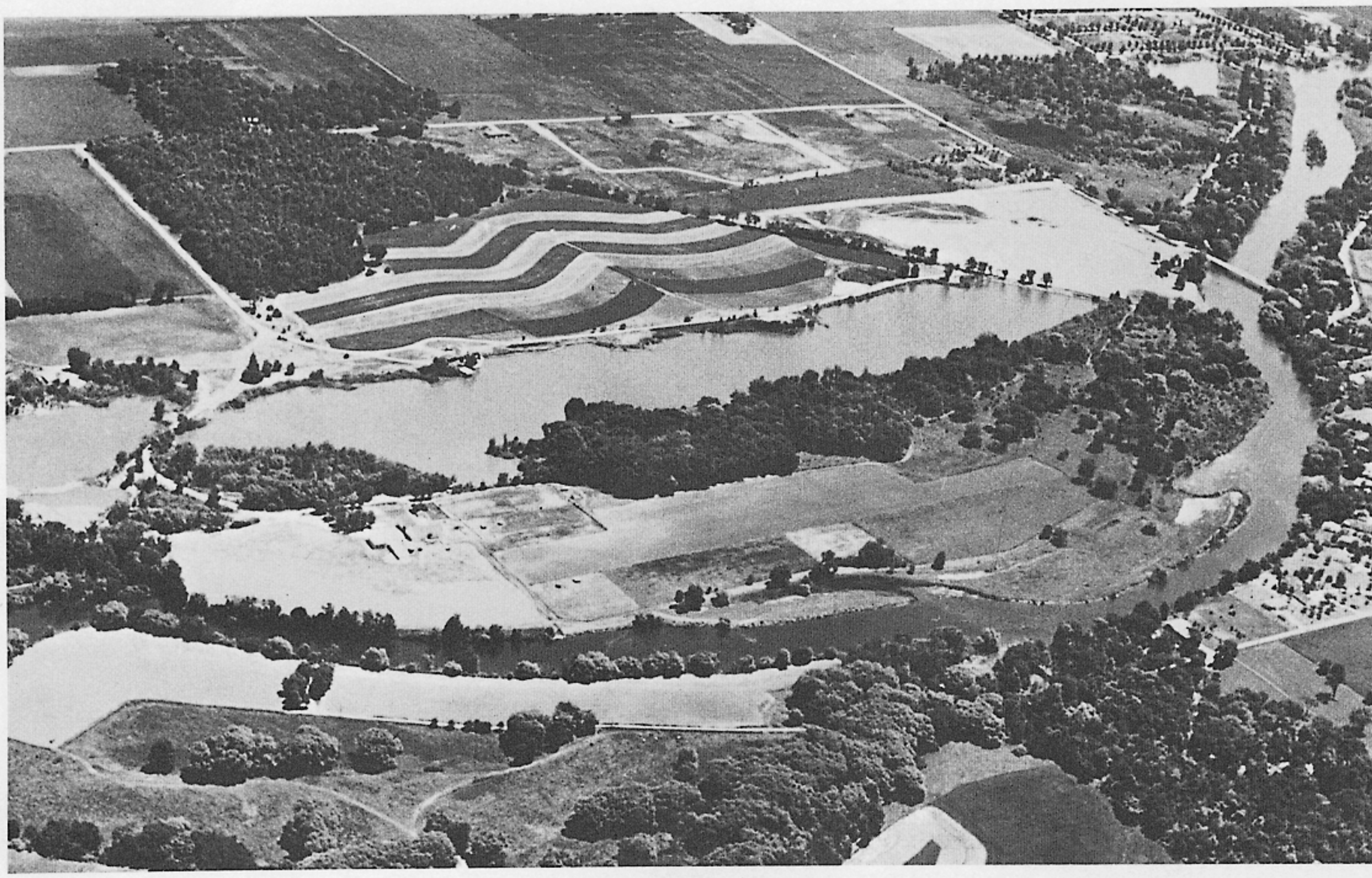
Issued September 1970

SOIL SURVEY
OZAUKEE COUNTY
Wisconsin



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF WISCONSIN
Wisconsin Geological and Natural History Survey
Soils Department
and
Wisconsin Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1962–64. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the Wisconsin Geological and Natural History Survey, Soils Department, and the Wisconsin Agricultural Experiment Station, University of Wisconsin, as part of the assistance furnished to the Ozaukee County Soil and Water Conservation District.

The fieldwork that is the basis for this soil survey was partly financed by Ozaukee County; by the Southeastern Wisconsin Regional Planning Commission; and by a joint planning grant from the State Highway Commission of Wisconsin; the U.S. Department of Commerce, Bureau of Public Roads; and the Department of Housing and Urban Development; under the provisions of the Federal Aid Highway Legislation and Section 701 of the Housing Act of 1954, amended.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Ozaukee County contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in judging the suitability of tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of Ozaukee County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, recreation group, planting group, or any other group in which the soil has been placed.

Interpretations not included in the text can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the section that discusses management of the soils for crops and pasture, for woodland, for wildlife, and for recreational purposes.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Community planners and others concerned with suburban development can read about the soil properties that affect the choice of homesites, industrial sites, schools, and parks in the section "Nonfarm Uses of the Soils."

Engineers and builders will find under "Engineering Uses of the Soils" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation, Morphology, and Classification of Soils."

Newcomers in Ozaukee County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

***Cover picture.*—Multiple land use on Kewaunee and Manawa soils in southeastern Ozaukee County.**

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SOIL SURVEY OF OZAUKEE COUNTY, WISCONSIN

BY DALE E. PARKER, DONALD C. KURER, AND JOSEPH A. STEINGRAEBER, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, SOILS DEPARTMENT, AND THE WISCONSIN AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF WISCONSIN

OZAUKEE COUNTY is in the southeastern part of Wisconsin along Lake Michigan (fig. 1). It is bordered on the west by Washington County, on the south by Milwaukee County, and on the north by Sheboygan County. The total land area is 235 square miles, or 150,400 acres. The county has six civil townships. Port Washington, the county seat is in the east-central part of the county along Lake Michigan. The largest city, Mequon, is also along Lake Michigan and is near the southern border of the county.

Figure 1.—**Location of Ozaukee County in Wisconsin.**

The soils in Ozaukee County are mostly nearly level to rolling. They are suitable for many different crops. Corn, oats, and alfalfa are the chief crops, but truck crops and canning crops are grown in some areas. Wooded areas are mainly on the steeper soils and on wet soils in low areas. Much of the income on the farms comes from dairying and from livestock and livestock products.

Ozaukee County is part of the metropolitan area of the city of Milwaukee, and much of the southern part is in suburban developments. Such developments also are spreading through the central parts of the county. The increasing demand for sites for homes, industries, and recreational facilities makes it important to select suitable soil areas for the intended use. This survey therefore is designed to provide information useful for community and county planning as well as for farming purposes.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Ozaukee County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; 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 to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. For successful use of this survey, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Kewaunee and Ozaukee, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soil by man.

Many soil series contain soils that differ in texture. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Kewaunee silt loam and Kewaunee silty clay loam are two soil types in the Kewaunee series. The difference in texture of their surface layer is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases, primarily on the basis of difference in slope or degree of erosion because these differences affect management. For example, Ozaukee silt loam, 0 to 2 percent slopes, is one of several phases of Ozaukee silt loam, a soil type that has slopes ranging from 0 to 30 percent.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, such an area is shown as one mapping unit and is called a soil complex. Ordinarily, a soil complex is named for the major soil series in it. For example, the Casco-Rodman complex in Ozaukee County consists mainly of Casco loam and Rodman sandy loam. Most surveys also include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rough broken land or Marsh, and are called land types.

While a soil survey is in progress, samples are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the published soil survey. On the basis of the yield and practice tables and other data, the soil scientists set up trial groups, and then test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Ozaukee County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, or choosing the site for a building or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The five soil associations in Ozaukee County are described in the pages that follow and are shown on the colored map at the back of this survey.

1. Kewaunee-Manawa Association

Well-drained to somewhat poorly drained soils that have a subsoil of clay to silty clay loam; formed in thin loess and silty clay loam glacial till; on uplands

The soils of this association are on the glacial moraine along Lake Michigan in the eastern part of the county. Locally the till making up the moraine is known as red clay glacial till, but it actually is silty clay loam. In much of this association, the soils are nearly level and are on broad areas in the lowlands, but in other areas they are gently sloping and are in the uplands and in drainageways. Some steeper soils along the major drainageways are moderately eroded or severely eroded. This association is the largest in the county; it makes up about 50 percent of the total land area.

The Kewaunee and Manawa soils are dominant in this association (fig. 2). Kewaunee soils make up about 70 percent of the association; Manawa soils about 15 percent; Poygan soils, about 5 percent; and minor soils, the remaining 10 percent.

Kewaunee soils are nearly level to very strongly sloping and are well drained. They have a dark-brown surface layer and a dark reddish-brown to reddish-brown, compact, clayey subsoil.

Manawa soils, which are in upland waterways and shallow depressions, have restricted drainage and a temporary high water table. Their surface layer is very dark brown to very dark grayish brown, and their subsoil is mottled.

The Poygan soils, in depressions and in nearly level areas, are very poorly drained. They have a black surface layer and a dark-gray to gray subsoil. Other minor areas consist of soils that are shallow over sand and gravel, of organic soils, or of sandy soils. The sandy soils occupy a strip less than one-fourth mile wide on a lake bench in Belgium Township.

Nearly all of this association is cultivated. Corn, oats, and alfalfa are the chief crops, but small acreages of truck crops and canning crops are grown. Growth of corn is somewhat restricted, but oats and alfalfa grow well. The soils in this association are sticky when wet and are hard when dry. Erosion control and tile drainage are the main concerns in managing these soils.

In recent years extensive residential development has taken place in the southern and central parts of this association. Because the subsoil and underlying material of the soils are compact, special care must be taken in locating a site and in designing a sewage disposal system. The dominant soils have moderate to severe limitations for use as filter fields. Basements commonly are wet because of seepage water.

The soils in this association have large volume change as the content of moisture increases. They also have low bearing capacity when wet. Use of the soils as sites for heavy buildings or for highways therefore is limited without major costs for foundations. The potential of the soils for recreational areas is good.

2. Ozaukee-Mequon Association

Well-drained to somewhat poorly drained soils that have a subsoil of silty clay loam and silty clay; formed in thin loess and silty clay loam glacial till; on uplands

The soils of this association are in the uplands in the southwestern part of the county on silty clay loam glacial till. They are mostly gently sloping and sloping. Somewhat poorly drained soils are along waterways and in scattered broad drainageways. Some steeper soils are on slopes along the major drainageways. This association makes up about 15 percent of the county.

Dominant in this association are the Ozaukee and Mequon soils (fig. 3). Ozaukee soils make up about 65 percent of the association; Mequon soils, about 20 percent; and all of the minor soils, the remaining 15 percent. Among the minor soils are the Ashkum, Fabius, Palms, and Sebewa.

Ozaukee soils are nearly level to steep and are well drained and moderately well drained. They have a dark

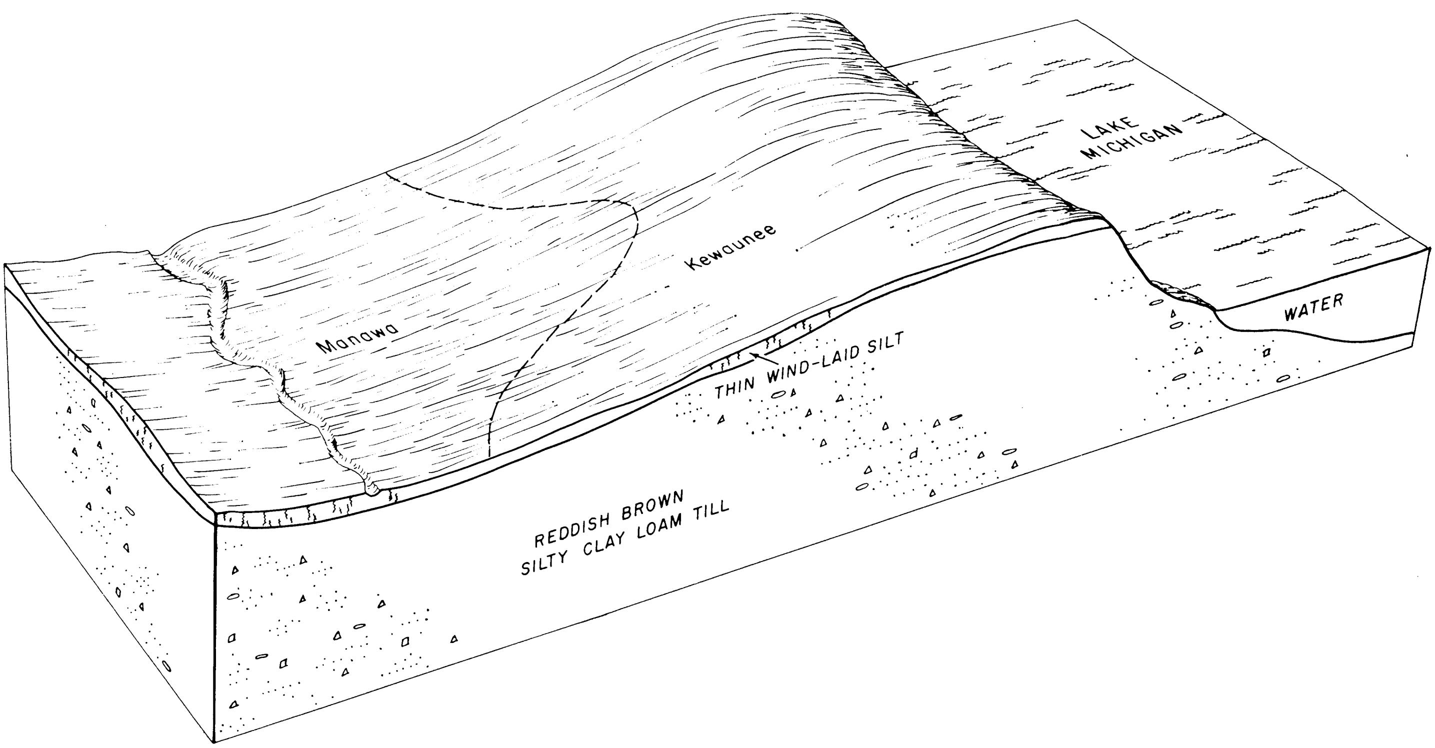

Figure 2.—**Dominant soils of the Kewaunee and Manawa soil association and their parent materials.**

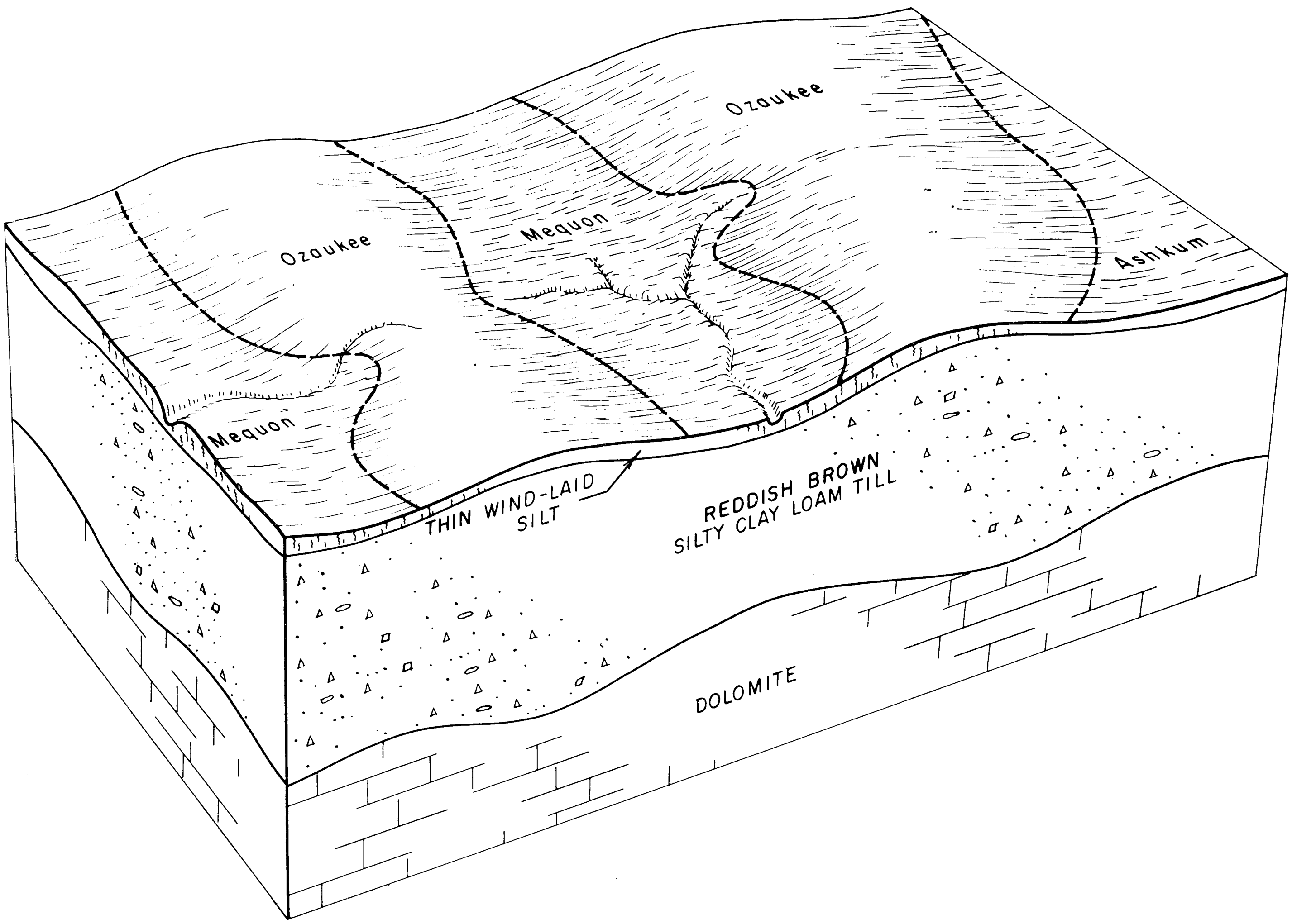

***Figure 3.*—Dominant soils of the Ozaukee-Mequon association and their parent materials.**

grayish-brown surface layer and a compact, clayey subsoil.

Mequon soils, in waterways and depressions, have restricted drainage and a temporary high water table. Their surface layer is very dark brown, and their subsoil is mottled.

The minor soils in this association are in depressions and on low flats along major drainageways.

Most of this association is cultivated. Corn, oats, and alfalfa are the chief crops, and they grow well. A few acres of truck crops and canning crops are grown. The soils are sticky when wet, and clods readily form in them when they are cultivated. Cultivating, therefore, must be done only when the moisture in the soils is at the proper level. Erosion control and drainage of low wet areas are the main concerns in managing these soils.

Large areas in this association are used for homesites. The dominant soils have moderate to severe limitations for use as filter fields. Basements are commonly wet because of seepage water.

The soils in this association have large volume change as the content of moisture increases. They also have low bearing capacity when wet. Consequently, use of the soils as sites for heavy buildings or for highways is limited without major costs for foundations.

3. Hochheim-Sisson-Casco Association

Well-drained soils that have a subsoil of loam to clay loam; underlain mainly by loamy till, outwash, and lake-laid deposits; on uplands and terraces and in lakebeds

The soils of this association are in the glaciated uplands on till, outwash, and lake-laid deposits. Gently sloping to rolling soils make up much of the association, but some of the soils are in kettle moraines where the topography is rough. Scattered areas of nearly level soils are in the lower areas. This association covers about 25 percent of the county.

