
Brady	12-24	5-22	1.35-1.45	2.0-6.0	0.12-0.17	5.1-6.5	Low----------	0.20			
	24-56	5-20	1.25-1.50	2.0-20	0.08-0.10	5.1-6.5	Low----------	0.20			
	56-68	0-10	1.25-1.50	>20	0.02-0.04	6.6-8.4	Low----------	0.10			
BrA-------------	0-17	2-15	1.14-1.60	2.0-6.0	0.13-0.15	5.1-7.3	Low----------	0.24	4	3	1-3
Bronson	17-33	10-20	1.26-1.59	2.0-6.0	0.12-0.18	5.1-6.0	Low----------	0.24			
	33-48	0-10	1.26-1.59	6.0-20	0.06-0.08	5.1-7.3	Low----------	0.17			
	48-66	0-5	1.20-1.47	>20.0	0.02-0.04	7.4-8.4	Low----------	0.10			
CoB, CoC, CoD----	0-10	5-12	1.35-1.65	6.0-20	0.09-0.12	5.1-6.0	Low----------	0.15	5	2	<1
Coloma	10-66	1-4	1.50-1.65	6.0-20	0.03-0.06	5.1-6.5	Low----------	0.15			
DoA-------------	0-16	7-25	1.10-1.64	0.6-2.0	0.16-0.18	5.6-6.5	Low----------	0.28	4	5	1-3
Dowagiac	16-29	27-35	1.22-1.87	0.6-2.0	0.13-0.14	5.1-6.5	Moderate-----	0.28			
	29-38	5-20	1.22-1.87	2.0-6.0	0.14-0.15	5.1-6.5	Low----------	0.28			
	38-60	0-10	1.48-1.67	6.0-20	0.01-0.04	5.6-7.3	Low----------	0.15			
Ed--------------	0-26	---	0.30-0.55	0.2-6.0	0.35-0.45	5.6-7.8	-------------	---	---	3	55-75
Edwards	26-60	---	---	---	---	7.4-8.4	-------------	---			
Gd--------------	0-17	10-20	1.50-1.70	2.0-6.0	0.13-0.15	6.1-7.3	Low----------	0.20	5	3	2-4
Gilford	17-31	8-17	1.60-1.80	2.0-6.0	0.12-0.14	6.1-7.3	Low----------	0.20			
	31-60	3-12	1.70-1.90	6.0-20	0.05-0.08	6.6-8.4	Low----------	0.15			
Gn--------------	0-10	0-15	1.35-1.50	2.0-20	0.07-0.15	6.1-7.8	Low----------	0.17	5	2	---
Glendora	10-60	0-10	1.40-1.65	6.0-20	0.05-0.11	6.1-8.4	Low----------	0.17			
Gy--------------	0-13	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	13-36	0-14	1.45-1.74	6.0-20	0.05-0.12	5.6-7.8	Low----------	0.17			
	36-60	0-10	1.45-1.74	6.0-20	0.05-0.09	6.6-8.4	Low----------	0.17			
Hn--------------	0-66	---	0.15-0.45	0.2-6.0	0.35-0.45	5.6-7.8	-------------	---	---	3	>70
Houghton											
Hs*:											
Houghton--------	0-60	---	0.08-0.30	0.2-6.0	0.35-0.45	6.6-7.8	-------------	---	---	---	---
Sebewa----------	0-11	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
	11-23	18-35	1.48-1.80	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.24			
	23-60	0-3	1.56-1.74	6.0-20	0.02-0.04	7.4-8.4	Low----------	0.10			
KaA, KaB, KaC----	0-16	8-25	1.10-1.64	0.6-2.0	0.16-0.22	5.1-7.3	Low----------	0.32	4	5	1-3
Kalamazoo	16-38	18-35	1.22-1.87	0.6-2.0	0.10-0.18	5.1-7.3	Moderate-----	0.32			
	38-55	2-15	1.48-1.67	6.0-20	0.02-0.08	5.1-7.8	Low----------	0.10			
	55-60	0-10	1.48-1.67	6.0-20	0.01-0.03	7.4-8.4	Low----------	0.10			
OsB, OsC, OsD,											
OsE-------------	0-19	2-10	1.14-1.60	2.0-6.0	0.10-0.15	5.1-6.5	Low----------	0.24	5	3	.5-3
Oshtemo	19-29	10-22	1.20-1.59	2.0-6.0	0.12-0.19	5.1-6.5	Low----------	0.24			
	29-42	5-15	1.20-1.59	6.0-20	0.06-0.08	5.1-7.3	Low----------	0.17			
	42-69	0-15	1.20-1.47	>20	0.02-0.04	7.4-8.4	Low----------	0.10			
Pb*.											
Pits											
PfB-------------	0-10	5-15	1.35-1.65	2.0-6.0	0.10-0.12	4.5-7.3	Low----------	0.17	5	2	<1
Plainfield	10-60	1-4	1.50-1.65	6.0-20	0.05-0.07	4.5-6.0	Low----------	0.17			