The Hochheim, Sisson, and Casco soils are dominant in this association (fig. 4). Hochheim soils make up about 40 percent of the association; Sisson soils and Casco soils, about 20 percent each; and all of the minor soils, about 20 percent. Hochheim soils are dominant in Cedarburg Township and near Little Kohler in Fredonia Township. Casco soils are dominant along the western third of Saukville Township and in sections 3, 4, and 6

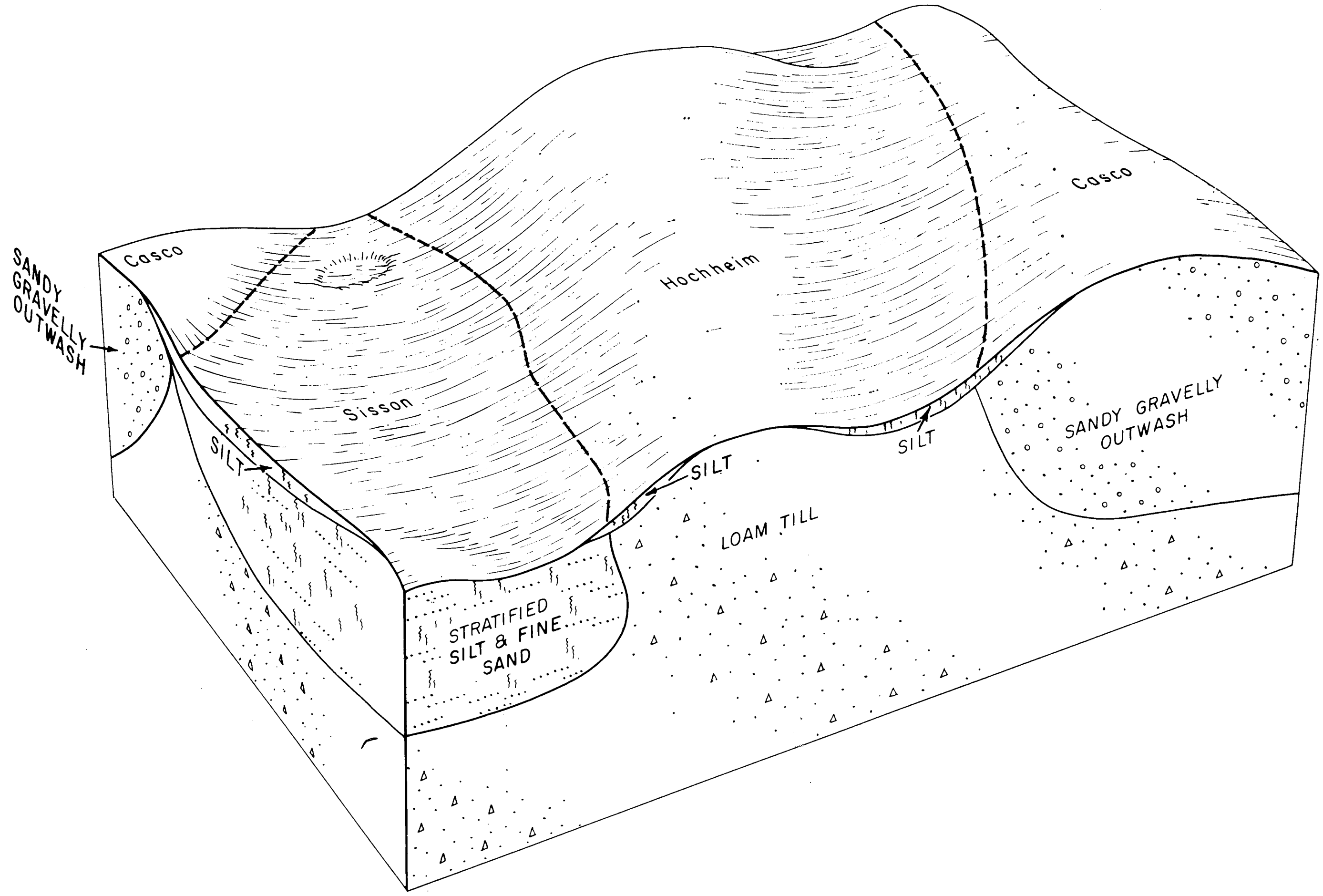

Figure 4.—**Dominant soils of the Hochheim-Sisson-Casco association and their parent materials.**

of Fredonia Township. The minor soils are the Adrian, Colwood, Fabius, Fox, Houghton, Nenno, Sebewa, and Theresa.

Hochheim soils are nearly level to steep and are well drained. They have a very dark grayish-brown surface layer. Their subsoil is brown to dark-brown loam and clay loam. Loamy glacial till that contains many pebbles and cobblestones is at a depth of less than 24 inches.

Sisson soils are in old glacial lake beds and along the edges of drainageways. They are well drained. They are fine sandy loam or very fine sandy loam throughout and are underlain by stratified silt and fine sand. Areas of the steeper Sisson soils are intermingled with areas of Hochheim and Casco soils.

Casco soils are well drained and are chiefly on outwash terraces along streams and drainageways. They have a brown to dark-brown surface layer. Their subsoil is brown to dark-brown clay loam and sandy clay loam that contains gravel. Depth to sand and gravel is less than 24 inches. Areas of the steeper Casco soils are intermingled with areas of Hochheim and Sisson soils.

Of the minor soils, the Fabius and Nenno are in upland waterways and on foot slopes; the Adrian, Colwood, Houghton, and Sebewa soils occupy small areas in depressions and in low wet places; and the well-drained Fox and Theresa soils occupy slopes throughout the association. All of these minor soils are deeper than the Casco and Hochheim soils.

The soils of this association are more variable than those in any other association. In many places the major soils are closely intermingled and are mapped together as complexes. Other areas consist wholly of Casco or Hochheim soils.

Most areas suitable for cultivation have been cleared and are cultivated. Corn, oats, and alfalfa are the chief crops. Woodland is more extensive than in other soil associations in the county. It is mainly on the steeper soils and in low wet areas. The soils in this association are susceptible to water erosion and are droughty. Crops grow well if practices are used to conserve soil and water.

Small areas of this soil association, mainly along the edges of villages, are being used for new residential areas. The major soils have few limitations for use as filter fields for septic tanks. Care is needed, however, in constructing roads, for frost boils occur if the roadbed is laid on stratified fine sand. The stratified material also liquefies when saturated or on thawing and flows rapidly and loses bearing strength.

Soils of this association have good potential for recreation areas and for wildlife habitat.

4. Houghton-Adrian Association

Very poorly drained organic soils in basins and depressions

This association consists chiefly of nearly level, organic soils in depressions and basins. The areas are on valley floors along streams throughout the county. In small areas the soils are very gently sloping. The association makes up about 5 percent of the county.

Dominant in this association are the Houghton and Adrian soils. Among the minor soils are the Muskego, Ogden, Palms, and Rollin. These are organic soils. Small areas of Brookston, Mussey, and Poygan soils, which are wet and loamy, also are in the association. Houghton soils make up about 60 percent of the association; Adrian soils, about 15 percent; and all of the minor soils, the remaining 25 percent.

Houghton soils consist of black mucky peat more than 42 inches thick over sand. Adrian soils are similar to the Houghton, but depth to loose sandy material ranges from 12 to 42 inches or more.

Most areas of this association are wooded and provide habitat for wildlife. Some areas are used for pasture and marsh hay. Areas that are drained are used intensively for corn and truck crops or for canning crops. Crops grow well on areas that are adequately drained if fertilizer is applied and if the soils are protected from soil blowing.

Throughout most of the year, the water table is high in the major soils of this association. The major soils also have low bearing capacity and are highly compressible under heavy loads. Therefore, use of the soils for residential or industrial developments and for highways is severely limited.

5. Casco-Fabius Association

Well-drained and somewhat poorly drained soils that have a subsoil of clay loam and sandy clay loam; shallow over gravel and sand; on stream terraces

The soils of this association are on low outwash terraces along the Milwaukee River and some of its major tributaries. They are mostly gently sloping, though in scattered areas they are nearly level. This association makes up about 5 percent of the county.

Dominant in this association are the Casco and Fabius soils. Casco soils make up about 45 percent of the association; Fabius soils, about 20 percent; and all minor soils and land types, the remaining 35 percent. Among the minor soils are the very poorly drained Adrian, the poorly drained Mussey and Sebewa, and areas of better drained soils. In addition small areas of Alluvial land and of Wet alluvial land are in the association.

Casco soils are well drained. They are mostly on outwash terraces along streams and drainageways. They have a surface layer of brown to dark-brown loam. Their subsoil is brown to dark-brown clay loam that contains gravel.

Fabius soils are nearly level, are somewhat poorly drained, and have a temporary high water table. They occupy drainageways and shallow depressions. Their surface layer is very dark gray to very dark grayish brown. The subsoil is mottled.

The minor Adrian, Mussey, and Sebewa soils are in depressions and on low flats. The better drained soils are in higher lying areas. Alluvial land and Wet alluvial land are on low flood plains along the Milwaukee River.

Most of the soils in this association are cultivated. Low, undrained areas are in woodland or pasture and provide habitat for wildlife. Corn, oats, and alfalfa are the common crops, though a few truck crops and canning crops also are grown. The soils are easy to cultivate, and erosion generally is not a serious hazard. The well-drained soils are somewhat droughty, however, and require practices that conserve moisture. In the other soils the water table is near the surface at times, and drainage is needed for good crop growth. Areas along the flood plains of the Milwaukee River, and those on low bottoms, are subject to flooding. If good management is used, all crops grow well on the soils in this association.

A few areas of this association are used for homesites or for industrial sites. Casco soils have few limitations, but Fabius soils have moderate limitations for such use. Soils on the flood plains, however, have severe limitations for this use. The dominant soils have few limitations for highway construction. They are a good source of sand and gravel.

In most of this association, a good supply of water is nearby, and more irrigation of the somewhat droughty soils therefore can be expected in the future. The areas on the flood plains have potential for recreational use and for wildlife habitat.

Descriptions of the Soils

This section describes the soil series and mapping units of Ozaukee County in alphabetical order. The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

The soil series contains a brief description of a soil profile, the major layers from the surface downward. This profile is considered typical for all the soils of the series. If a profile for a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, unless the differences are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetical order along with the soil series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of each mapping unit is the capability unit, the recreation group, and the planting group to which the mapping unit has been assigned. The page on which each group is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Many terms in the soil descriptions and in other parts of the survey are defined in the Glossary and are described more fully in the Soil Survey Manual (*6*)[1]. The acreage and the proportionate extent of the mapping units are shown in table 1. The location of the soils in the county is shown on the detailed map at the back of this survey.

[1] Italic numbers in parentheses refer to Literature Cited, p. 91.

Adrian Series

In the Adrian series are nearly level organic soils that are very poorly drained. These soils occupy depressions, low nearly level areas, and shallow old lakebeds throughout the county. They consist of reeds, sedges, and other fibrous plant remains and are underlain by sand.

In a typical profile the surface layer is friable, black mucky peat about 11 inches thick. Just below is similar

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Adrian mucky peat	1, 569	1. 0
Alluvial land	877	. 6
Ashkum silt loam	613	. 4
Aztalan loam, 1 to 3 percent slopes	756	. 5
Boyer loamy sand, 1 to 6 percent slopes, eroded	665	. 4
Boyer loamy sand, 6 to 20 percent slopes, eroded	143	. 1
Boyer sandy loam, 0 to 3 percent slopes	149	. 1
Boyer sandy loam, loamy substratum, 1 to 6 percent slopes	293	. 2
Brookston silt loam, 0 to 3 percent slopes	920	. 6
Casco loam, 2 to 6 percent slopes, eroded	2, 391	1. 6
Casco loam, 6 to 12 percent slopes, eroded	800	. 5
Casco sandy loam, 1 to 6 percent slopes, eroded	1, 047	. 7
Casco sandy loam, 6 to 12 percent slopes, eroded	207	. 1
Casco-Rodman complex, 12 to 20 percent slopes, eroded	850	. 6
Casco-Rodman complex, 20 to 35 percent slopes, eroded	943	. 6
Clayey land	60	[1]
Colwood silt loam	1, 347	. 9
Darroch fine sandy loam, neutral variant, 0 to 3 percent slopes	169	. 1
Darroch silt loam, neutral variant, 0 to 3 percent slopes	757	. 5
Dresden silt loam, 1 to 3 percent slopes	455	. 3
Fabius loam, 1 to 3 percent slopes	2, 233	1. 5
Fox loam, 0 to 2 percent slopes	2, 046	1. 4
Fox loam, 2 to 6 percent slopes	930	. 6
Fox sandy loam, 1 to 6 percent slopes	322	. 2
Granby loamy sand, loamy substratum	284	. 2
Hebron loam, 1 to 6 percent slopes	847	. 6
Hochheim loam, 0 to 2 percent slopes	292	. 2
Hochheim loam, 2 to 6 percent slopes, eroded	8, 750	5. 8
Hochheim loam, 6 to 12 percent slopes, eroded	1, 357	. 9
Hochheim loam, 12 to 20 percent slopes, eroded	1, 389	. 9
Hochheim-Sisson-Casco complex, 0 to 2 percent slopes	664	. 4
Hochheim-Sisson-Casco complex, 2 to 6 percent slopes, eroded	5, 143	3. 4
Hochheim-Sisson-Casco complex, 6 to 12 percent slopes, eroded	2, 693	1. 8
Hochheim-Sisson-Casco complex, 12 to 20 percent slopes, eroded	1, 833	1. 2
Hochheim-Sisson-Casco complex, 20 to 35 percent slopes, eroded	714	. 5
Houghton mucky peat	5, 408	3. 6
Keowns silt loam	346	. 2
Kewaunee silt loam, 0 to 2 percent slopes	3, 182	2. 1
Kewaunee silt loam, 2 to 6 percent slopes	24, 263	16. 1
Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	12, 133	8. 1
Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	4, 925	3. 3
Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	2, 485	1. 7
Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	1, 424	. 9
Knowles silt loam, 0 to 2 percent slopes	249	0. 2
Knowles silt loam, 2 to 6 percent slopes, eroded	384	. 3
Knowles silt loam, mottled subsoil variant, 0 to 2 percent slopes	244	. 2
Loamy land	350	. 2
Lorenzo loam, 1 to 3 percent slopes	405	. 3
Manawa silt loam, 1 to 3 percent slopes	9, 430	6. 3
Marsh	198	. 1
Martinton silt loam, 1 to 3 percent slopes	531	. 4
Matherton loam, 0 to 2 percent slopes	327	. 2
Matherton silt loam, 1 to 3 percent slopes	790	. 5
Mequon silt loam, 1 to 3 percent slopes	1, 976	1. 3
Muskego muck	227	. 2
Mussey loam	1, 410	. 9
Navan silt loam	226	. 2
Nenno silt loam, 1 to 3 percent slopes	2, 271	1. 5
Ogden mucky peat	1, 682	1. 1
Ozaukee silt loam, 0 to 2 percent slopes	1, 620	1. 1
Ozaukee silt loam, 2 to 6 percent slopes	5, 681	3. 8
Ozaukee silt loam, 2 to 6 percent slopes, eroded	2, 867	1. 9
Ozaukee silt loam, 6 to 12 percent slopes, eroded	2, 465	1. 6
Ozaukee silt loam, 12 to 20 percent slopes, eroded	412	. 3
Ozaukee silt loam, 20 to 30 percent slopes	110	. 1
Ozaukee clay loam, 6 to 12 percent slopes, severely eroded	140	. 1
Ozaukee clay loam, 12 to 20 percent slopes, severely eroded	140	. 1
Palms mucky peat	961	. 6
Pella silt loam	1, 385	. 9
Poygan silty clay loam	2, 633	1. 8
Radford silt loam, 0 to 3 percent slopes	1, 063	. 7
Ritchey silt loam, 0 to 6 percent slopes	215	. 1
Ritchey silt loam, 6 to 20 percent slopes, eroded	156	. 1
Rollin mucky peat	102	. 1
Rough broken land	747	. 5
Sandy and gravelly land	170	. 1
Sandy lake beaches	322	. 2
Saylesville silt loam, 0 to 2 percent slopes	219	. 1
Saylesville silt loam, 2 to 6 percent slopes, eroded	402	. 3
Sebewa silt loam	1, 852	1. 2
Sisson fine sandy loam, 1 to 6 percent slopes, eroded	551	. 4
Theresa silt loam, 2 to 6 percent slopes	1, 007	. 7
Wasepi sandy loam, 1 to 3 percent slopes	350	. 2
Wet alluvial land	842	. 6
Yahara very fine sandy loam, 1 to 3 percent slopes	622	. 4
Zurich silt loam, 0 to 2 percent slopes	417	. 3
Zurich silt loam, 2 to 6 percent slopes, eroded	1, 000	. 7
Water	1, 514	1. 0
Quarries and gravel pits	506	. 3
Made land	555	. 4
Total	150, 400	100. 0

[1] Less than 0.05 percent.

material that is more brown or more gray than the surface layer and is 21 inches thick. Gray, calcareous fine sand is at a depth of about 32 inches.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is low. The organic material generally is alkaline, but in places it is slightly acid. The underlying sand is calcareous.

A few areas of Adrian soils are drained and are used for crops. Most areas of these soils, however, are in wetland woods or permanent pasture that also provide habitat for wildlife.

Typical profile of a nearly level Adrian mucky peat in a wooded area (SW¼SE¼ sec. 31, T. 11 N., R. 21 E.):

1—0 to 11 inches, black (10YR 2/1) mucky peat; disintegrated; friable; a few roots; moderately alkaline; clear, smooth boundary.

2—11 to 21 inches, very dark brown (7.5YR 2/2) mucky peat; weak, coarse, subangular blocky structure; friable; moderately alkaline; clear, smooth boundary.

3—21 to 32 inches, very dark gray (10YR 3/1) mucky peat; weak, coarse, subangular blocky structure; friable; fine sand is scattered throughout this layer; moderately alkaline; abrupt, smooth boundary.

IIC—32 to 60 inches +, gray (5Y 5/1) fine sand; single grain; loose; calcareous.

The surface layer is black (10YR 2/1) or very dark brown (10YR 2/2) in color. The organic material generally is mucky peat, but in places it includes layers of peat or muck. In some places the third layer is black (10YR 2/1). In undrained areas depth to sand ranges from 18 to 42 inches, but in drained areas, it ranges from 12 to 42 inches. In some places the substratum is a mixture of sand and gravel. The organic material is slightly acid in places.

Adrian soils are shallower to underlying mineral soil than Houghton soils.

Adrian mucky peat (0 to 2 percent slopes) (Ak).—This is the only Adrian soil mapped in the county. The areas are long and narrow or are roughly circular in shape.

Included with this soil in mapping are some cultivated soils that have a surface layer of muck. Also included are small areas where the organic material is slightly less than 12 inches thick.

In this Adrian soil the water table is at or near the surface most of the year. Water stands in ponds on the areas in spring and after a heavy rain. The hazards of soil blowing and of subsidence are serious in drained areas. Capability unit IVw–7; recreation group 8; planting group 6.

Alluvial land (0 to 2 percent slopes) (Am) consists of silty and sandy sediment deposited by streams. It is on the lower parts of flood plains along major streams and drainageways. The areas are flooded frequently and receive fresh deposits of material during each flood. The soil material has been in place long enough for trees or other plants to grow. It has been deposited too recently, however, for distinct horizons to have formed in the soil profile, although the material generally is stratified and may be mottled.

The soil material is dominantly silt loam, but in places it ranges to sandy loam and contains thin layers of sand. It ranges from brown to very dark brown in color and from neutral to calcareous in reaction. Mottles generally occur at a depth below 18 inches, but in places they are at a depth of less than 10 inches. The soil material has moderate available moisture capacity and moderate permeability. It has a temporary high water table within 1 foot of the surface.

Included with this land type in mapping are some areas of silty deposits that overlie a dark-colored, old buried soil. Also included are small areas of Wet alluvial land. Other included areas, in sections 20 and 21 of Belgium Township, are underlain by reddish-brown silty clay loam and have moderate permeability.

A few acres of Alluvial land protected from flooding are used for corn. Areas not protected are used for permanent pasture, woodland, or wildlife. Capability unit IIw–13; recreation group 6; planting group 4.

Ashkum Series

The Ashkum series consists of nearly level, loamy soils that are poorly drained. These soils occupy depressions and drainageways near the Mequon soils in the southwestern part of the county. They formed partly in silt and partly in calcareous silty clay loam glacial till. The capping of silt was less than 20 inches thick.

In a typical profile the surface layer is firm, very dark gray silt loam about 7 inches thick. Just below is black, firm light silty clay loam about 3 inches thick. The subsoil is dark gray to grayish brown and is about 16 inches thick. It is firm silty clay loam to silty clay in the upper 7 inches and very firm silty clay in the next 4 inches. The remaining 5 inches is firm silty clay loam that contains a few pebbles. It is underlain by firm, brown, dark-brown, and grayish-brown silty clay loam glacial till that contains a few pebbles.

These soils have high available moisture capacity and moderately slow permeability. They have an almost permanent water table within 1 foot of the surface, and internal drainage therefore is slow. Fertility is high.

Most areas of the Ashkum soils are drained and are cultivated. Undrained areas are wooded and provide habitat for wildlife.

Typical profile of a nearly level Ashkum silt loam in a cultivated area (NW¼NW¼ sec. 32, T. 10 N., R 21 E.):

Ap—0 to 7 inches, very dark gray (10YR 3/1) silt loam; weak, fine, subangular blocky structure; firm; many roots; mildly alkaline; abrupt, smooth boundary.

A12—7 to 10 inches, very dark gray (10YR 3/1) to black (10YR 2/1) light silty clay loam; moderate, fine, angular blocky structure that breaks to subangular blocky; firm; many roots; a few, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) mottles; mildly alkaline; gradual, smooth boundary.

B21tg—10 to 17 inches, dark-gray (10YR 4/1) silty clay loam to silty clay; moderate, fine, angular blocky structure; firm; a few roots; a few, thin, patchy clay films on surfaces of peds; many, fine, distinct, yellowish-brown (10YR 5/4) mottles; mildly alkaline; clear, smooth boundary.

IIB22tg—17 to 21 inches, mixed grayish-brown (10YR 5/2) and dark-brown (7.5YR 4/2) silty clay; moderate, medium, angular blocky structure; very firm; a few weathered dolomite pebbles; mildly alkaline; clear, smooth boundary.

IIB3tg—21 to 26 inches, varicolored grayish-brown (10YR 5/2), yellowish-brown (10YR 5/6), and dark-brown (7.5YR 4/2) silty clay loam; weak, medium, angular blocky structure; firm; a few weathered pebbles of sandstone and dolomite; strongly calcareous; gradual, wavy boundary.

IIC—26 to 60 inches +, mixed dark-brown (7.5YR 4/2) and grayish-brown (2.5Y 5/2) silty clay loam glacial till; massive; firm; a few dolomite pebbles; strongly calcareous.

The A horizon is very dark gray (10YR 3/1) or black (10YR 2/1) in color and ranges from 8 to 14 inches in thickness. Texture of the B horizon is silty clay loam or silty clay. Color of the B21tg horizon is gray (10YR 5/1) or dark gray (10YR 4/1). Thickness of the solum ranges from 20 to 26 inches. The profile is alkaline to a depth of about 20 inches and is calcareous below.

Ashkum soils are a drainage associate of the well drained to moderately well drained Ozaukee soils and the somewhat poorly drained Mequon soils. They are browner (7.5YR and 10YR hues) in the lower part of the solum than the Poygan soils.

Ashkum silt loam (0 to 2 percent slopes) (As).—This is the only Ashkum soil mapped in the county. The areas generally are small and are irregular in shape.

Included with this soil in mapping are small areas of a soil that has a thicker surface layer than that in this soil because material washed from surrounding eroded soils in the uplands has accumulated on the areas. Also included are small areas that have a surface layer of peat or muck, small areas of Mequon soils, and small gently sloping soil areas.

This Ashkum soil is subject to ponding in spring and after a heavy rain. Capability unit IIw-1; recreation group 7; planting group 5.

Aztalan Series

Nearly level to very gently sloping, loamy soils that are somewhat poorly drained are in the Aztalan series. These soils occupy old glacial lakebeds and drainageways. They are mostly in the western part of the county on deposits of outwash that overlie clayey material.

In a typical profile the surface layer is friable, very dark gray loam about 9 inches thick. The subsoil is brown to dark brown, is mottled in the lower part, and is about 14 inches thick. It is friable light sandy clay loam in the upper 4 inches and friable sandy clay loam in the next 7 inches, and these layers contain many pebbles. The remaining 3 inches is firm silty clay loam that contains a few pebbles. Below is firm, light yellowish-brown silty clay loam containing a few pebbles and small cobbles.

Aztalan soils have high available moisture capacity and slow permeability. Internal drainage is slow because of a temporary high water table 1 to 3 feet from the surface. Fertility is moderate. These soils are neutral to mildly alkaline to a depth of about 24 inches and are calcareous below that depth.

Most areas of Aztalan soils are drained and cropped.

Typical profile of a nearly level Aztalan loam in a cultivated area (SW¼SE¼ sec. 26, T. 11 N., R. 21 E.):

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam; weak, fine, subangular blocky structure that breaks to weak, medium, granular; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1—9 to 13 inches, dark-brown (10YR 4/3) light sandy clay loam; moderate, fine, subangular blocky structure; friable; a few roots; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; many pebbles; mildly alkaline; clear, smooth boundary.

Bt2—13 to 20 inches, brown (10YR 4/3) sandy clay loam; moderate, medium, subangular blocky structure; friable; a few roots; thick continuous clay films; common, medium, distinct, yellowish-brown (10YR 5/6) and faint grayish-brown (10YR 5/2) mottles; many pebbles; mildly alkaline; clear, wavy boundary.

IIB3t—20 to 23 inches, brown (10YR 5/3) silty clay loam; moderate, medium, subangular blocky structure; firm; thin patchy clay films; many, coarse, distinct, yellowish-brown (10YR 5/6) and faint grayish-brown (10YR 5/2) mottles; a few pebbles; calcareous; clear, wavy boundary.

IIC—23 to 60 inches +, light yellowish-brown (10YR 6/4) silty clay loam; massive; firm; many, coarse, faint, yellowish-brown (10YR 5/6) and light brownish-gray mottles; a few large pebbles and small cobblestones; strongly calcareous.

In color the surface layer ranges from very dark gray (10YR 3/1) to very dark grayish brown (10YR 3/2). The part of the B horizon that formed in outwash ranges from loam to sandy clay loam and clay loam in texture and from 12 to 30 inches in thickness. That part of the B horizon that formed in the finer textured underlying material ranges from silty clay loam to silty clay in texture. The IIC horizon consists of stratified silt and clay or of silty clay loam glacial till. Thickness of the solum ranges from 18 to 36 inches.

Aztalan soils are a drainage associate of the well drained to moderately well drained Hebron soils and of the poorly drained Navan soils.

Aztalan loam, 1 to 3 percent slopes (AzA).—In some places this soil is nearly level and occupies oblong or irregularly shaped areas. In other places it is very gently sloping and occurs in long, narrow areas.

Included with this soil in mapping are some areas of silt loam; small areas of sandy loam, which are susceptible to soil blowing; and some areas of a soil that has a darker colored surface layer than that in this soil. Also included are small areas that have deposits of sandy material about 30 inches thick over clayey material. Other included areas consist of poorly drained Navan soils that are too small to be mapped separately.

Where this Aztalan soil is nearly level, it is subject to ponding in spring and after a heavy rain. Where the soil is very gently sloping, the hazard of water erosion is slight. Capability unit IIw-2; recreation group 6; planting group 4.

Boyer Series

The Boyer series consists of nearly level to gently sloping, loamy and sandy soils that are well drained. These soils are on sandy outwash terraces along streams and drainageways throughout the county. They formed partly in loamy material and partly in calcareous outwash sand.

In a typical profile the surface layer is very friable, brown loamy sand about 9 inches thick. The subsoil is yellowish brown or dark brown and is about 23 inches thick. It is very friable loamy sand in the upper 7 inches and friable sandy clay loam in the next 8 inches. The remaining 8 inches is very friable sandy loam. Just below is yellowish-brown, loose, medium sand that contains some gravel.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is rapid, and fertility is low. Boyer soils are somewhat droughty. They are slightly acid to alkaline to a depth of about 32 inches and are calcareous below.

Most areas of the Boyer soils are cultivated.

Typical profile of a gently sloping Boyer loamy sand in a cultivated area (SE¼NE¼ sec. 29, T. 10 N., R. 21 E.):

Ap—0 to 9 inches, brown (10YR 4/3) loamy sand; weak, medium, crumb structure; very friable; many roots; some mixing of material with that in the B1 horizon at the place where the two horizons come into contact; neutral; abrupt, smooth boundary.

B1—9 to 16 inches, yellowish-brown (10YR 5/4) loamy sand; weak, medium, subangular blocky structure to weak, medium, crumb; very friable; many roots; neutral; clear, irregular boundary.

B2t—16 to 24 inches, dark-brown (7.5YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; friable; a few roots; a few thin clay films; some spots are surrounded by material from the B1 horizon; mildly alkaline; clear, irregular boundary.

B3—24 to 32 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; very friable; a few roots; mildly alkaline; clear, irregular boundary.

C—32 to 60 inches, yellowish-brown (10YR 5/6) medium sand that contains some gravel; stratified; single grain; loose; calcareous.

The surface layer is sandy loam or loamy sand in texture. Its color is dark grayish brown (10YR 4/2) or brown (10YR 4/3). In many places the B2t horizon is partly degraded and in some places a weak Birh horizon occurs. The B2t horizon ranges from sandy loam to sandy clay loam and is less than 10 inches thick. Thickness of the solum ranges from 24 to 40 inches. In places gravel occurs throughout the profile.

Boyer soils are a drainage associate of the somewhat poorly drained Wasepi soils. They have a thicker solum than the Casco soils and are coarser textured than the Fox soils.

Boyer loamy sand, 1 to 6 percent slopes, eroded (BmB2).—This soil has the profile described for the series. It is on sandy outwash terraces along drainageways. The areas are oblong or are roughly circular in shape.

Included with this soil in mapping are small areas of soils that have a surface layer of loamy fine sand or that have a surface layer that is similar in texture to that in this soil but is darker colored. Also included are soils that are more than 40 inches deep over underlying sand or that are less than 24 inches deep over sand and are droughty.

Runoff is slow on this Boyer soil, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. Capability unit IVs-3; recreation group 5; planting group 2.

Boyer loamy sand, 6 to 20 percent slopes, eroded (BmD2).—This soil is in the uplands and on sandy areas that are either oblong or roughly circular. It is shallower to stratified sand, but its profile otherwise is similar to that described for the series.

Included with this soil in mapping are some soils that are less than 24 inches deep over sand or that have a surface layer of sandy loam. Also included are a few areas of a soil that has a darker colored surface layer than this soil. A few other included soils have steeper slopes than this soil, have stratified sand just below the surface, and are droughty.

Runoff is moderate on this Boyer soil. The hazard of soil blowing is severe, and the soil is droughty.

Many areas of this soil are wooded. Most areas that formerly were in crops are now under grass and are used as pasture or are left idle. Capability unit IVe-9; recreation group 5; planting group 2.

Boyer sandy loam, 0 to 3 percent slopes (BnA).—This soil is on sandy outwash terraces along drainageways. The areas are oblong or are roughly circular. The first two layers are sandy loam, but otherwise the profile of this soil is like that described for the series.

Included with this soil in mapping are some soils that are more sloping than this soil or have a thicker, darker colored surface layer.

Runoff on this Boyer soil is slow. The hazards of water erosion and of soil blowing are slight. Capability unit IIIs-2; recreation group 1; planting group 3.

Boyer sandy loam, loamy substratum, 1 to 6 percent slopes (BoB).—This soil is on sandy outwash terraces along drainageways. The areas are oblong or are roughly circular. The surface layer is darker colored than that described for the series and is sandy loam and the second layer also is sandy loam. Depth to the substratum of loamy material is between 42 and 60 inches.

Included with this soil in mapping are some soils that are less than 24 inches deep over sand, and underlain by loamy material at a depth between 30 to 60 inches, or have a surface layer of loamy fine sand. Also included are areas in which part of the subsoil has formed in stony and loamy material.

Runoff is slow on this Boyer soil. The hazards of water erosion and soil blowing are slight. Capability unit IIIe-4; recreation group 1; planting group 3.

Brookston Series

The Brookston series consists of nearly level to gently sloping, loamy soils that are poorly drained. Most areas are in the western part of the county on low nearly level areas and foot slopes or are in drainageways. The soils formed in calcareous loamy glacial till that had a thin capping of silt.

In a typical profile the surface layer is about 11 inches thick. It is friable, black silt loam in the upper 8 inches and firm, black and dark-gray silty clay loam in the remaining 3 inches. The subsoil is gray throughout and is about 19 inches thick. It is friable heavy loam in the upper 11 inches and gray silt loam that feels gritty in the remaining 8 inches. Pebbles and yellowish-red mottles occur throughout the subsoil. The underlying material is brown loamy glacial till that contains many small pebbles.

These soils have high available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is high. Brookston soils generally are mildly alkaline to a depth of about 11 inches and are slightly calcareous or calcareous below.

About half the acreage of these soils is drained and used for crops. The rest is in permanent pasture, is used as woodland, or provides habitat for wildlife.

Typical profile of a nearly level Brookston silt loam in a cultivated area (SE corner sec. 30, T. 10 N., R. 21 E.):

Ap—0 to 8 inches, black (10YR 2/1) silt loam; moderate, medium, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A3g—8 to 11 inches, black (10YR 2/1) and dark-gray (5Y 4/1) silty clay loam; moderate, medium, subangular blocky structure; firm; many roots; mildly alkaline; clear, wavy boundary.

B2tg—11 to 16 inches, gray (5Y 5/1) heavy loam; weak, coarse, prismatic structure that breaks to moderate, medium, subangular blocky; friable; many roots; a few, medium, distinct, yellowish-red (5YR 4/6 to 5/8) mottles; a few clay films on ped surfaces; weathered pebbles of lime and sandstone and white (5YR 8/1) spots of lime; slightly calcareous; gradual, wavy boundary.

B31tg—16 to 22 inches, gray (5Y 5/1) heavy loam; moderate, coarse, prismatic structure that breaks to moderate, medium, subangular blocky; friable; many roots; black (10YR 2/1) organic stains and clay flows along root channels; common, medium, distinct, yellowish-red (5YR 4/6 and 5/8) mottles; weathered pebbles of lime and sandstone and white spots of lime; calcareous; gradual, wavy boundary.

B32g—22 to 30 inches, gray (5Y 5/1) silt loam that feels gritty; weak, coarse, prismatic structure that breaks to weak, coarse, subangular blocky; friable; a few roots; common, medium, distinct, yellowish-red (5YR 4/6 and 5/8) mottles; a few pebbles; calcareous; gradual, wavy boundary.

C—30 to 60 inches +, brown (10YR 5/3) loamy glacial till; massive; friable; a few roots; many small pebbles; highly calcareous.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) in color. It ranges from 8 to 15 inches in thickness. In texture the Bg horizon ranges from heavy loam to silty clay loam that feels gritty. The solum ranges from 24 to 36 inches in thickness. The underlying till ranges from silt loam that feels gritty to sandy loam, and in places it is weakly stratified. Pebbles and cobblestones are common throughout the profile, and areas that have never been cleared commonly have stones on the surface.

Brookston soils are a drainage associate of the well-drained Hochheim soils and the somewhat poorly drained Nenno soils.

Brookston silt loam, 0 to 3 percent slopes (BsA).—This is the only Brookston soil mapped in the county. In some places the soil is nearly level and occupies low areas, but in other places it is gently sloping and is in drainageways or on foot slopes. The areas are either long and narrow or are roughly circular.

Included with this soil in mapping are some small areas of a soil that is wetter than this soil and has a surface layer that is partly peat or muck. Also included are small areas that have steeper slopes. Other included areas consist of somewhat poorly drained Nenno soils.

Runoff is slow to very slow on this Brookston soil, and the hazard of water erosion is slight. The water table is at or near the surface most of the year. This soil is susceptible to ponding for fairly long periods in spring and after a heavy rain. Capability unit IIw–1; recreation group 7; planting group 5.

Casco Series

Soils of the Casco series are loamy, nearly level to steep, and well drained. Most areas are gently sloping and are on outwash terraces, but many areas are in the uplands, where they are closely intermixed with areas of Hochheim and Sisson soils. Casco soils formed partly in loamy material and partly in calcareous sandy and gravelly outwash.

In a typical profile (fig. 5) the surface layer is friable, dark-brown loam about 7 inches thick. The subsoil is dark brown and is about 11 inches thick. It is firm clay loam in the upper 5 inches and contains gravel and cobblestones in the lower part. The remaining 6 inches is firm sandy clay that contains many pebbles and some cobblestones. Just below is loose, dark yellowish-brown, stratified sand and gravel that contains some cobblestones.

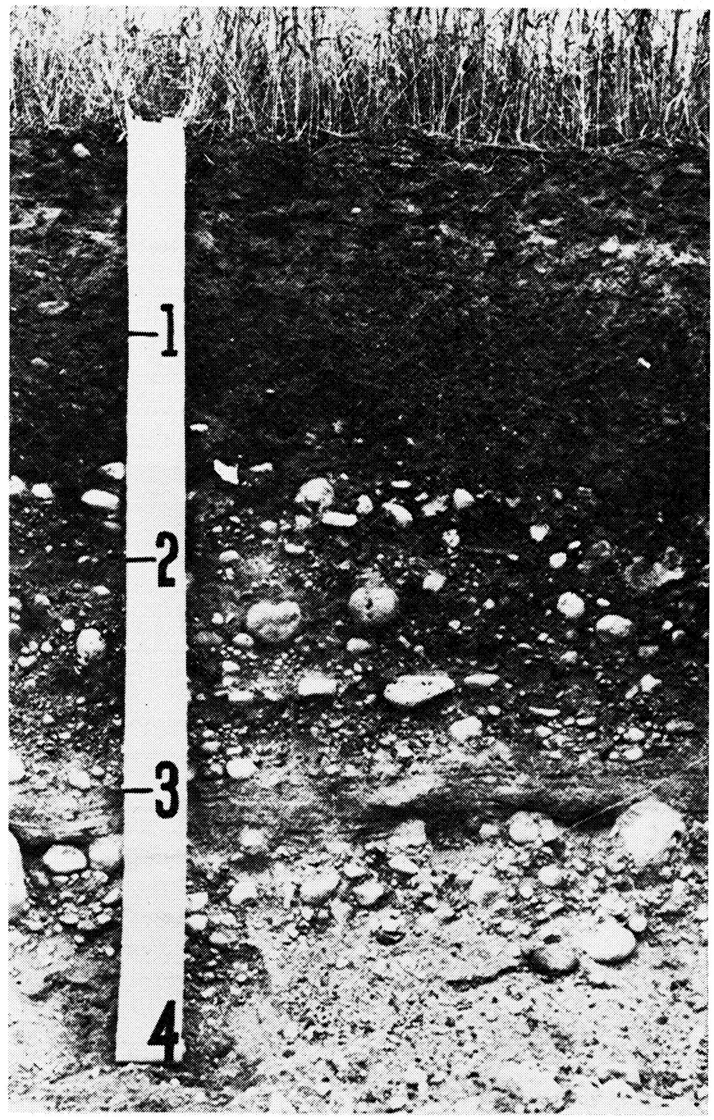

Figure 5.—Typical profile of a Casco loam in a cultivated area. Measure is in feet.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is rapid, and the soils are droughty. Fertility is low. Casco soils are alkaline in the surface layer and in the upper part of the subsoil and are slightly calcareous just below. The underlying material is calcareous.

Except for the steeper areas, most of the Casco soils are cultivated.

Typical profile of a gently sloping Casco loam in a cultivated area (NE¼NW¼ sec. 3, T. 12 N., R. 21 E.):

Ap—0 to 7 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure that breaks to weak, medium, granular; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B2t—7 to 12 inches, dark-brown (10YR 4/3) clay loam; moderate, fine to medium, subangular blocky structure; firm; a few roots; many clay films on ped surfaces;

pebbles and cobblestones are in the lower part; moderately alkaline; clear, wavy boundary.

B3t—12 to 18 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium to coarse, subangular blocky structure; firm; a few roots; many pieces of gravel 2 to 3 inches in diameter and some cobblestones; slightly calcareous; clear, wavy boundary.

IIC—18 to 60 inches, dark yellowish-brown (10YR 4/4) sand and gravel that includes some cobblestones; stratified; single grain; loose; calcareous.

The surface layer is loam or sandy loam in texture. In most places it is dark brown (10YR 4/3) or dark grayish brown (10YR 4/2) in color. In texture the B2t horizon is sandy clay loam or clay loam to a depth of more than 6 inches, but it ranges to sandy loam. Thickness of the solum ranges from 10 to 24 inches.