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/cm^3	In/hr	In/in	pH					Pct
RdB, RdC----------	0-15	---	---	0.6-2.0	0.20-0.24	6.1-7.3	Low-----------	0.32	5	5	---
Riddles	15-25	---	---	0.6-2.0	0.16-0.18	5.1-7.3	Moderate-----	0.32			
	25-50	---	---	0.6-2.0	0.15-0.19	5.1-7.3	Moderate-----	0.32			
	50-80	---	---	0.6-2.0	0.05-0.19	6.6-8.4	Low-----------	0.32			
SaA, SaB----------	0-12	12-20	1.31-1.78	0.6-2.0	0.18-0.24	5.6-7.3	Low-----------	0.28	4	5	1-3
Schoolcraft	12-29	18-35	1.31-1.86	0.6-2.0	0.12-0.19	4.5-5.5	Moderate-----	0.28			
	29-38	12-20	1.33-1.86	0.6-2.0	0.10-0.14	4.5-5.5	Low-----------	0.20			
	38-60	0-10	1.20-1.47	6.0-20	0.02-0.04	5.6-8.4	Low-----------	0.10			
Sb----------------	0-11	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
Sebewa	11-23	18-35	1.48-1.80	0.6-2.0	0.15-0.19	6.1-7.8	Low-----------	0.24			
	23-60	0-3	1.56-1.74	6.0-20	0.02-0.04	7.4-8.4	Low-----------	0.10			
SeA---------------	0-10	---	---	0.6-2.0	0.20-0.24	6.6-7.3	Low-----------	0.32	5	5	---
Sleeth	10-39	---	---	0.6-2.0	0.15-0.19	5.6-6.5	Moderate-----	0.32			
	39-46	---	---	0.6-2.0	0.14-0.16	6.6-8.4	Moderate-----	0.32			
	46-66	---	---	>20	0.02-0.04	7.9-8.4	Low-----------	0.10			
SpB, SpC, SpD-----	0-10	2-15	1.14-1.60	6.0-20	0.08-0.10	5.1-7.3	Low-----------	0.17	5	2	2-4
Spinks	10-28	3-15	1.26-1.59	6.0-20	0.08-0.10	5.6-7.3	Low-----------	0.17			
	28-86	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low-----------	0.17			
StE*:											
Spinks-----------	0-10	2-15	1.14-1.60	6.0-20	0.08-0.10	5.1-7.3	Low-----------	0.17	5	2	2-4
	10-28	3-15	1.26-1.59	6.0-20	0.08-0.10	5.6-7.3	Low-----------	0.17			
	28-86	0-15	1.20-1.47	2.0-20	0.04-0.08	5.6-7.8	Low-----------	0.17			
Coloma-----------	0-42	5-12	1.35-1.65	6.0-20	0.09-0.12	5.1-6.0	Low-----------	0.15	5	2	<1
	42-66	1-4	1.50-1.65	6.0-20	0.03-0.06	5.1-6.5	Low-----------	0.15			
ThA---------------	0-13	2-15	1.25-1.41	2.0-6.0	0.10-0.13	5.1-6.0	Low-----------	0.17	5	2	1-4
Thetford	13-55	8-18	1.35-1.45	2.0-6.0	0.08-0.13	5.1-6.0	Low-----------	0.17			
	55-66	0-10	1.25-1.50	6.0-20	0.05-0.08	4.5-5.5	Low-----------	0.17			
Ua*. Udipsamments											
Ub*. Urban land											
Ug*: Urban land.											
Glendora---------	0-10	0-15	1.35-1.50	2.0-20	0.07-0.15	6.1-7.8	Low-----------	0.17	5	2	---
	10-60	0-10	1.40-1.65	6.0-20	0.05-0.11	6.1-8.4	Low-----------	0.17			
UkB*, UkC*: Urban land.											
Kalamazoo--------	0-11	8-25	1.10-1.64	0.6-2.0	0.16-0.22	5.1-7.3	Low-----------	0.32	4	5	1-3
	11-38	18-35	1.22-1.87	0.6-2.0	0.10-0.18	5.1-7.3	Moderate-----	0.32			
	38-55	2-15	1.48-1.67	6.0-20	0.02-0.08	5.1-7.8	Low-----------	0.10			
	55-60	0-10	1.48-1.67	6.0-20	0.01-0.03	7.4-8.4	Low-----------	0.10			
UoD*: Urban land.											
Oshtemo----------	0-19	2-10	1.14-1.60	2.0-6.0	0.10-0.15	5.1-6.5	Low-----------	0.24	5	3	.5-3
	19-29	10-22	1.20-1.59	2.0-6.0	0.12-0.19	5.1-6.5	Low-----------	0.24			
	29-42	5-15	1.20-1.59	6.0-20	0.06-0.08	5.1-7.3	Low-----------	0.17			
	42-69	0-15	1.20-1.47	>20	0.02-0.04	7.4-8.4	Low-----------	0.10			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