Casco soils are a drainage associate of the somewhat poorly drained Fabius soils and the poorly drained Mussey soils. They are similar to the Rodman soils, but unlike them have a Bt horizon. Their solum is not so thick as that of the Fox soils.

Casco loam, 2 to 6 percent slopes, eroded (CeB2).—This soil has the profile described for the series. It is on outwash terraces along streams and drainageways. The areas generally are large and are roughly circular.

Included with this soil in mapping are many areas that have a surface layer of silt loam. Also included are a few severely eroded areas. In the severely eroded areas, most of the material formerly in the second layer has been mixed with the remaining surface layer by plowing. In these areas, available moisture capacity is low and the soil is very droughty.

Runoff is slow on this Casco soil, and the hazard of water erosion is slight. Capability unit IIIe-4; recreation group 1; planting group 2.

Casco loam, 6 to 12 percent slopes, eroded (CeC2).—This soil occupies areas that generally are oblong in shape and are along drainageways in the uplands. Depth to sand and gravel is a few inches less than in the profile described for the series.

Included with this soil in mapping are a few areas that have a surface layer of silt loam. Also included are a few areas that are slightly deeper than 24 inches to sand and gravel. Other included areas are severely eroded. In the severely eroded areas, most of the material formerly in the second layer has been mixed with the remaining surface layer by plowing. In these areas, the available moisture capacity is low and the soils are very droughty.

Runoff is medium on this Casco soil, and the hazard of water erosion is moderate. Capability unit IVe-4; recreation group 1; planting group 2.

Casco sandy loam, 1 to 6 percent slopes, eroded (CcB2).—This soil occupies roughly circular areas on outwash terraces along streams and drainageways. The surface layer is sandy loam, but otherwise the profile is similar to the one described for the series.

Included with this soil in mapping are a few severely eroded areas, where most of the material formerly in the second layer has been mixed with the remaining surface layer by plowing. In these areas available moisture capacity is low and the soil is very droughty.

Runoff is slow on this Casco soil, and the hazards of water erosion and soil blowing are slight. Capability unit IIIe-4; recreation group 1; planting group 2.

Casco sandy loam, 6 to 12 percent slopes, eroded (CcC2).—This soil occupies areas that generally are oblong in shape and are on upland slopes along drainageways. Depth to sand and gravel is a few inches less than in the profile described for the series.

Included with this soil in mapping are a few severely eroded areas, where most of the material formerly in the second layer has been mixed with the remaining surface layer by plowing. In these areas available moisture capacity is low and the soil is very droughty.

Runoff is medium on this Casco soil. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Capability unit IVe-4; recreation group 1; planting group 2.

Casco-Rodman complex, 12 to 20 percent slopes, eroded (CrD2).—This complex consists of moderately steep and rolling soils in the uplands. Most areas are long and narrow, but some of the rolling areas are roughly circular and have short slopes that face in different directions. Casco loam and Rodman silt loam each make up about 50 percent of this complex. The profile of the Casco soil is slightly thinner than the one described for the Casco series, but that of the Rodman soil is similar to the profile described for the Rodman series. Casco soils are in swales and on the less steep part of the slopes, and Rodman soils occupy convex slope breaks and the steeper part of the slopes.

Included with this complex in mapping are small areas that have a surface layer of silt loam. Also included are a few severely eroded areas that have a surface layer of gravelly sandy loam that is calcareous. A few other included areas consist of Boyer loamy sand.

Runoff is medium on the soils of this complex, and the hazard of water erosion is severe. More than half the acreage is in permanent pasture or is wooded. The rest is used mainly for oats and hay or for rotation pasture. Capability unit VIe-4; recreation group 1; planting group 1.

Casco-Rodman complex, 20 to 35 percent slopes, eroded (CrE2).—This complex consists of hilly and steep soils on eskers and kettle moraines in the uplands. Most areas are long and narrow, but some of the hilly areas are roughly circular and have slopes that face in different directions. Casco loam makes up about 40 percent of this complex, and Rodman sandy loam, about 60 percent. The Casco soil is about 12 to 15 inches thick. The profile of the Rodman soil is similar to the one described for its series, though the soil is steeper. The Casco soil is in swales and on the less steep part of the slopes. The Rodman soil occupies convex slope breaks and the steeper part of the slopes.

Included with this complex in mapping are a few areas of a soil that has a surface layer of gravelly sandy loam. Also included are a few areas of Boyer loamy sand.

Runoff is medium on the soils in this complex, and the hazard of water erosion is very severe. Most of the acreage is in permanent pasture or is wooded. A few scattered areas are used mainly for hay or for rotation pasture. Capability unit VIIe-4; recreation group 1; planting group 1.

Clayey land (Cv) consists of cut and filled areas that are mainly in and around urban areas in the county.

In cut or borrow areas, the original soil material has been removed by man and raw, fairly inert soil material is exposed. The banks of cut areas have been sloped and graded. As a result, the areas blend in with adjacent, relatively undisturbed soil areas and can be used as sites for buildings and for highways or other kinds of transportation facilities.

In filled areas, the fill material ranges from 1 to about 5 feet in thickness. Originally, the areas generally consisted of mineral soils that were somewhat poorly drained to very poorly drained. Some of the areas however originally contained well-drained mineral soils, and some other areas consisted of organic soils.

Clayey land ranges from clay loam to clay in texture. In cut areas all of the soil material above the parent material has been removed. The material remaining generally is silty clay loam glacial till that contains pockets of loamy or silty material. In filled areas, the soil material is more variable. In places it contains such debris as rocks, bricks, and fragments of pavement, as well as loamy or gravelly material.

The surface of Clayey land generally is compacted, and runoff is excessive. The soil material is unfavorable for growth of plants. Capability unit VIIIs–10; recreation group 6; planting group 4.

Colwood Series

The Colwood series consists of nearly level, loamy soils that are poorly drained. These soils are in the western half of the county in depressions in old glacial lake basins. They formed in calcareous, lake-laid silt and fine sand.

In a typical profile the surface layer is friable, black silt loam about 9 inches thick. The subsoil is dark gray, gray, or light brownish gray and is about 18 inches thick. It is firm clay loam or coarse silty clay loam in the upper 2 inches and firm silty clay loam in the next 9 inches. Both parts have yellowish-brown mottles. The remaining 7 inches is friable heavy loam that contains thin lenses of sand and silt. Just below is light brownish-gray silt and very fine sand. Both of these layers have brownish-yellow mottles.

The water table is at or near the surface of Colwood soils for most of the year. Available moisture capacity is high, permeability is moderate, and internal drainage is very slow. Fertility is high. Colwood soils are alkaline to a depth of about 27 inches and are strongly calcareous below.

Most areas of these soils are drained and are used for crops. Undrained areas are in permanent pasture, are wooded, or provide habitat for wildlife.

Typical profile of a nearly level Colwood silt loam in a cultivated area (NW¼NE¼ sec. 21, T. 10 N., R. 21 E.):

Ap—0 to 9 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1g—9 to 11 inches, dark-gray (10YR 4/1) clay loam or coarse silty clay loam; moderate, medium, subangular blocky structure; firm; many roots; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; very dark gray (10YR 3/1) organic stains on ped surfaces; mildly alkaline; clear, wavy boundary.

B2g—11 to 20 inches, gray (10YR 5/1) silty clay loam; moderate, medium, prismatic structure that breaks to moderate, medium, subangular block; firm; a few roots; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, wavy boundary.

B3g—20 to 27 inches, light brownish-gray (10YR 6/2) heavy loam that contains thin lenses of sand and silt; moderate, coarse, subangular blocky structure; friable; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; moderately alkaline; clear, wavy boundary.

C—27 to 60 inches +, light brownish-gray (10YR 6/2) silt and very fine sand; stratified; friable; many, coarse, prominent, brownish-yellow (10YR 6/6) mottles; some old roots and root channels; strongly calcareous.

The surface layer is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) in color. Thickness of the solum ranges from 24 to 40 inches. The B2g horizon is more than 6 inches thick and ranges from silt loam to silty clay loam in texture. In places the C horizon includes thin, clayey strata.

Colwood soils are a drainage associate of the well-drained Sisson soils and of the somewhat poorly drained variants from the Darroch series. They are sandier in the C horizon than the Pella soils, which are underlain by silt and clay. Colwood soils have a finer textured B horizon than the Keowns soils and are deeper to carbonates.

Colwood silt loam (0 to 2 percent slopes) (Cw).—This is the only Colwood soil mapped in the county. The areas are irregular in shape.

Included with this soil are some areas that have a surface layer of fine sandy loam and some gently sloping areas. Also included are some areas that are underlain by sandy material at a depth between 30 and 60 inches. Other included areas are fine silt throughout.

Runoff is very slow on this soil. Water is likely to stand in ponds on the areas in spring and after a heavy rain. Capability unit IIIw–3; recreation group 7; planting group 5.

Darroch Series, Neutral Variant

The variants from the normal Darroch series are nearly level to sloping loamy soils that are somewhat poorly drained and are neutral in reaction. They are in the western half of the county in old glacial lakebeds and drainageways or are on foot slopes. The soils formed in lake-laid silt and fine sand. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, very dark grayish-brown to very dark gray silt loam about 10 inches thick. The subsoil is about 15 inches thick. It is friable, brown to dark-brown silty clay loam in the upper 4 inches and firm, dark yellowish-brown clay loam in the next 8 inches. The remaining 3 inches is friable, light yellowish-brown and yellowish-brown light clay loam. Just below is friable, light yellowish-brown silt and fine sand that is laminated. Mottles occur throughout the subsoil and underlying material.

The water table is temporarily 1 to 3 feet from the surface in these soils, and internal drainage is slow. Available moisture capacity is high, and permeability is moderate. Fertility is moderate. The soils are neutral in the surface layer and neutral to mildly alkaline below. The underlying material is strongly calcareous.

Most of these soils are drained and are used for crops. Undrained areas are in permanent pasture or are used as woodland.

Typical profile of a nearly level Darroch silt loam, neutral variant, in a cultivated field (SE¼SE¼ sec. 1, T. 10 N., R. 21 E.):

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) to very dark gray (10YR 3/1) silt loam; weak, fine, subangular blocky structure to weak, medium, granular; friable; many roots; neutral; abrupt, smooth boundary.

B1t—10 to 14 inches, dark-brown (10YR 4/3) silty clay loam; moderate, fine, subangular blocky structure; friable; a few roots; common, medium, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; about one-half inch of discontinuous A2 material that is dark grayish brown (10YR 4/2) in color and has platy structure; neutral; clear, smooth boundary.

B2t—14 to 22 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, fine, subangular blocky structure; firm; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6 to 5/8) mottles; patchy clay films; mildly alkaline; clear, wavy boundary.

B3t—22 to 25 inches, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/4) light clay loam; friable; many, medium, distinct, grayish-brown (10YR 5/2) and brownish-yellow (10YR 6/6) mottles; contains stratified fine lenses of silt and sand; mildly alkaline; clear, wavy boundary.

C—25 to 60 inches +, light yellowish-brown (10YR 6/4) silt and fine sand; laminated; friable; many, strong, distinct, grayish-brown (10YR 5/2) and brownish-yellow (10YR 6/6 to 6/8) mottles; strongly calcareous.

The surface layer is silt loam or fine sandy loam. It ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) in color. Mottles occur at a depth between 8 and 14 inches. Thickness of the solum ranges from 15 to 30 inches. In places the underlying material includes thin clayey strata.

Soils of the Darroch series, neutral variant, are a drainage associate of the well-drained Sisson soils and the poorly drained Colwood soils. They have a coarser textured profile than Martinton soils, which formed in lacustrine silt and clay.

Darroch fine sandy loam, neutral variant, 0 to 3 percent slopes (DaA).—In places this soil is nearly level and is in old lakebeds, and in other places it is very gently sloping and is on the edges of drainageways. The areas are small and irregular in shape or are long and narrow.

Included with this soil in mapping are some areas that are more sloping than this soil. Also included are small areas of Fabius soil that has a surface layer of sandy loam and is underlain by silt and fine sand at a depth of 30 to 60 inches. Other included small areas are underlain by clayey material at a depth of 30 to 60 inches.

Runoff is slow on this variant. Water is likely to stand in ponds on the nearly level areas during wet periods. On the very gently sloping areas, the hazard of water erosion is slight. Capability unit IIIw–3; recreation group 6; planting group 4.

Darroch silt loam, neutral variant, 0 to 3 percent slopes (DcA).—This soil has the profile described for the series. In places it is nearly level and is in old lakebeds, and in other places it is very gently sloping and is on the edges of drainageways. The areas are small and irregular in shape or are long and narrow.

Included with this soil in mapping are some small areas that are slightly more sloping than this soil. Also included are small areas of poorly drained Colwood soils that are nearly level. Other included small areas have a thicker surface layer than this soil because material washed from surrounding soils in the uplands has accumulated on the areas.

Water is likely to stand on the nearly level areas of this variant during wet periods. On the very gently sloping areas, the hazard of water erosion is slight. Capability unit IIIw–3; recreation group 6; planting group 4.

Dresden Series

Dresden soils are nearly level to gently sloping, loamy, and well drained. They are on outwash terraces along streams and drainageways throughout the county. The soils formed in loamy material underlain by calcareous sandy and gravelly outwash.

In a typical profile the surface layer is friable, very dark grayish-brown silt loam about 8 inches thick. The subsoil is about 18 inches thick. It is friable, very dark grayish-brown silt loam in the upper 5 inches and firm, dark-brown light silty clay loam in the next 5 inches. Just below is 8 inches of dark-brown, firm clay loam that has strong-brown mottles. The remaining 2 inches is friable, dark yellowish-brown loam that has yellowish mottles and contains some gravel. Just below is loose, yellowish-brown to very pale brown, stratified sand and gravel.

Dresden soils have medium available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. These soils are slightly droughty. They are mildly alkaline to a depth of about 26 inches and are calcareous to strongly calcareous below.

Most areas of Dresden soils are cropped intensively.

Typical profile of a nearly level Dresden silt loam in a cultivated area (SW¼SE¼ sec. 4, T. 9 N., R. 21 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1—8 to 13 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, subangular blocky structure; friable; many roots; mildly alkaline; clear, smooth boundary.

B21t—13 to 18 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; firm; a few roots; thick continuous clay films; dark grayish-brown (10YR 4/2) coatings; mildly alkaline; clear, smooth boundary.

IIB22t—18 to 26 inches, dark-brown (7.5YR 4/4) clay loam; moderate to strong, medium, subangular blocky structure; very firm; thick continuous clay films; common, medium, distinct, strong-brown (7.5YR 5/6 to 5/8) mottles; a few weathered pebbles; mildly alkaline; clear, wavy boundary.

IIB3t—26 to 28 inches, dark yellowish-brown (10YR 4/4) loam; weak, medium, subangular blocky structure; friable; thin patchy clay films; a few, medium, distinct, yellowish-brown (10YR 5/6 to 5/8) mottles; contains some gravel; calcareous; clear, wavy boundary.

IIC—28 to 60 inches +, yellowish-brown (10YR 5/4) to very pale brown (10YR 7/4) sand and gravel; stratified; single grain; loose; strongly calcareous.

The surface layer is loam or silt loam. It ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 4/3) in color. The B2t horizon ranges from sandy clay loam to clay loam and light silty clay loam in texture. The solum ranges from 24 to 40 inches in thickness. In places mottles occur in the lower part of the B horizon at a depth of more than 16 inches.

Dresden soils are a drainage associate of the somewhat poorly drained Matherton soils and the poorly drained Sebewa soils.

Dresden silt loam, 1 to 3 percent slopes (DsA).—This is the only Dresden soil mapped in the county. It occupies areas that are either oblong or roughly circular.

Included with this soil in mapping are small areas that have a surface layer of loam. Also included are small areas of well-drained Fox soils and of somewhat poorly drained Matherton soils.

Runoff is slow on this Dresden soil. On the very gently sloping areas, the hazard of water erosion is slight. Capability unit IIs–1; recreation group 6; planting group 3.

Fabius Series

The Fabius series consists of nearly level to very gently sloping, loamy soils that are somewhat poorly drained. These soils occupy nearly level areas and waterways on outwash terraces throughout the county. They formed partly in loamy material and partly in calcareous outwash sand and gravel.

In a typical profile the surface layer is friable, very dark grayish-brown loam about 10 inches thick. The subsoil is brown to dark brown and is about 9 inches thick. It is firm light clay loam in the upper 6 inches and friable sandy loam in the remaining 3 inches. Just below is loose, brown sand and gravel that contains some cobblestones.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is slow because of a temporary water table 1 to 3 feet from the surface. Fertility is low. Fabius soils are mildly alkaline to a depth of about 16 inches and calcareous below.

Most areas of the Fabius soils are cultivated. A few small areas are used as permanent pasture or woodland.

Typical profile of a nearly level Fabius loam in a cultivated area (NW¼SW¼ sec. 31, T. 11 N., R. 21 E.):

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A12—7 to 10 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, subangular blocky structure; friable; many roots; mildly alkaline; clear, smooth boundary.

B2t—10 to 16 inches, brown (10YR 4/3) light clay loam; moderate, medium, subangular blocky structure; firm; a few roots; a few thin clay films on ped faces; the upper part has been mixed by worms; common, fine, distinct, strong-brown (7.5YR 5/6) and grayish-brown (10YR 5/2) mottles; mildly alkaline; clear, wavy boundary.

B3t—16 to 19 inches, brown (10YR 5/3) sandy loam that contains gravel and cobblestones; weak, medium, subangular blocky structure; friable; thin patchy clay films; many, coarse, faint, grayish-brown (10YR 5/2) and distinct brownish-yellow (10YR 6/6 to 6/8) mottles; calcareous; gradual, wavy boundary.

IIC—19 to 60 inches +, brown (10YR 5/3) sand and gravel that contains some cobblestones; stratified; single grain; loose; many mottles; strongly calcareous.

The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The B2t horizon ranges from heavy sandy loam to clay loam in texture and from 3 to 10 inches in thickness. Thickness of the solum ranges from 12 to 20 inches.

Fabius soils are a drainage associate of the well-drained Lorenzo soils and of the poorly drained Mussey soils. They have a slightly thinner solum than the Matherton soils.

Fabius loam, 1 to 3 percent slopes (FaA).—This is the only Fabius soil mapped in the county. The areas are either long and narrow or are roughly circular in shape.

Included with this soil in mapping are small areas that have a surface layer of silt loam or sandy loam. Also included are a few moderately eroded areas that are more sloping than this soil. Other included small areas consist of poorly drained Mussey soils.

Runoff on this Fabius soil is slow. For short periods in spring and after a heavy rain water stands in ponds on the areas. In the very gently sloping areas the hazard of water erosion is slight. Capability unit IIw–5; recreation group 6; planting group 4.

Fox Series

The Fox soils are nearly level to gently sloping, loamy, and well drained. They are on outwash terraces along streams and drainageways throughout the county. They formed partly in loamy material and partly in calcareous outwash sand and gravel.

In a typical profile the surface layer is friable, dark grayish-brown loam about 9 inches thick. The subsoil is about 27 inches thick. It is friable, yellowish-brown loam in the upper 5 inches and firm, dark-brown light clay loam in the next 8 inches. Just below is very firm, dark-brown clay loam that is 9 inches thick. The last 5 inches of the subsoil is friable, brown gravelly loam. Below is loose, yellowish-brown stratified sand and gravel.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is medium. Fertility is moderate in the loams and low in the sandy loams. Fox soils are slightly droughty. They are neutral or slightly acid to a depth of about 31 inches and are calcareous to strongly calcareous below.

Most areas of the Fox soils are cropped intensively.

Typical profile of a nearly level Fox loam in a cultivated area (SE¼SE¼ sec. 9, T. 9 N., R. 21 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, subangular blocky structure; friable; many roots; neutral; abrupt, smooth boundary.

B1—9 to 14 inches, yellowish-brown (10YR 5/4) loam; moderate, fine, subangular blocky structure; friable; many roots; a few, thin, patchy, brown to dark-brown (7.5YR 4/4) clay films; slightly acid; clear, smooth boundary.

B21t—14 to 22 inches, dark-brown (7.5YR 4/4) light clay loam; moderate to strong, medium, angular blocky structure; firm; a few roots; brown to dark-brown (7.5YR 4/2) clay films; slightly acid; clear, smooth boundary.

IIB22t—22 to 31 inches, dark-brown (7.5YR 3/4) clay loam; moderate to strong, medium, angular blocky structure and subangular blocky; very firm; a few roots; continuous dark-brown (7.5YR 3/2) clay films; weathered dolomitic pebbles; neutral; clear, wavy boundary.

IIB3t—31 to 36 inches, brown (7.5YR 4/4) gravelly loam; weak, medium, subangular blocky structure; friable; calcareous; gradual, wavy boundary.

IIC—36 to 60 inches +, yellowish-brown (10YR 5/4) sand and gravel; stratified; single grain; loose; strongly calcareous.

The surface layer is loam or sandy loam in texture. It ranges from dark grayish brown (10YR 4/2), in nearly level areas, to brown (10YR 5/3), in gently sloping, eroded areas. In places the B1t horizon is dark yellowish brown in color. Texture of the B2t horizon generally is sandy clay loam where the texture of the surface layer is sandy loam, and clay loam where the texture of the surface layer is loam. Thickness of the solum ranges from 24 to 40 inches. In some places the IIC horizon is very pale brown (10YR 7/4).

Fox soils have a lighter colored or thinner surface layer than Dresden soils. Their B horizon is finer textured and is better developed than that in Boyer soils.

Fox sandy loam, 1 to 6 percent slopes (FmB).—This soil occupies areas that are either oblong or roughly circular. The surface layer is sandy loam, the next layer is loam, and depth to sand and gravel is a few inches less, but the profile otherwise is similar to that described for the series.

Included with this soil in mapping are a few areas that have mottles in the sand and gravel and in the layer just above. Also included are small areas of Casco soils.

Runoff is slow on this Fox soil. The hazards of water erosion and of soil blowing are slight. Capability unit IIIe–4; recreation group 1; planting group 3.

Fox loam, 0 to 2 percent slopes (FoA).—This soil has the profile described for the series. It occupies areas that are either oblong or roughly circular in shape.

Included with this soil in mapping are small areas that have a surface layer of silt loam. Also included are small areas of Casco loams and silt loams.

Runoff is slow on this Fox soil. Capability unit IIs–1; recreation group 1; planting group 3.

Fox loam, 2 to 6 percent slopes (FoB).—This soil occupies areas that generally are large and are either oblong or roughly circular. Depth to sand and gravel is a few inches less than in the profile described for the series.

Included with this soil in mapping are small areas that have a surface layer of silt loam. Also included are small areas of Casco soils.

Runoff is slow on this Fox soil. The hazard of water erosion is slight. Capability unit IIe–2; recreation group 1; planting group 3.

Granby Series

Granby soils are nearly level and sandy and are poorly drained. They are in low areas, mainly in Cedarburg and Belgium Townships. These soils formed in calcareous, stratified, sandy glacial drift.

In a typical profile the surface layer is friable, black loamy sand about 7 inches thick. The next layer is loose, grayish-brown medium sand about 10 inches thick. Just below is loose, light brownish-gray medium sand that is calcareous.

The water table is at or near the surface of these soils for most of the year, and internal drainage therefore is very slow. Available moisture capacity is low, and permeability is moderately rapid. Fertility is low. The soils are neutral to a depth of about 17 inches and are calcareous below.

Some areas of the Granby soils are cultivated. The remaining acreage is used as woodland and as wildlife habitat. The hazard of soil blowing is severe if the areas are drained.

Typical profile of a nearly level Granby loamy sand, loamy substratum, in a cultivated area (NW¼SW¼ sec. 20, T. 10 N., R. 21 E.):

Ap—0 to 7 inches, black (10YR 2/1) loamy sand; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

AC—7 to 17 inches, grayish-brown (2.5Y 5/2) medium sand; loose; neutral; clear, smooth boundary.

C1—17 to 24 inches, light brownish-gray (10YR 6/2) medium sand; single grain; loose; many, medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; mildly alkaline; gradual boundary.

C2—24 to 45 inches, light brownish-gray (10YR 6/2) medium sand; single grain; loose; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; calcareous; clear, smooth boundary.

IIC3—45 to 58 inches, brownish-gray (10YR 5/2) silt and fine sand; massive; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; calcareous; clear, smooth boundary.

IIIC4—58 to 60 inches +, brownish-gray (10YR 5/2) medium sand; loose; calcareous.

The Ap horizon ranges from 7 to 14 inches in thickness, and is black (10YR 2/1) or very dark gray (10YR 3/1) in color. Thickness of the IIC3 horizon ranges from 10 to 15 inches.

Granby soils are a drainage associate of the well-drained Boyer soils and the somewhat poorly drained Wasepi soils.

Granby loamy sand, loamy substratum (0 to 2 percent slopes) (Ge).—This is the only Granby soil mapped in the county. The areas are irregular or are long and narrow in shape. Depth to stratified silt and fine sand is between 30 and 60 inches.

Included with this soil in mapping are small areas that have stratified silt and fine sand at a depth of more than 60 inches. Also included are small areas along Lake Michigan in Belgium Township that lack the loamy substratum. Other included small areas have a surface layer of loam or sandy loam. Still other included areas have a calcareous surface layer or have a highly organic surface layer and very gentle slopes.

Runoff is very slow on this Granby soil. Water is likely to pond on the areas in spring and after a heavy rain. The stratified silt and fine sand flow readily when wet. Capability unit IVw–5; recreation group 7; planting group 5.

Hebron Series

In the Hebron series are nearly level to gently sloping, loamy soils that are well drained and moderately well drained. Most areas are in the western part of the county in old glacial lakebeds. The soils formed in loamy outwash underlain by clayey material.

The surface layer in a typical profile is friable, dark grayish-brown loam about 7 inches thick. Just below is similar, but lighter colored, material that is about 4 inches thick. The subsoil is about 15 inches thick. It is friable, dark-brown heavy loam in the first 3 inches and friable, dark-brown sandy clay loam in the next 7 inches. The last layer of the subsoil is firm, dark-brown silty clay that is about 5 inches thick. Below is friable, light reddish-brown silty clay loam that has yellowish-brown mottles.

These soils have high available moisture capacity and slow permeability. Internal drainage is medium, and fertility is moderate. The soils are mildly alkaline to moderately alkaline to a depth of about 21 inches and are strongly calcareous below.

Most areas of the Hebron soils are cultivated.

Typical profile of a gently sloping Hebron loam in a cultivated area (SW¼SW¼ sec. 4, T. 9 N., R. 21 E.):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—7 to 11 inches, brown (10YR 5/3) loam; weak, medium, platy structure that breaks to weak, medium, granular; friable; many roots; mildly alkaline; clear, smooth boundary.

B1—11 to 14 inches, dark-brown (10YR 4/3) heavy loam; weak, medium, subangular blocky structure; friable; a few roots and pebbles; moderately alkaline; clear, smooth boundary.

B21t—14 to 21 inches, dark-brown (10YR 3/3) sandy clay loam; weak, medium, subangular blocky structure; friable; a few roots and pebbles; moderately alkaline; clear, smooth boundary.

IIB22t—21 to 26 inches, dark-brown (7.5YR 4/2) silty clay; moderate, medium to fine, subangular blocky structure; firm; thin patchy clay films; strongly calcareous; clear, smooth boundary.

IIC—26 to 60 inches +, light reddish-brown (5YR 6/3) silty clay loam; massive; friable; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; strongly calcareous.

The surface layer is dark grayish brown (10YR 4/2) or brown (10YR 4/3) in color. Depth to the IIB22t horizon ranges from 18 to 30 inches. The texture of the B1 and B21t horizons is loam, sandy clay loam, or clay loam, and the part that formed in the underlying material is silty clay loam to silty clay in texture. Thickness of the solum ranges from 24 to 36 inches.

Hebron soils are a drainage associate of the wetter Aztalan and Navan soils, which also have a darker colored surface layer.

Hebron loam, 1 to 6 percent slopes (HeB).—This is the only Hebron soil mapped in the county. The areas are either oblong or are irregular in shape.

Included with this soil in mapping are many small areas that have a surface layer of silt loam and some small areas that have a surface layer of sandy loam. Also included are small areas that have a darker colored surface layer than this soil, and also some small steeper areas. The hazard of soil blowing is slight on the areas that have a surface layer of sandy loam.

Runoff is medium on this Hebron soil. The hazard of water erosion is slight. Capability unit IIe–6; recreation group 2; planting group 3.

Hochheim Series

The Hochheim series consists of nearly level to very steep, loamy soils that are well drained. Most areas are in the uplands in the western part of the county on side slopes and ridges. The soils formed in calcareous, loamy glacial till. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, very dark grayish-brown loam about 9 inches thick. The subsoil is brown to dark brown and is about 12 inches thick. It is friable loam in the upper 3 inches and firm clay loam in the next 7 inches. The remaining 2 inches is friable loam that contains a few pebbles and cobblestones. Just below is friable, light yellowish-brown loamy glacial till that contains many pebbles and cobblestones.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. Hochheim soils are neutral in the surface layer and are neutral to slightly calcareous below. The underlying till is calcareous.

Except for the steeper areas, most of the Hochheim soils are cultivated. Corn, oats, and alfalfa are the crops commonly grown.

Typical profile of a gently sloping Hochheim loam in a cultivated area (NW¼SE¼ sec. 15, T. 10 N., R. 21 E.):

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine, subangular blocky structure that breaks to weak, fine, granular; friable; many roots; a few pebbles; neutral; abrupt, smooth boundary.

B1—9 to 12 inches, brown (7.5YR 4/2) loam; moderate, fine, subangular blocky structure; friable; many roots; a few pebbles and cobblestones; neutral; clear, smooth boundary.

B2t—12 to 19 inches, brown to dark-brown (7.5YR 4/4) clay loam; moderate, fine, subangular blocky structure; firm; a few roots; dark reddish-brown (5YR 3/3) clay films on peds; a few pebbles and cobblestones; mildly alkaline; clear, smooth boundary.

B3t—19 to 21 inches, dark-brown (7.5YR 4/4) loam; moderate, fine to medium, subangular blocky structure; friable; a few dark reddish-brown (5YR 3/3) clay films; a few pebbles and cobblestones; slightly calcareous; clear, smooth boundary.

C—21 to 60 inches +, light yellowish-brown (10YR 6/4) loamy glacial till; massive; friable; many pebbles and cobblestones; calcareous.

The surface layer generally is very dark brown (10YR 2/2) in undisturbed areas and dark brown (10YR 3/3) in cultivated areas. The B horizon ranges from heavy loam to silty clay loam that feels gritty in texture, and it ranges from 4 to 16 inches in thickness. Thickness of the solum ranges from 12 to 24 inches, but it generally ranges from 16 to 22 inches. The underlying glacial till generally is 10YR in hue, but it ranges to 7.5YR in the northwest corner of the county. The till ranges in texture from sandy loam to silt loam that feels gritty, and in places it is weakly stratified. Pebbles and cobblestones are common throughout the profile. Areas undisturbed commonly have stones on the surface.

Hochheim soils are a drainage associate of the somewhat poorly drained Nenno soils and the poorly drained Brookston soils. They have a thinner capping of silt than the Theresa soils and also have a thinner solum.

Hochheim loam, 0 to 2 percent slopes (HmA).—This soil has the profile described for the series. It is on ridges in roughly circular areas.

Included with this soil in mapping are some areas that have a surface layer of silt loam, as well as a few areas that have a surface layer of sandy loam.

Runoff is slow on this Hochheim soil. Capability unit I–1; recreation group 2; planting group 3.

Hochheim loam, 2 to 6 percent slopes, eroded (HmB2).—This soil occupies irregularly shaped areas or roughly circular areas on ridges.

Included with this soil in mapping are some areas that have a surface layer of sandy loam. Also included are some areas of soils that are mottled in the lower part of the subsoil.

Runoff is medium on this Hochheim soil, and the hazard of water erosion is slight. Capability unit IIe–1; recreation group 2; planting group 3.

Hochheim loam, 6 to 12 percent slopes, eroded (HmC2).—This soil occupies irregularly shaped or roughly circular areas on upland slopes. Depth to loamy glacial till is a few inches less than in the profile described for the series.

Included with this soil in mapping are a few areas where the surface layer is silt loam. Also included are a few severely eroded areas. In the severely eroded areas, most of the material formerly in the upper 3 inches of the subsoil has been mixed with the remaining surface layer by plowing.

Runoff is medium on this Hochheim soil, and the hazard of water erosion is moderate. Capability unit IIIe–1; recreation group 2; planting group 3.

Hochheim loam, 12 to 20 percent slopes, eroded (HmD2).—This soil occupies small, irregularly shaped or long, narrow areas in the uplands. Depth to loamy glacial till is a few inches less than in the profile described for the series.

Included with this soil in mapping are a few areas where the surface layer is silt loam, and also a few slightly steeper areas. Also included are a few severely eroded areas. In the severely eroded areas, all but a few inches of the subsoil has been mixed into the remaining surface layer by plowing. As a result the present surface layer generally is clay loam.

Runoff is rapid on this Hochheim soil, and the hazard of water erosion is severe. Capability unit IVe–1; recreation group 2; planting group 3.

Hochheim-Sisson-Casco complex, 0 to 2 percent slopes (HsA).—This complex occupies roughly circular areas on the crests of ridges. Hochheim silt loam makes up about 50 percent of this complex, and Sisson silt loam and Casco silt loam, the remaining 50 percent in about equal parts. The profile of the Hochheim and Casco soils is finer textured than those described for their respective series. The different soils occupy no definite position on the landscape of each area. They are closely intermixed, and their lower layers generally are stratified (fig. 6.)

Included with this complex in mapping are small areas of Casco and Hochheim loams. Also included are small areas of Sisson fine sandy loam and of Zurich silt loam.

The characteristics of the various soils in this complex are described under their respective series. Capability unit I–1; recreation group 2; planting group 3.

Hochheim-Sisson-Casco complex, 2 to 6 percent slopes, eroded (HsB2).—This complex consists of gently sloping and gently undulating soils in roughly circular areas in the uplands. Some of the gently undulating soils have short slopes that face different directions. Hochheim silt loam makes up about 50 percent of this complex, and Sisson silt loam and Casco silt loam, the remaining 50 percent in about equal parts. The profile of the Hochheim and Casco soils is finer textured than the one described for their respective series. The different soils occupy no definite position on the landscape of each area. They are closely intermixed, and their lower layers generally are stratified. The stratified material lies at different angles, which water follows downhill until it shows as seeps, or wet spots, on the surface.

Included with this complex in mapping are small areas of Hochheim and Casco loams. Also included are small areas of Sisson fine sandy loam and of Zurich silt loam.

The characteristics of the various soils in this complex are described under their respective series. Capability unit IIe–1; recreation group 2; planting group 3.

Figure 6.—**A vertical cut in an area of Hochheim–Sisson–Casco complex, 0 to 2 percent slopes, shows the stratified, variable material underlying the soils. Near the spade are dark-colored areas caused by seepage.**

Hochheim-Sisson-Casco complex, 6 to 12 percent slopes, eroded (HsC2).—This complex consists of sloping and undulating soils in the uplands, which generally occupy areas that are oblong in shape. Some of the undulating soils, however, occupy areas that are roughly circular in shape and have short slopes that face different directions. Hochheim silt loam makes up about 40 percent of this complex, and Sisson silt loam and Casco silt loam, the remaining 60 percent in about equal parts. The profile of the Hochheim and Casco soils is finer textured than those described for their respective series. The different soils occupy no definite position on the landscape of each area. They are closely intermixed, and their lower layers generally are stratified. The stratified material lies at different angles, which water follows downhill until it shows as seeps, or wet spots, on the surface.

Included with this complex in mapping are small areas of Hochheim and Casco loams. Also included are small areas of Sisson fine sandy loam and of Zurich silt loam. In addition a few, small areas of severely eroded soils are included.

Runoff is medium on soils of this complex, and the hazard of water erosion is moderate. The characteristics of the various soils in this complex are described under their respective series. Capability unit IIIe–1; recreation group 2; planting group 3.

Hochheim-Sisson-Casco complex, 12 to 20 percent slopes, eroded (HsD2).—This complex consists of moderately steep and rolling soils in the uplands which generally occupy areas that are oblong in shape. Some of the rolling soils, however, occupy areas that are irregular in shape and have slopes that face different directions. Hochheim loam makes up about 40 percent of this complex, and Sisson silt loam and Casco loam, the remaining 60 percent in about equal parts. The different soils occupy no definite position on the landscape of each area. They are closely intermixed, and the lower layers generally are stratified. The stratified material lies at different angles, which water follows downhill until it shows as seeps, or wet spots, on the surface.

Included with this complex in mapping are small areas of severely eroded soils. Also included are small areas of Hochheim and Casco silt loams and of Sisson fine sandy loam.

Runoff is rapid on the soils in this complex, and the hazard of erosion is severe. About two-thirds of the acreage is used for the cultivated crops that commonly are grown in the county. The rest is used as permanent pasture and as woodland. The characteristics of the various soils that make up this complex are described under their respective series. Capability unit IVe–1; recreation group 2; planting group 3.

Hochheim-Sisson-Casco complex, 20 to 35 percent slopes, eroded (HsE2).—This complex consists of steep and hilly areas that are mostly oblong in shape. Some of the hilly soils, however, are irregular in shape and have slopes that face different directions. Hochheim loam, on 20 to 35 percent slopes, makes up about 40 percent of this complex. Sisson loam, on 20 to 35 percent slopes, and Casco loam, on 20 to 30 percent slopes, in about equal parts, make up the remainder of the complex. The different soils occupy no definite position on the landscape of each area. They are closely intermixed, and the lower layers generally are stratified. The stratified materials lie at different angles, which water follows downhill until it shows as seeps, or wet spots, on the surface.

Included with this soil in mapping are small areas of gently sloping Hochheim, Sisson, and Casco silt loams, in swales. Also included are some small areas of soils that have a surface layer of sandy loam and some areas of Rodman soils, all of which commonly have steeper slopes than the soils in this complex.

Runoff is rapid on soils in this complex, and the hazard of water erosion is very severe. About two-thirds of the acreage is used as woodland and permanent pasture. A few scattered areas are used chiefly for hay or for rotation pasture. The characteristics of the various soils that make up this complex are described under their respective series. Capability unit VIe–1; recreation group 2; planting group 3.

Houghton Series

In the Houghton series are nearly level organic soils that are very poorly drained. These soils are in depressions and in old lakebeds scattered throughout the county. They consist of more than 42 inches of fibrous plant remains, such as grasses, sedges, and reeds.

The surface layer in a typical profile is friable, black to very dark brown mucky peat about 12 inches thick. It overlies friable, very dark brown sedge peat that extends to a depth of about 60 inches.

These soils have high available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is low. The soils generally are neutral throughout, but they range to acid in places.

Areas of Houghton soils that are drained are cropped intensively to corn, truck crops, and canning crops. More than half the acreage, however, is in wetland woods or permanent pasture. Such areas also provide habitat for wildlife.

Typical profile of a nearly level Houghton mucky peat in a wooded area (SW¼SW¼ sec. 9, T. 12 N., R. 21 E.):

1—0 to 5 inches, black (10YR 2/1) mucky peat; contains disintegrated, coarse herbaceous material and tree roots; friable; neutral; clear, smooth boundary.

2—5 to 12 inches, very dark brown (10YR 2/2) mucky peat; weak, coarse, subangular blocky structure; contains coarse herbaceous material and tree roots; cleavage planes; friable; neutral; clear, smooth boundary.

3—12 to 36 inches, very dark brown (10YR 2/3) sedge peat; weak, platy structure; friable; neutral; abrupt, smooth boundary.

4—36 to 60 inches, very dark brown (10YR 2/2) sedge peat; weak, platy structure; friable; neutral.

In color the surface layer is black (10YR 2/1) or very dark brown (10YR 2/2). The organic material ranges from disintegrated peat to raw, matted peat. Depth to the mineral substratum is more than 60 inches in undrained areas, but it is 42 inches in places in artificially drained areas. The soils generally are neutral throughout but are slightly acid in places. Small amounts of woody material are present in some areas.