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.
BdA---------------- Brady	B	None--------	---	---	1.0-3.0	Apparent	Nov-May	---	High-----	Low------	Moderate.
BrA---------------- Bronson	B	None--------	---	---	2.0-3.5	Apparent	Nov-May	---	High-----	Low------	High.
CoB, CoC, CoD------ Coloma	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
DoA---------------- Dowagiac	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
Ed----------------- Edwards	B/D	Frequent----	Long------	Sep-May	0-0.5	Apparent	Sep-Jun	25-30	High-----	High-----	Low.
Gd----------------- Gilford	B/D	Frequent----	Brief-----	Dec-May	0-1.0	Apparent	Dec-May	---	High-----	High-----	Moderate.
Gn----------------- Glendora	A/D	Frequent----	Long------	Jan-Dec	0-1.0	Apparent	Nov-Jun	---	Moderate	High-----	Moderate.
Gy----------------- Granby	A/D	Frequent----	Brief-----	Mar-Apr	0-1.0	Apparent	Nov-Jun	---	Moderate	High-----	Low.
Hn----------------- Houghton	A/D	Frequent----	Long------	Nov-May	0-1.0	Apparent	Sep-Jun	55-60	High-----	High-----	Low.
Hs*:											
Houghton**--------	D	Frequent----	Very long	Sep-Jun	+2-0.5	Apparent	Sep-Jun	40-60	High-----	High-----	Low.
Sebewa------------	B/D	Frequent----	Brief-----	Mar-May	0-1.0	Apparent	Sep-May	---	High-----	High-----	Low.
KaA, KaB, KaC------ Kalamazoo	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Low.
OsB, OsC, OsD, OsE--------------- Oshtemo	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
Pb*. Pits											
PfB---------------- Plainfield	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.
RdB, RdC----------- Riddles	B	None--------	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.

See footnotes 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			
SaA, SaB---------- Schoolcraft	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Moderate.
Sb--------------- Sebewa	B/D	Frequent----	Brief-----	Mar-May	0-1.0	Apparent	Sep-May	---	High-----	High-----	Low.
SeA--------------- Sleeth	C	None--------	---	---	1.0-3.0	Apparent	Jan-Apr	---	High-----	High-----	Low.
SpB, SpC, SpD----- Spinks	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
StE*:											
Spinks-----------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Low.
Coloma-----------	A	None--------	---	---	>6.0	---	---	---	Low------	Low------	Moderate.
ThA--------------- Thetford	A	None--------	---	---	1.0-2.0	Apparent	Feb-May	---	Moderate	Low------	Moderate.
Ua*. Udipsamments											
Ub*. Urban land											
Ug*: Urban land.											
Glendora---------	A/D	Frequent----	Long------	Jan-Dec	0-1.0	Apparent	Nov-Jun	---	Moderate	High-----	Moderate.
UkB*, UkC*: Urban land.											
Kalamazoo--------	B	None--------	---	---	>6.0	---	---	---	Moderate	Low------	Low.
UoD*: Urban land.											
Oshtemo----------	B	None--------	---	---	>6.0	---	---	---	Low------	Low------	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

** The plus sign preceding the range in depth to the water table means that the range in this soil is from 2 feet above the surface to 0.5 feet below.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
*Brady	Coarse-loamy, mixed, mesic Aquollic Hapludalfs
Bronson	Coarse-loamy, mixed, mesic Aquic Hapludalfs
Coloma	Mixed, mesic Alfic Udipsamments
Dowagiac	Fine-loamy, mixed, mesic Mollic Hapludalfs
Edwards	Marly, euic, mesic Limnic Medisaprists
Gilford	Coarse-loamy, mixed, mesic Typic Haplaquolls
Glendora	Mixed, mesic Mollic Psammaquents
*Granby	Sandy, mixed, mesic Typic Haplaquolls
Houghton	Euic, mesic Typic Medisaprists
Kalamazoo	Fine-loamy, mixed, mesic Typic Hapludalfs
Oshtemo	Coarse-loamy, mixed, mesic Typic Hapludalfs
Plainfield	Mixed, mesic Typic Udipsamments
Riddles	Fine-loamy, mixed, mesic Typic Hapludalfs
Schoolcraft	Fine-loamy, mixed, mesic Typic Argiudolls
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiaquolls
Sleeth	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Spinks	Sandy, mixed, mesic Psammentic Hapludalfs
*Thetford	Sandy, mixed, mesic Psammaquentic Hapludalfs
Udipsamments	Mixed, mesic Typic Udipsamments

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