Houghton mucky peat (0 to 2 percent slopes) (Hu).—This soil has the profile described for the series. It occupies areas that are either oblong or roughly circular.

Included with this soil in mapping are small areas of Marsh, some cultivated areas that have a surface layer of muck, and some cultivated areas that have a surface layer of peat. One of the uncultivated areas is mostly fibrous, matted peat. It is in an old glacial lakebed in the central part of the Cedarburg Bog and consists of about 350 acres. Also included are small areas of organic soil on which mineral soil washed from surrounding uplands has been deposited.

The water table is at or near the surface of this Houghton soil for most of the year. Water stands in ponds on the areas in spring and after a heavy rain. In drained areas the hazards of wind erosion and subsidence are serious. Capability unit IIIw–9; recreation group 8; planting group 6.

Keowns Series

The Keowns series consists of nearly level, loamy soils that are poorly drained. These soils are in depressions in old glacial lake basins in the western part of the county. They formed in lacustrine silt and fine sand. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, very dark gray silt loam about 7 inches thick. The subsoil is friable, light olive-gray very fine sandy loam that is mottled with brownish yellow and is about 15 inches thick. Below is friable, pale-brown to very pale brown, stratified silt and very fine sand that has yellowish and grayish mottles.

The water table is at or near the surface of Keowns soils for most of the year. Available moisture capacity is high, permeability is moderate, and internal drainage is very slow. Fertility is moderate. The profile commonly is calcareous throughout.

Most areas of Keowns soils are drained and cultivated. Areas undrained are used as woodland and as wildlife habitat.

Typical profile of a nearly level Keowns silt loam in a cultivated field (NE¼SE¼ sec. 6, T. 12 N., R. 21 E.):

Ap—0 to 7 inches, very dark gray (10YR 3/1) silt loam; weak, fine, granular structure; friable; many roots; moderately alkaline; abrupt, smooth boundary.

Bg—7 to 22 inches, light olive-gray (5Y 6/2) very fine sandy loam; weak, thick, platy structure; friable; a few roots; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; moderately alkaline to slightly calcareous; gradual, wavy boundary.

C—22 to 60 inches, pale-brown (10YR 6/3) coarse silt and very pale brown (10YR 7/3) very fine sand in alternate layers; stratified; friable; common, medium, distinct, grayish-brown (10YR 5/2) and brownish-yellow (10YR 6/6) mottles; strongly calcareous.

The surface layer is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2) in color. Thickness of the Bg horizon ranges from 14 to 25 inches. Depth to free carbonates generally is about 12 inches. In places a few, fine, faint mottles are in the Bg horizon, and in other places the mottles are prominent. The underlying material is dominantly fine sand and coarse silt, but some thin, clayey strata occur.

Keowns soils are a drainage associate of the somewhat poorly drained Yahara soils. They have a coarser textured Bg horizon than the Colwood soils and are shallower to free carbonates.

Keowns silt loam (0 to 2 percent slopes) (Km).—This is the only Keowns soil mapped in the county. The areas are irregular in shape.

Included with this soil in mapping are small areas that have a surface layer of fine sandy loam. Also included are some small areas that are more sloping than this soil. Other included small areas consist of Colwood silt loam.

Runoff is very slow on this soil. Water is likely to stand in ponds on the areas in spring and after a heavy rain. Capability unit IIIw-3; recreation group 7; planting group 5.

Kewaunee Series

Kewaunee soils are nearly level to steep, well drained, and loamy. Most areas are gently sloping and are in the glaciated uplands throughout the eastern half of the county. The soils formed in reddish silty clay loam material laid down in lakes and then redeposited by glacial ice. Some areas, however, have a thin capping of silt on them. Locally, the soils are called "red clays," but they actually are silt loams, silty clay loams, or silty clays.

In a typical profile the surface layer is dark-brown silty clay loam about 7 inches thick. The subsoil is very firm, dark reddish-brown clay or silty clay in the upper 13 inches and firm, reddish-brown heavy silty clay loam in the remaining 3 inches. Just below is firm, reddish-brown heavy clay loam. The lower part of the subsoil and the underlying material contain a few pebbles.

These soils have high available moisture capacity and slow permeability. Internal drainage is medium. Fertility is moderate. The soils are mildly alkaline in the upper two layers and are slightly calcareous below.

Kewaunee soils are suitable for deep-rooted plants, and most areas are in crops. In the southern part of the county, however, large areas are in suburban or rural residential uses.

Typical profile of a gently sloping, moderately eroded Kewaunee silty clay loam in a cultivated area (NE¼NE¼ sec. 24, T. 11 N., R. 21 E.):

Ap—0 to 7 inches, dark-brown (7.5YR 4/2) silty clay loam that is pinkish gray (7.5YR 6/2) when dry; weak, medium, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B2t—7 to 20 inches, dark reddish-brown (5YR 3/3) silty clay; strong, fine, angular blocky structure; very firm; many roots; mildly alkaline; clear, wavy boundary.

B3t—20 to 23 inches, reddish-brown (5YR 4/3) heavy silty clay loam; moderate, medium, angular blocky structure; firm; a few roots; a few dolomitic pebbles; slightly calcareous; clear, wavy boundary.

C—23 to 60 inches +, reddish-brown (5YR 4/3) heavy clay loam; moderate, medium, subangular blocky structure in the upper part and massive in the lower part; firm; white segregated lime coatings on faces of peds; a few dolomitic pebbles; strongly calcareous.

The surface layer is silty clay loam, silt loam, or silty clay in texture. The silty clays are in severely eroded areas and the silty clay loams are in less eroded areas. In color the surface layer ranges from dark brown (7.5YR 3/2) to dark reddish brown (5YR 3/4) in eroded, cultivated areas. Thickness of the solum generally is about 22 or 23 inches, but it ranges from 20 inches in the steep, eroded silty clays to 32 inches in the nearly level silt loams. In places the profile contains a few pebbles and cobblestones. In Ozaukee County these soils are on the coarse end of the range for the series and the underlying till is coarser than typical for the series.

Kewaunee soils are a drainage associate of the somewhat poorly drained Manawa soils and the very poorly drained Poygan soils. They are similar to the Saylesville soils, but unlike them have glacial pebbles in their profile. Kewaunee soils are redder (5YR hue) in the B horizon than Ozaukee soils.

Kewaunee silt loam, 0 to 2 percent slopes (KnA).—This soil occupies the higher parts of the uplands, and the areas generally are irregular in shape. The surface layer is more silty and more friable, but the profile otherwise is like that described for the series. Depth to silty clay loam glacial till is slightly greater.

Included with this soil in mapping are some areas of somewhat poorly drained Manawa soils that are too small to be mapped separately.

The lower layers in this soil are clayey, and the soil therefore warms and dries slowly in spring and after a heavy rain. Capability unit IIs-7; recreation group 3; planting group 3.

Kewaunee silt loam, 2 to 6 percent slopes (KnB).—This soil is on the crests of ridges. The areas generally are gently sloping, are large, and are irregular in shape. A few gently undulating areas, however, have short slopes that face different directions. The surface layer is more silty and more friable, but the profile otherwise is like that described for the series. Depth to silty clay loam glacial till is slightly greater.

Included with this soil in mapping are some areas of somewhat poorly drained Manawa soils that are too small to be mapped separately. Also included are areas that have a surface layer of loam or sandy loam.

This Kewaunee soil has long slopes and slowly permeable lower layers. Runoff is medium, especially during a heavy rain. The hazard of water erosion is slight. Capability unit IIe-6; recreation group 3; planting group 3.

Kewaunee silty clay loam, 2 to 6 percent slopes, eroded (KoB2).—This soil has the profile described for the series. It is on the crests of ridges. The areas generally are gently sloping, are large, and are irregular in shape. A few gently sloping areas, however, have short slopes that face in different directions.

Much of the original surface layer of this soil has been removed through erosion, and part of the material formerly in the subsoil has been mixed with the remaining surface layer by plowing. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas of somewhat poorly drained Manawa soils. Also included are some areas of severely eroded Kewaunee silty clays and of Kewaunee silt loams. Other included small areas of Kewaunee soils are along the western edge of this Kewaunee soil. In these areas loamy glacial till, like that underlying the Hochheim soils, is at a depth between 30 and 60 inches.

This Kewaunee soil has long slopes and slowly permeable lower layers. Runoff is medium, especially during a heavy rain. The hazard of water erosion is slight. Capability unit IIe-6; recreation group 3; planting group 3.

Kewaunee silty clay loam, 6 to 12 percent slopes, eroded (KoC2).—This soil occupies long, narrow areas near drainageways.

Included with this soil in mapping are small areas that have a surface layer of loam or silt loam. Also included are small areas of severely eroded silty clays.

This Kewaunee soil has strong slopes and slowly permeable lower layers. Runoff is rapid, especially during a heavy rain. The hazard of further water erosion is moderate. Capability unit IIIe-6; recreation group 3; planting group 3.

Kewaunee silty clay, 6 to 12 percent slopes, severely eroded (KrC3).—This soil generally occupies long, narrow areas near drainageways. The surface layer contains more clay and the second layer is thinner, but the profile otherwise is like that described for the series. This soil has lost most of its original surface layer through erosion, and plowing has mixed clayey material formerly in the second layer with the remaining surface layer. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas of Kewaunee silty clay loams.

This Kewaunee soil has strong slopes and slowly permeable lower layers. Runoff is rapid, especially during a heavy rain. Capability unit IVe-6; recreation group 3; planting group 3.

Kewaunee silty clay, 12 to 20 percent slopes, severely eroded (KrD3).—This soil generally occupies long, narrow areas near major drainageways. The surface layer contains more clay and the second layer is thinner, but the profile of this soil otherwise is like that described for the series. This soil has lost most of its original surface layer through erosion, and plowing has mixed material formerly in the second layer with the remaining surface layer. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas of Kewaunee silty clay loams. Also included are small areas that have steeper slopes.

Because of the slopes, runoff is very rapid on this soil. Capability unit VIe-6; recreation group 3; planting group 3.

Knowles Series

Nearly level to gently sloping, loamy, well-drained soils are in the Knowles series. These soils are scattered throughout the western half of the county. They formed partly in silt and partly in glacial drift 20 to 42 inches thick over bedrock.

In a typical profile the surface layer is friable, dark grayish-brown silt loam about 8 inches thick. Just below is about 4 inches of friable, brown silt loam. The subsoil is about 16 inches thick and has a few pebbles in the lower part. It is friable, brown silt loam in the upper 3 inches and firm, dark yellowish-brown silty clay loam in the next 8 inches. The remaining 5 inches is firm, dark yellowish-brown heavy clay loam. It overlies pale-brown dolomitic limestone bedrock.

Knowles soils have medium available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. Root depth is slightly limited. The soils generally are mildly alkaline in the surface layer and neutral to medium acid in the subsoil.

Most areas of the Knowles soils are cultivated.

Typical profile of a gently sloping Knowles silt loam in a cultivated area (NE¼NW¼ sec. 9, T. 9 N., R. 21 E.):

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, subangular blocky structure that breaks to moderate, medium, granular; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) silt loam; moderate, thin, platy structure; friable; many roots; light-gray (10YR 7/1) silica coatings on peds; mildly alkaline; clear, wavy boundary.

B1—12 to 15 inches, brown (10YR 4/3) silt loam; weak, thick, platy structure that breaks to fine, subangular blocky; friable; many roots; light-gray (10YR 7/1) silica coatings on peds; neutral; clear, smooth boundary.

IIB21t—15 to 23 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; many roots; distinct, thin clay films on peds; some silica coatings; a few weathered pebbles; medium acid; clear, wavy boundary.

IIB22t—23 to 28 inches, dark yellowish-brown (10YR 3/4) heavy clay loam; moderate, medium, subangular blocky structure; firm; many roots; thick, continuous clay films; a few weathered pebbles; neutral; abrupt, wavy boundary.

IIIR—28 to 60 inches +, pale-brown (10YR 6/3) dolomitic limestone bedrock.

The surface layer ranges from dark grayish brown (10YR 4/2) or brown to dark brown (10YR 4/3) in color. Texture of the B horizon ranges from silt loam to silty clay loam. In some areas the upper part of the bedrock is severely fractured. Reaction ranges from acid to alkaline.

Knowles soils are deeper to bedrock than the Ritchey soils.

Knowles silt loam, 0 to 2 percent slopes (KwA).—This soil occupies areas that are roughly circular. The soil is a few inches deeper to bedrock, but its profile otherwise is similar to the one described for the series.

Included with this soil in mapping are a few small areas of Casco loam, 0 to 2 percent slopes, that are underlain by bedrock. Also included are small areas that are more than 42 inches to bedrock or that are less than 20 inches to bedrock.

Runoff is slow on this Knowles soil. Capability unit IIs–1; recreation group 4; planting group 3.

Knowles silt loam, 2 to 6 percent slopes, eroded (KwB2).—This soil has the profile described for the series. It occupies areas that are irregular in shape.

Included with this soil in mapping are a few areas that have a surface layer of loam and a few areas that are slightly steeper than this soil. Also included are small areas that are more than 42 inches to bedrock or are less than 20 inches to bedrock.

Runoff is medium on this Knowles soil. The hazard of water erosion is slight. Capability unit IIe–2; recreation group 4; planting group 3.

Knowles Series, Mottled Subsoil Variant

The variants from the normal Knowles soils are nearly level, loamy soils that are somewhat poorly drained. These soils occupy small areas mainly in the western part of the county. They formed partly in silt and partly in glacial drift 20 to 42 inches thick over bedrock.

In a typical profile the surface layer is friable, very dark grayish-brown silt loam about 7 inches thick. Just below is friable, dark grayish-brown silt loam about 5 inches thick. The subsoil is about 12 inches thick. It is firm, brown silty clay loam in the upper 6 inches. The remaining 6 inches is friable, yellowish-brown loam that is mottled with brown and strong brown. Below is pale-brown dolomitic limestone bedrock.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is slow because of a temporary high water table. Fertility is moderate. Root depth is slightly limited. The soils are moderately alkaline throughout.

About half the acreage of these soils is cultivated. The remainder is in permanent pasture or is wooded.

Typical profile of a nearly level Knowles silt loam, mottled subsoil variant, in a cultivated field (NE¼SW¼ sec. 10, T. 9 N., R. 21 E.):

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; moderately alkaline; abrupt, smooth boundary.

A3—7 to 12 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, subangular blocky structure; friable; moderately alkaline; clear, wavy boundary.

B2t—12 to 18 inches, brown (7.5YR 4/2) silty clay loam; moderate, medium to fine, subangular blocky structure; firm; a few, fine, faint mottles; moderately alkaline; clear, wavy boundary.

IIB3t—18 to 24 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable; common, medium, distinct, brown (7.5YR 5/2) and strong-brown (7.5YR 5/6 and 5/8) mottles; weathered limestone pebbles and rock fragments; moderately alkaline; abrupt, smooth boundary.

IIIR—24 to 60 inches +, pale-brown dolomitic limestone bedrock.

The surface layer is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3) in color. Texture of the B2t horizon ranges from heavy silt loam to silty clay loam. In places the upper part of the bedrock is fractured.

These variants are similar to the normal Knowles soils, but unlike them, have mottles in the subsoil. They have a slightly thicker solum than the Ritchey soils.

Knowles silt loam, mottled subsoil variant, 0 to 2 percent slopes (KyA).—This is the only variant from the normal Knowles soils mapped in the county. It occupies low areas or areas that receive seepage from higher lying soils. The areas are long and narrow or are roughly circular in shape.

Included with this soil in mapping are several gently sloping areas that are less than 20 inches to bedrock. In these areas root depth is moderately limited to severely limited. Also included are a few small areas that are more than 42 inches to bedrock.

This soil has a temporary water table 1 to 3 feet from the surface. Runoff is slow. Water is likely to pond on the areas in spring and after a heavy rain. Capability unit IIw–5; recreation group 6; planting group 4.

Loamy land (Lu) consists of cut and filled areas that are mainly in and around urban areas in the county.

In cut or borrow areas, the original soil material has been removed by man and raw, fairly inert soil material is exposed. The banks of cut areas have been sloped and graded. As a result, the areas blend in with adjacent, relatively undisturbed soil areas and can be used as sites for buildings and for highways or other kinds of transportation facilities.

In filled areas, the fill material ranges from 1 to about 5 feet in thickness. Originally, the areas generally consisted of mineral soils that were somewhat poorly drained to very poorly drained. Some of the areas, however, originally contained well-drained mineral soils, and some other areas consisted of organic soils.

Loamy land ranges from sandy loam to silt loam in texture. In cut areas all of the soil material above the parent material has been removed. The material remaining generally is loamy glacial till that contains pockets of sand and gravel or of clayey material. In filled areas the soil material is more variable. In places it contains such debris as cinders, rocks, and broken concrete slabs.

The surface of Loamy land generally is compacted. The soil material however, is somewhat more favorable for growth of plants than is Clayey land. Capability unit VIIIs–10; recreation group 2; planting group 3.

Lorenzo Series

The Lorenzo series consists of nearly level to gently sloping, loamy soils that are well drained. These soils are on outwash terraces, mainly along the Milwaukee River. They formed partly in loamy material and partly in calcareous outwash sand. Grasses made up the original vegetation.

In a typical profile the surface layer is very friable, very dark brown loam about 8 inches thick. The subsoil is about 10 inches thick. It is friable, dark yellowish-brown loam in the upper 2 inches and firm, dark-brown sandy clay loam in the next 6 inches. The remaining 2 inches is friable, dark-brown gravelly sandy loam. Below is loose, yellowish-brown sand and gravel.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is rapid, and the soils are droughty. Fertility is low. The soils are neutral to mildly alkaline to a depth of about 16 inches and are calcareous below.

Typical profile of a nearly level Lorenzo loam in a cultivated area (NW¼NW¼ sec. 25, T. 11 N., R. 21 E.):

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; very friable; many roots; neutral; abrupt, smooth boundary.

B1—8 to 10 inches, dark yellowish-brown (10YR 3/4) loam; weak, fine, subangular blocky structure; friable; many roots; neutral; clear, wavy boundary.

B2t—10 to 16 inches, dark-brown (7.5YR 3/3) sandy clay loam; moderate, medium, subangular blocky structure; firm; a few roots; continuous clay films on ped faces; mildly alkaline; clear, wavy boundary.

B3—16 to 18 inches, dark-brown (10YR 3/3) gravelly sandy loam; weak, medium, subangular blocky structure; friable; calcareous; clear, wavy boundary.

C—18 to 60 inches +, yellowish-brown (10YR 5/4) sand and gravel; stratified; single grain; loose; strongly calcareous.

The surface layer is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) in color. The B horizon is loam or sandy loam in texture, but 6 inches or more of the horizon is sandy clay loam or clay loam. Thickness of the solum ranges from 12 to 20 inches.

Lorenzo soils are a drainage associate of the somewhat poorly drained Fabius soils and the poorly drained Mussey soils. Their surface layer is darker colored (10YR 2/2) than that in the Casco soils (10YR 4/3) and it contains more organic matter. Lorenzo soils are similar to the Rodman soils, but unlike them, have an argillic horizon.

Lorenzo loam, 1 to 3 percent slopes (LyA).—This is the only Lorenzo soil mapped in the county. The areas are roughly circular.

Included with this soil in mapping are a few small areas that have a surface layer of silt loam. Also included are a few small areas in which depth to sand and gravel is slightly greater than 20 inches. A few other included areas are sloping and eroded and commonly have pebbles and cobblestones on the surface.

Runoff is slow on this soil. In the very gently sloping areas, the hazard of water erosion is slight. Capability unit IIIs-2; recreation group 1; planting group 2.

Manawa Series

In the Manawa series are nearly level or very gently sloping, loamy soils that are somewhat poorly drained. These soils are mostly in waterways in the eastern half of the county near the Kewaunee soils. They formed in reddish-brown silty clay loam lake-laid material that had a thin capping of silt. The lake-laid material had been redeposited by glacial ice.

The surface layer in a typical profile is friable, very dark grayish-brown silt loam about 8 inches thick. Just below is about 4 inches of friable, grayish-brown silt loam. The subsoil is firm, brown to strong-brown silty clay loam in the upper 6 inches. The remaining 9 inches is light silty clay mottled with dark gray and reddish gray. Below is firm, reddish-brown silty clay loam.

Manawa soils have high available moisture capacity and slow permeability. Internal drainage is slow because of a temporary water table 1 to 3 feet from the surface. Fertility is moderate. The soils are mildly alkaline in the upper three layers, moderately alkaline in the next layer, and calcareous below.

Nearly all areas of Manawa soils are drained and are cropped intensively.

Typical profile of a gently sloping Manawa silt loam in a cultivated area (SE¼SW¼ sec. 5, T. 9 N., R. 22 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, subangular blocky structure that breaks to moderate, medium, granular; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—8 to 12 inches, grayish-brown (10YR 5/2) silt loam; weak, thin, platy structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1t—12 to 18 inches, brown (7.5YR 5/2) and strong-brown (7.5YR 5/6) silty clay loam in equal parts; strong, fine and medium, angular blocky structure; firm; many roots; streaks of dark gray (5YR 4/1) along root channels; mildly alkaline; gradual, wavy boundary.

B2t—18 to 27 inches, reddish-brown (5YR 4/4) light silty clay; strong, medium, angular blocky structure; firm; a few roots; common, fine, distinct, reddish-gray (5YR 5/2) mottles; streaks of dark gray (5YR 4/1) along root channels; a few weathered dolomite pebbles; moderately alkaline; gradual, wavy boundary.

C—27 to 60 inches +, reddish-brown (5YR 4/4) silty clay loam; massive; firm; common, fine, distinct, reddish-gray (5YR 5/2) mottles; a few dolomite pebbles; calcareous.

The surface layer ranges from 7 to 9 inches in thickness, but it is thickest where material washed from surrounding uplands has accumulated. In some places the surface layer is very dark brown (10YR 2/2). Thickness of the solum ranges from 24 to 30 inches. Mottles generally occur just below the surface layer, but in places they are at a depth of as much as 18 inches. In some areas the profile contains a few cobblestones.

Manawa soils are a drainage associate of the well-drained Kewaunee soils and the very poorly drained Poygan soils. They are redder (5YR hue) throughout the profile than Mequon soils.

Manawa silt loam, 1 to 3 percent slopes (MaA).—This is the only Manawa soil mapped in the county. Some areas are very gently sloping and are in waterways, and other areas are nearly level and are in the uplands. The areas generally are long and narrow or are roughly circular. Depth to glacial till is slightly greater, but otherwise the profile of this soil is like that described for the series.

Included with this soil in mapping are small areas that have a surface layer of loam. Also included are some areas that have a thicker surface layer than that in this soil because material washed from higher lying areas has accumulated on them. Other included small areas have a surface layer that is darker colored than that in this soil. Still other included small areas consist of very poorly drained Poygan silty clay loam.

The lower layers of Manawa silt loam, 1 to 3 percent slopes, are clayey, and runoff is slow. As a result, the nearly level areas are slow to dry in spring and water is likely to stand in ponds on them in spring or after a heavy rain. On the very gently sloping areas, runoff is medium and the hazard of water erosion is slight. Capability unit IIw-2; recreation group 6; planting group 4.

Marsh (0 to 2 percent slopes) (Mf) consists of wet organic soils intermixed with mineral material of various kinds. It is on bottom lands or along the edges of lakes and depressions throughout the county.

The water table is permanently high in this land type, and the areas often are flooded for fairly long periods. The vegetation is mostly marsh grasses, cattails, and reeds, but shrubs that tolerate wetness grow in some places.

Marsh is not suitable for cultivation or for use as pasture or woodland. It is used mainly for wildlife habitat. In most places the areas are too low for drainage to be feasible. Capability unit VIIIw-15; recreation group 9; planting group not assigned.

Martinton Series

Nearly level or very gently sloping, loamy soils that are somewhat poorly drained are in the Martinton series. These soils are in the western part of the county in waterways and in low areas in the beds of glacial lakes. They formed in lake-laid silt and clay. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, very dark brown heavy silt loam. The subsoil is about 16 inches thick. It is firm, brown silty clay in the upper 5 inches and firm, pale-brown heavy silt loam that is stratified with silty clay in the next 4 inches. The remaining 9 inches is firm, pinkish-gray and reddish-brown silty clay loam that also contains stratified silty clay. Just below is pinkish-gray and reddish-brown, stratified silt and silty clay.

Martinton soils have high available moisture capacity and slow permeability. Internal drainage is slow because of a temporary high water table 1 to 3 feet from the surface. The soils are moderately alkaline to a depth of about 17 inches and are calcareous below.

Most areas of these soils are drained and are cropped intensively.

Typical profile of a nearly level Martinton silt loam in a cultivated area (NW¼NW¼ sec. 9, T. 10 N., R. 21 E.):

Ap—0 to 8 inches, very dark brown (10YR 2/2) heavy silt loam; moderate, medium, granular structure; friable; many roots; moderately alkaline; abrupt, smooth boundary.

B2t—8 to 13 inches, brown (10YR 5/3) silty clay; moderate, medium, subangular blocky structure; thick continuous clay films; firm; many roots; a few, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderately alkaline; clear, smooth boundary.

B31t—13 to 17 inches, pale-brown (10YR 6/3) heavy silt loam stratified with silty clay; weak to moderate, medium, subangular blocky structure; thin patchy clay films; firm; a few roots; common, medium, faint, yellowish-brown (10YR 5/4) mottles; moderately alkaline; clear, wavy boundary.

B32—17 to 24 inches, pinkish-gray (7.5YR 6/2) and reddish-brown (5YR 5/3) silty clay loam in equal parts, and thin layers of silty clay; moderate, medium, subangular blocky structure; firm; segregated lime coatings on ped surfaces; calcareous; gradual, wavy boundary.

C—24 to 60 inches +, equal parts pinkish-gray (7.5YR 6/2) and reddish-brown (5YR 5/3) stratified silt and silty clay; very firm; segregated lime spots; strongly calcareous.

The surface layer is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2) in color. Texture of the B2t horizon is silty clay or clay. Mottling occurs at a depth between 8 and 14 inches. Thickness of the solum ranges from 15 to 30 inches. In places silt increases in amount at a depth below 30 inches and thin layers of fine sand are present.

Martinton soils generally are finer textured throughout the profile than Darroch soils.

Martinton silt loam, 1 to 3 percent slopes (MgA).—This is the only Martinton soil mapped in the county. Some areas are nearly level and are in low places in lakebeds. Other areas are very gently sloping and are in waterways and on foot slopes. The areas generally are oblong or irregular in shape.

Included with this soil in mapping are small areas that have a lighter colored surface layer than this soil and some areas that are more sloping. Also included are small areas of poorly drained Poygan silty clay loam in depressions.

On the nearly level areas of this Martinton soil, water is likely to stand in ponds for short periods in spring and after a heavy rain. On the very gently sloping areas, the hazard of water erosion is slight. Capability unit IIw-2; recreation group 6; planting group 4.

Matherton Series

The Matherton series consists of nearly level or very gently sloping, loamy soils that are somewhat poorly drained. These soils are on flats and in waterways on outwash terraces throughout the county. They formed partly in loamy material and partly in calcareous outwash sand and gravel.

In a typical profile the surface layer is friable, very dark grayish-brown silt loam about 9 inches thick. The subsoil is dark brown and is about 19 inches thick. It is firm clay loam in the upper 3 inches and firm sandy clay loam in the next 13 inches. The remaining 3 inches is very friable sandy loam that is mottled with grayish brown and yellowish brown. Just below is loose, light yellowish-brown, stratified sand and gravel that is mottled with grayish brown and yellowish brown.

Matherton soils have medium available moisture capacity and moderate permeability. Internal drainage is slow because of a temporary high water table 1 to 3 feet from the surface. Fertility is moderate. The soils are neutral to moderately alkaline in the upper layers and strongly calcareous in the stratified sand and gravel.

Most areas of these soils are cropped intensively. A few small undrained areas are in permanent pasture or are wooded.

Typical profile of a nearly level Matherton silt loam in a cultivated area (NW¼NE¼ sec. 26, T. 11 N., R. 21 E.):

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, subangular blocky structure to weak, medium, granular; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1t—9 to 12 inches, dark-brown (10YR 4/3) clay loam; moderate, medium, subangular blocky structure; firm; a few roots; contains dark grayish-brown (10YR 4/2) A2 material in the top ½ to 1 inch of this horizon that has been mixed with material from this horizon by worms; common, medium, faint, yellowish-brown (10YR 5/6) mottles; neutral; clear, smooth boundary.

IIB2t—12 to 25 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; a few roots; brown (7.5YR 4/2) clay coatings on the surface of peds; common, medium, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, wavy boundary.

IIB3—25 to 28 inches, dark-brown (10YR 4/3) sandy loam; weak, coarse, subangular blocky structure; very friable; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; a few dolomitic pebbles; moderately alkaline; clear, wavy boundary.

IIC—28 to 60 inches +, light yellowish-brown (10YR 6/4), stratified sand and gravel; single grain; loose; common, coarse, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/8) mottles; strongly calcareous.

The surface layer is loam or silt loam in texture. The IIB2t horizon is sandy clay loam, clay loam, or silty clay loam that feels gritty. It is more than 10 inches thick where the solum is more than 24 inches thick. Thickness of the solum ranges from 24 to 36 inches, and mottles occur at a depth between 8 and 16 inches. The soils are neutral to alkaline to a depth of about 28 inches.

Matherton soils are a drainage associate of the well-drained Dresden soils and of the poorly drained Sebewa soils.

Matherton loam, 0 to 2 percent slopes (MkA).—Areas of this soil are either long and narrow or are roughly circular. The surface layer is loam, but the profile is otherwise similar to the one described for the series.

Included with this soil in mapping are a few, small, gently sloping areas and a few small areas of Sebewa silt loam. Also included are some areas that are more silty in the middle part of the profile than this soil and that also contain thin, stratified silty clay and fine sand. These areas are mainly in Belgium Township.

Runoff is slow on this Matherton soil. The soil has a temporary high water table and is subject to ponding in spring and after a heavy rain. Capability unit IIw–5; recreation group 6; planting group 4.

Matherton silt loam, 1 to 3 percent slopes (MmA).—This soil has the profile described for the series. Some areas are nearly level and are on flats, and others are very gently sloping and are in drainageways. The areas are either long and narrow or are roughly circular.

Included with this soil in mapping are small areas of well-drained Dresden silt loam, 1 to 3 percent slopes, and of poorly drained Sebewa silt loam. Also included are small areas that are underlain by loamy material at a depth between 42 and 60 inches.

Sloping areas of this Matherton soil are susceptible to slight erosion even though runoff is slow. The soil has a temporary high water table and is subject to ponding in spring and after a heavy rain. Capability unit IIw–5; recreation group 6; planting group 4.

Mequon Series

Nearly level or gently sloping, loamy, somewhat poorly drained soils are in the Mequon series. These soils are in the southwestern part of the county in waterways and on foot slopes. They formed in calcareous silty clay loam glacial till that had a capping of silt less than 20 inches thick.

In a typical profile the surface layer is friable, very dark brown silt loam about 7 inches thick. Just below is about 4 inches of similar material that is dark grayish brown in color. The subsoil is about 19 inches thick. It is firm, dark grayish-brown silty clay loam in the upper 5 inches and firm, dark-brown silty clay in the next 4 inches. The next 7 inches is very firm, brown to dark-brown heavy silty clay loam, and the remaining 3 inches is very firm, dark-brown silty clay loam. Below is brown silty clay loam. Mottles begin just below the surface layer, and pebbles, in the second layer of the subsoil.

These soils have high available moisture capacity and moderately slow permeability. Internal drainage is slow. The water table is temporarily high. Fertility is moderate. The soils are mildly alkaline to a depth of about 27 inches and are calcareous below.

Nearly all areas of the Mequon soils are drained and are cropped intensively.

Typical profile of a nearly level Mequon silt loam in a cultivated area (SE¼SE¼ sec. 31, T. 10 N., R. 21 E.):

Ap—0 to 7 inches, very dark-brown (10YR 2/2) silt loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—7 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, platy structure that breaks to weak, fine, subangular blocky; friable; many roots; some material from the Ap horizon has been mixed with this horizon by worms; a few, fine, distinct, dark yellowish-brown (10YR 4/4) and dark-brown (7.5YR 4/4) mottles; mildly alkaline; clear, wavy boundary.

IIB1t—11 to 16 inches, dark grayish-brown (10YR 4/2) silty clay loam; moderate, fine, subangular blocky structure; firm; a few roots; thin, patchy clay films; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, smooth boundary.

IIB21t—16 to 20 inches, dark-brown (7.5YR 4/4) silty clay; strong, medium,, angular blocky structure; firm; a few roots; discontinuous clay films on ped surfaces; many, fine to medium, distinct, strong-brown (7.5YR 5/6 to 5/8) mottles; a few weathered pebbles; mildly alkaline; clear, smooth boundary.

IIB22t—20 to 27 inches, dark-brown (7.5YR 4/4) heavy silty clay loam; strong, medium, angular blocky structure; very firm; a few roots; discontinuous clay films on ped surfaces; many, medium to coarse, distinct, dark grayish-brown (10YR 4/2) and strong-brown (7.5YR 5/6 to 5/8) mottles; a few weathered pebbles; mildly alkaline; gradual, smooth boundary.

IIB3t—27 to 30 inches, brown (7.5YR 4/2) silty clay loam; moderate, coarse, angular blocky structure; very firm; common, medium, distinct, strong-brown (7.5YR 5/6 to 5/8) mottles; a few pebbles; calcareous; gradual, wavy boundary.

IIC—30 to 60 inches +, brown (7.5YR 4/4) silty clay loam; massive to weak, coarse, subangular blocky structure; firm; a few, fine, distinct, strong-brown (7.5YR 5/8) mottles; a few pebbles; strongly calcareous.

In color the surface layer is black (10YR 2/1) in undisturbed areas and very dark grayish-brown (10YR 3/2) in cultivated areas. In some places the A2 horizon is dark brown (10YR 4/3). The B2 horizon is silty clay or heavy silty clay loam in texture. It is dark grayish brown (10YR 4/2) or dark brown (7.5YR 4/4) in color. Thickness of the solum ranges from 20 to 36 inches. Mottles begin at a depth of between 7 and 15 inches, and they vary in number and intensity.

Mequon soils are a drainage associate of the well drained to moderately well drained Ozaukee soils and the poorly drained Ashkum soils. They contain more pebbles than the Martinton soils and are browner in hue than the Manawa soils.

Mequon silt loam, 1 to 3 percent slopes (MtA).—This is the only Mequon soil mapped in the county. Some areas are very gently sloping and are in waterways. Other areas are nearly level and are in the uplands. The areas generally are long and narrow or are roughly circular.

Included with this soil in mapping are small areas of the darker colored, poorly drained Ashkum silt loam. Also included are small areas that have a thicker surface layer than this soil because material from higher lying areas has accumulated on them.

Because of the temporary water table 1 to 3 feet from the surface and slow runoff, water is likely to pond on nearly level areas of this Mequon soil in spring and after a heavy rain. On the very gently sloping areas, runoff is medium and the hazard of water erosion is slight. Capability unit IIw–2; recreation group 6; planting group 4.

Muskego Series

In the Muskego series are nearly level organic soils that are very poorly drained. These soils are in depressions and on low flats scattered throughout the county. They consist of the remains of grasses, sedges and reeds, and other fibrous plant material.

The surface layer in a typical profile is friable, black muck about 9 inches thick. It overlies black peaty muck and dark-brown peat about 21 inches thick. At a depth of about 30 inches is dark olive-gray, rubbery, sedimentary peat.

Muskego soils have very high available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is low. The underlying sedimentary peat hardens when dry and generally stays hard even when moistened again. The soils generally are neutral throughout.

About half the acreage of these soils is in wetland woods or permanent pasture that also provide habitat for wildlife. Areas that are drained are cropped intensively.

Typical profile of a nearly level Muskego muck in a cultivated area (NE¼SE¼ sec. 11, T. 11 N., R. 21 E.):

1p—0 to 9 inches, black (10YR 2/1) muck; weak, fine, subangular blocky structure; friable; many roots; neutral; abrupt, smooth boundary.

2—9 to 14 inches, black (10YR 2/1) peaty muck; moderate, thick, platy structure to moderate, fine, subangular blocky; friable; many roots; contains fragments of peat; neutral; abrupt, smooth boundary.

3—14 to 30 inches, dark-brown (7.5YR 4/4) peat; matted and partly disintegrated; spongy; slightly acid; diffuse, smooth boundary.

4—30 to 48 inches, dark olive-gray (5Y 3/2) sedimentary peat; laminated; rubbery; contains some yellowish-brown (10YR 5/6) fibrous peat; neutral; diffuse, smooth boundary.

5—48 to 60 inches, very dark grayish-brown (2.5Y 3/2) sedimentary peat; massive; mildly alkaline.

The surface layer is black (10YR 2/1) or very dark brown (10YR 2/2) in color. The organic layers formed from fibrous material generally are peaty muck, but in places these layers are muck or are matted peat. The sedimentary peat ranges from dark olive gray (5Y 3/2) to very dark grayish brown (2.5YR 3/2) in color. This material is laminated to massive. Depth to the sedimentary peat generally ranges from 24 to 42 inches, and the minimum thickness of the sedimentary peat is 12 inches.

Muskego soils, unlike other organic soils in the county, are underlain by sedimentary peat rather than by mineral materials, and the sedimentary peat is at a depth of less than 5 feet.

Muskego muck (0 to 2 percent slopes) (Mzg).—This is the only Muskego soil mapped in the county. The areas are roughly circular in shape. Included in mapping are small areas of Houghton mucky peat.

The water table is at or near the surface of Muskego muck for most of the year. Water stands in ponds on the areas in spring and after a heavy rain. In drained areas the hazards of soil blowing and of subsidence are serious. Capability unit IIIw–9; recreation group 8; planting group 6.

Mussey Series

The Mussey series consists of nearly level, loamy soils that are poorly drained. These soils are on low nearly level areas and in depressions on outwash terraces throughout the county. They formed partly in loamy material and partly in calcareous, sandy and gravelly outwash.

In a typical profile the surface layer is friable, very dark brown loam about 8 inches thick. The subsoil is firm, dark-gray clay loam in the first 5 inches and loose, light yellowish-brown gravelly sandy loam that is mottled with brownish yellow and light brownish gray in the remaining 4 inches. Below is light brownish-gray, stratified sand and gravel.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is low. The soils are alkaline to a depth of about 13 inches and are calcareous below.

About half the acreage of Mussey soils is drained and is used for crops. The remaining acreage is in permanent pasture or is wooded and also provides habitat for wildlife.

Typical profile of a nearly level Mussey loam in a cultivated area (SW¼SE¼ sec. 24, T. 11 N., R. 21 E.):

Ap—0 to 8 inches, very dark-brown (10YR 2/2) loam; moderate, medium, granular structure; friable; many roots; moderately alkaline; abrupt, smooth boundary.

B2tg—8 to 13 inches, dark-gray (10YR 4/1) clay loam; moderate, fine to medium, subangular blocky structure; thick continuous clay films; firm; a few roots; a few, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderately alkaline; clear, smooth boundary.

B3—13 to 17 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam; weak, fine, granular structure; loose; brownish-yellow (10YR 6/6) and light brownish-gray (10YR 6/2) mottles; calcareous; clear, smooth boundary.

C—17 to 60 inches, light brownish-gray (10YR 6/2), stratified sand and gravel that is more sandy at a depth below 30 inches; single grain; loose; strongly calcareous.

The Ap horizon ranges from 8 to 12 inches in thickness and is very dark brown (10YR 2/2), black (10YR 2/1), or very dark gray (10YR 3/1) in color. The B2g horizon ranges from loam to clay loam in texture and from 3 to 10 inches in thickness. Thickness of the solum ranges from 12 to 20 inches.

Mussey soils are a drainage associate of the well-drained Lorenzo soils and the somewhat poorly drained Fabius soils. They are shallower to sand and gravel than the Sebewa soils.

Mussey loam (0 to 2 percent slopes) (Mzk).—This is the only Mussey soil mapped in the county. The areas are either long and narrow or are roughly circular.

Included with this soil in mapping are small areas that have a surface layer of sandy loam or silt loam. Also included are a few, small, gently sloping areas on foot slopes where seepage accumulates. Other included small areas have a surface layer that is partly peat or muck. Still other included small areas consist of Fabius loam, 1 to 3 percent slopes, or of areas that are underlain by loamy material at a depth between 30 and 60 inches.

The water table is at or near the surface of Mussey loam for most of the year. In spring and after a heavy rain, runoff water accumulates and is likely to stand in ponds on the areas for fairly long periods. Capability unit IIw–5; recreation group 7; planting group 5.

Navan Series

Nearly level, loamy, poorly drained soils are in the Navan series. These soils are chiefly in the western part of the county in depressions and in old lake basins. They formed in loamy outwash underlain by silty clay loam glacial till or lake-laid silt and clay.

In a typical profile the surface layer is black silt loam about 9 inches thick. The subsoil is very friable, light brownish-gray heavy sandy loam in the upper 11 inches and contains a few mottles. It is firm, greenish-gray and light-brown silty clay loam in the remaining 4 inches and has reddish-yellow mottles. Just below is firm, greenish-gray and light-brown silt and silty clay loam that also has reddish-yellow mottles.

These soils have an almost permanent high water table at or near the surface. The available moisture capacity is high, and permeability is slow. Internal drainage is very slow, and fertility is high. The soils are alkaline to a depth of about 24 inches and are calcareous below.

Navan soils generally are drained and are used for crops. Areas undrained are in permanent pasture or are used as woodland and as wildlife habitat.

Typical profile of a nearly level Navan silt loam in a pasture (NE¼NW¼ sec. 20., T. 12 N., R. 21 E.):

A1—0 to 9 inches, black (10YR 2/1) silt loam; moderate, medium, subangular blocky structure; friable; many roots; mildly alkaline; clear, wavy boundary.

B1g—9 to 20 inches, light brownish-gray (10YR 6/2) heavy sandy loam; weak, medium, subangular blocky structure; very friable; a few roots; a few, fine, faint mottles; mildly alkaline; clear, wavy boundary.

IIB2tg—20 to 24 inches, silty clay loam that is about 60 percent greenish-gray (5G 6/1) and about 40 percent light brown (7.5YR 6/4); strong, medium, angular blocky structure; thick continuous clay films; firm; a few roots; common, medium, distinct, reddish-yellow (7.5YR 6/6) mottles; moderately alkaline; clear, wavy boundary.

IIC—24 to 60 inches +, greenish-gray (5G 6/1) and light-brown (7.5YR 6/4) silt and silty clay loam in equal parts; laminated; firm; common, medium, distinct, reddish-yellow (7.5YR 6/6) mottles; calcareous.

In color the surface layer is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The lower part of the Bg horizon that formed in finer textured material is silty clay loam or silty clay. Thickness of the solum ranges from 18 to 36 inches.

Navan soils are a drainage associate of the well drained to moderately well drained Hebron soils and the somewhat poorly drained Aztalan soils. They are similar to Pella soils, but part of their Bg horizon formed in outwash and that of Pella soils did not.

Navan silt loam (0 to 2 percent slopes) (Na).—This is the only Navan soil mapped in the county. The areas are irregular in shape. Included in mapping are small sloping areas and small areas that have a surface layer of loam.

Runoff is very slow on this soil. Water is likely to pond on the areas in spring and after a heavy rain. Capability unit IIw–1; recreation group 7; planting group 5.

Nenno Series

Nenno soils are nearly level to very gently sloping, loamy, and somewhat poorly drained. They are chiefly in the western part of the county in waterways and on foot slopes. The soils formed in calcareous, loamy glacial till that had a thin capping of silt.

In a typical profile the surface layer is friable, very dark brown silt loam about 8 inches thick. The subsoil is firm, dark yellowish-brown silt loam in the upper 8 inches and feels gritty. It is friable, brown to dark-brown heavy loam in the last 12 inches. Both parts have yellowish-brown mottles, and the lower part also has grayish-brown mottles and a few pebbles and cobblestones.

These soils have high available moisture capacity and moderate permeability. Internal drainage is slow because of a temporary water table 1 to 3 feet from the surface. The soils are alkaline in the surface layer, mildly alkaline in the next two layers, and calcareous below a depth of about 18 inches. Most areas of Nenno soils are drained and are cropped intensively.

Typical profile of a nearly level Nenno silt loam in a cultivated area (SW¼NW¼ sec. 23, T. 10 N., R. 21 E.):

Ap—0 to 8 inches, very dark-brown (10YR 2/2) silt loam; moderate, fine and medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B2t—8 to 16 inches, dark yellowish-brown (10YR 3/4) silty clay loam that feels gritty; moderate, medium, subangular blocky structure; firm; many roots; dark-brown (10YR 3/3) clay films on ped surfaces; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; a few pebbles; mildly alkaline; clear, smooth boundary.

B3t—16 to 18 inches, brown to dark-brown (10YR 4/3) heavy loam; moderate, medium, subangular blocky structure; friable; a few roots; dark grayish-brown (10YR 4/2) clay films on ped surfaces; common, fine, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; a few pebbles and cobblestones; mildly alkaline; clear, smooth boundary.

C—18 to 60 inches +, pale-brown (10YR 6/3) loamy glacial till; massive; friable; many, medium, distinct, brownish-yellow (10YR 6/6) mottles; contains many pebbles and cobblestones; calcareous.

In color the surface layer is black (10YR 2/1) in undisturbed areas and very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2) in cultivated areas. The silt capping generally is less than 12 inches thick. The texture of the B horizon ranges from heavy loam to silty clay loam that feels gritty. Thickness of the solum generally is 14 to 20 inches, but it ranges from 12 to 24 inches. Depth to mottling ranges from 8 to 14 inches. Texture of the underlying till ranges from sandy loam to silt loam that feels gritty. The till is weakly stratified in places and contains thin lenses or pockets of silt, fine sand, or sand and gravel. Pebbles and cobblestones are common throughout the profile, and areas undistrubed commonly have stones on the surface.

These soils are a drainage associate of the well-drained Hochheim soils and the poorly drained Brookston soils.

Nenno silt loam, 1 to 3 percent slopes (NnA).—This is the only Nenno soil mapped in the county. Some areas are nearly level and are in drainageways, and others are very gently sloping and are on foot slopes. The areas generally are long and narrow or are roughly circular.

Included with this soil in mapping are small areas of light-colored, well-drained Hochheim soils and of darker colored, poorly drained Brookston silt loam, 0 to 3 percent slopes. Also included are small areas that have a thicker surface layer than that in this soil because material washed from surrounding uplands has accumulated on them. Other included small areas are steeper than this soil, though the slope generally is no more than 5 percent steeper. Another included area has a thicker, more silty upper subsoil than that in this soil. This included area consists of about 50 acres and is one-half mile east of Freistadt.

On the nearly level areas of this Nenno soil, runoff is slow. As a result, runoff water accumulates in ponds for short periods in spring and after a heavy rain. On the very gently sloping areas, runoff is medium and the hazard of erosion is slight. Capability unit IIw–2; recreation group 6; planting group 4.

Ogden Series

Nearly level, organic soils that are very poorly drained are in the Ogden series. These soils occur throughout the county in depressions and in beds of old glacial lakes. They consist of the remains of reeds, sedges, and similar plants and are underlain by clayey material at a depth of less than 5 feet.

In a typical profile the surface layer is black mucky peat about 10 inches thick. The second layer, of similar material, is 14 inches thick, and the third layer is friable, black fibrous peat that is 12 inches thick. Below is massive, grayish-brown to light olive-brown silty clay that is plastic and sticky when wet.

The organic layers in these soils have high available moisture capacity and moderate permeability. The clayey layers are very slowly permeable. Internal drainage is very slow in the Ogden soils because of an almost permanent high water table. Fertility is low. The soils are neutral or alkaline in the organic material and calcareous below.

About half the acreage of the Ogden soils is drained and is cropped intensively. Areas undrained are in permanent pasture or are wooded and also provide habitat for wildlife.

Typical profile of a nearly level Ogden mucky peat in a wooded area (NE¼NE¼ sec. 15, T. 12 N., R. 22 E.):

1—0 to 10 inches, black (10YR 2/1) mucky peat; disintegrated; friable; a few roots; neutral; clear, smooth boundary.

2—10 to 24 inches, black (10YR 2/1) mucky peat; well decomposed; peat fibers are distinct; friable; neutral; clear, smooth boundary.

3—24 to 36 inches, black (5YR 2/1) fibrous peat; well decomposed; friable; neutral; abrupt, smooth boundary.

IIC—36 inches +, grayish-brown (2.5Y 5/2) silty clay; massive; plastic and sticky; calcareous.

The surface layer is black (10YR 2/1) or very dark brown (10YR 2/2) in color. The organic material generally is mucky peat but in places it contains layers of peat or muck. The underlying material ranges from clay loam to clay in texture. Its color is grayish brown (2.5Y 5/2) or light olive brown (2.5Y 5/4). Depth to clayey material ranges from 18 to 60 inches in undrained areas and from 12 to 42 inches in drained areas.

Ogden soils are similar to other organic soils in the county but are underlain by finer textured mineral material. The organic material is not so thick in the Ogden soils as in the Houghton soils.

Ogden mucky peat (0 to 2 percent slopes) (Od).—This is the only Ogden soil mapped in the county. The areas are either oblong or roughly circular.

Included with this soil in mapping are small cultivated areas that have a surface layer of muck.

The water table is at or near the surface of Ogden mucky peat for most of the year. Water ponds on the areas in spring and after a heavy rain. In drained areas the hazards of soil blowing and of subsidence are serious. Capability unit IIIw–9; recreation group 8; planting group 6.

Ozaukee Series

The Ozaukee series consists of nearly level to steep, loamy soils that are well drained or moderately well drained. Most areas are gently sloping and are in the uplands west of the Milwaukee River in the southern part of the county. The soils formed in calcareous silty clay loam glacial till that had a capping of silt less than 20 inches thick.

In a typical profile the surface layer is friable, dark grayish-brown silt loam about 7 inches thick. The subsoil is dark brown and is about 17 inches thick. It is firm silty clay in the upper 12 inches and firm silty clay loam in the next 5 inches. Just below is firm, dark-brown silty clay loam glacial till.

Ozaukee soils have high available moisture capacity, moderately slow permeability, and medium internal drainage. Fertility is moderate, and the soils are suitable for deep-rooted plants. These soils are neutral in the surface layer, alkaline in the subsoil, and calcareous below.

Most areas of these soils are cropped intensively. Large areas, however, are in suburban and rural-residential uses.

Typical profile of a gently sloping Ozaukee silt loam in a cultivated area (SW¼SE¼ sec. 21, T. 9 N., R. 21 E.):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, subangular blocky structure that breaks to moderate, medium, granular; friable; many roots; neutral; abrupt, smooth boundary.

B2t—7 to 19 inches, dark-brown (7.5YR 4/3) silty clay; moderate, fine, angular blocky structure; firm; many roots; patchy dark-brown (7.5YR 3/2) clay coatings on peds; mildly alkaline; clear, wavy boundary.

IIB3t—19 to 24 inches, dark-brown (7.5YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; a few roots; a few glacial pebbles; moderately alkaline; clear, wavy boundary.

IIC—24 to 42 inches +, dark-brown (7.5YR 5/4) silty clay loam; glacial till; weak, thick, platy structure; firm; contains limestone pebbles and cobblestones; calcareous.

The surface layer is very dark gray (10YR 3/1) in undisturbed areas, where it is 3 to 5 inches thick, and dark grayish brown (10YR 4/2) in cultivated areas, where it is 7 to 9 inches thick. Texture of the B2t horizon ranges from clay to heavy silty clay loam. Thickness of the solum ranges from 18 to 26 inches. The underlying glacial till ranges from heavy silt loam to heavy silty clay loam in texture. In places mottles occur in the IIB3t horizon and below.

Ozaukee soils are a drainage associate of the somewhat poorly drained Mequon soils and the poorly drained Ashkum soils. They are browner (7.5YR hue) in the B horizon than Kewaunee soils (5YR hue), and their solum and underlying material are finer textured than those in the Hochheim or Theresa soils.

Ozaukee silt loam, 0 to 2 percent slopes (OuA).—This soil is on the higher parts of broad glacial ridges. The areas generally are irregular in shape. The soil is a few inches deeper to glacial till, but otherwise its profile is like the one described for the series.

Included with this soil in mapping are small areas of somewhat poorly drained Mequon silt loam, 1 to 3 percent slopes.

The subsoil in this Ozaukee soil is clayey, and runoff is slow. As a result, this soil warms and dries slowly in spring and after a heavy rain. Capability unit IIs–7; recreation group 3; planting group 3.

Ozaukee silt loam, 2 to 6 percent slopes (OuB).—Most areas of this soil are gently sloping and are on glacial ridges. A few areas are gently undulating, however, and have short slopes that face in different directions. The areas generally are large and are irregular in shape. The surface layer is thicker and depth to glacial till is slightly greater, but otherwise the profile is similar to that described for the series.

Included with this soil in mapping are small eroded areas and small areas of somewhat poorly drained Mequon silt loam, 1 to 3 percent slopes.

The hazard of water erosion is slight on this Ozaukee soil. Slopes are long and permeability of the lower layers is moderately slow. As a result runoff is medium, especially during periods of heavy rain. Capability unit IIe-6; recreation group 3; planting group 3.

Ozaukee silt loam, 2 to 6 percent slopes, eroded (OuB2).—This soil has the profile described for the series. The areas are on glacial ridges, and they generally are large and are irregular in shape. Part of the original surface layer has been removed through erosion, and material formerly in the second layer has been mixed with the remaining surface layer by plowing. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas of somewhat poorly drained Mequon silt loam, 1 to 3 percent slopes, and some small severly eroded areas. Also included are small severely eroded areas that have a surface layer of clay loam and are more cloddy than this soil.

The hazard of water erosion is slight on this Ozaukee soil. Slopes are long, and permeability of the lower layers is moderately slow. As a result, runoff is medium during periods of heavy rain. Capability unit IIe–6; recreation group 3; planting group 3.

Ozaukee silt loam, 6 to 12 percent slopes, eroded (OuC2.)—Most areas of this soil are along waterways. A few areas, however, are undulating and have short slopes that face in different directions. The areas are either oblong or irregular in shape. This soil is slightly shallower to glacial till, but its profile otherwise is like that described for the series.

Included with this soil in mapping are small severely eroded areas that have a surface layer of clay loam and some small areas that have moderately steep slopes. Also included are some small areas of pasture and woodland that are slightly eroded or are not eroded.

The hazard of erosion is moderate on this Ozaukee soil. Because of the slope and moderately slow permeability of the lower layers, runoff is rapid during periods of heavy rain. Capability unit IIIe–6; recreation group 3; planting group 3.

Ozaukee silt loam, 12 to 20 percent slopes, eroded (OuD2).—This soil is adjacent to drainageways in areas that generally are long and narrow. It is a few inches shallower to glacial till, but otherwise its profile is similar to the one described for the series. Part of the original surface layer has been removed through erosion, and clayey material formerly in the second layer has been mixed with the remaining surface layer by plowing. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas that have a surface layer of clay loam and are severely eroded. Also included are small steep areas and some small slightly eroded areas.

The hazard of water erosion is severe on this Ozaukee soil. Because of the moderately steep slopes and the clayey lower layers, runoff is very rapid during periods of heavy rain. About half the acreage is cultivated, and hay and rotational pastures are dominant in these areas. The remaining acreage is in permanent grasses or is in trees. Capability unit IVe–6; recreation group 3; planting group 3.

Ozaukee silt loam, 20 to 30 percent slopes (OuE).—This soil is adjacent to drainageways in areas that are long and narrow. It is a few inches shallower to glacial till, but its profile otherwise is like that described for the series.

Included with this soil in mapping are small eroded areas that have a surface layer of clay loam. Also included are some small very steep areas.

The hazard of water erosion is very severe on this Ozaukee soil. Runoff is very rapid in spring and after a heavy rain. Most areas are in trees and grass. Capability unit VIe–6; recreation group 3; planting group 3.

Ozaukee clay loam, 6 to 12 percent slopes, severely eroded (OzC3).—This soil is along waterways in areas that are oblong or irregular in shape. The surface layer is loam and the second layer is thinner, but the profile otherwise is similar to that described for the series. Most of the original surface layer has been removed through erosion, and plowing has mixed much of the clayey material formerly in the second layer with the remaining surface layer. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas that have a surface layer of silt loam or silty clay loam.

The hazard of water erosion is moderate on this Ozaukee soil. Slopes are strong, and permeability of the lower layers is moderately slow. Runoff therefore is rapid during periods of heavy rain. Capability unit IVe–6; recreation group 3; planting group 3.

Ozaukee clay loam, 12 to 20 percent slopes, severely eroded (OzD3).—This soil is in major drainageways in areas that generally are long and narrow. The surface layer is dominantly clay loam, and the second layer is thinner, but the profile otherwise is similar to that described for the series. Most of the original surface layer has been removed through erosion, and plowing has mixed much of the clayey material formerly in the second layer with the remaining surface layer. As a result, the present surface layer is cloddy.

Included with this soil in mapping are small areas that have a surface layer of silt loam or silty clay loam. Also included are some small areas that are steeper than this soil.

The hazard of erosion is severe on this Ozaukee soil. Because of the slopes and the moderately slow permeability of the lower layers, runoff is very rapid in spring and after a heavy rain. Capability unit VIe–6; recreation group 3; planting group 3.

Palms Series

In the Palms series are nearly level, organic soils that are very poorly drained. These soils occur throughout the county in depressions, in low areas, and in the beds of old glacial lakes. They consist of the remains of reeds, sedges, and other fibrous plants and are underlain by loamy material at a depth of less than 5 feet.

The surface layer in a typical profile is black mucky peat about 9 inches thick. It is underlain by about 23 inches of friable, very dark brown muck to peaty muck. Below is friable, reddish-gray loam that is mottled and contains dolomitic pebbles.

These soils have high available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is low. The soils generally are mildly alkaline in the organic material and calcareous below.

About one-third of the acreage of the Palms soils is drained and cropped intensively. Areas undrained are in permanent pasture or are used as woodland and also provide habitat for wildlife.

Typical profile of a nearly level Palms mucky peat in a wooded area (NW¼NW¼ sec. 23, T. 11 N., R. 21 E.):

1—0 to 9 inches, black (7.5YR 2/1) mucky peat and matted disintegrated peat; a few roots; mildly alkaline; clear, smooth boundary.

2—9 to 18 inches, black (7.5YR 2/1) muck; moderate, coarse, subangular blocky structure; friable; vertical cleavage planes that have dark reddish-brown (5YR 3/4) coatings of iron jell and carbon; mildly alkaline; clear, smooth boundary.

3—18 to 32 inches, very dark brown (7.5YR 2/2) peaty muck; weak, coarse, subangular blocky structure; friable; mildly alkaline; abrupt, smooth boundary.

IIC—32 to 60 inches +, reddish-gray (5YR 5/2) loam that contains dolomitic pebbles; massive; friable; common, coarse, distinct, brownish-yellow (10YR 6/6) and light yellowish-brown (10YR 6/5) mottles at a depth below 40 inches; calcareous.

The organic material generally is mucky peat, but in some places it contains layers of peat or muck. It generally is black (7.5YR 2/1) or very dark brown (10YR 2/2). Thickness of the organic layers ranges from 18 to 60 inches in undrained areas, and from 12 to 42 inches in drained areas. The organic deposits generally are alkaline, but in places they range to slightly acid. Texture of the underlying material (IIC horizon) ranges from sandy loam to silt.

Palms soils are similar to other organic soils in the county, but they are underlain by material that is different in texture. They are not so deep to underlying mineral material as the Houghton soils.

Palms mucky peat (0 to 2 percent slopes) (Pc).—This is the only Palms soil mapped in the county. The areas are either oblong or roughly circular in shape.

Included with this soil in mapping are small cultivated areas that have a surface layer of muck. Also included are small areas in which the organic material ranges from less than 12 inches to more than 60 inches in thickness.

The water table is at or near the surface of Palms mucky peat for most of the year, and water is ponded on the areas in spring and after a heavy rain. In drained areas the hazards of soil blowing and subsidence are serious. Capability unit IIw–8; recreation group 8; planting group 6.

Pella Series

Nearly level, loamy soils that are poorly drained are in the Pella series. These soils are mainly in the western part of the county in low broad areas and in drainageways. They formed in silty material underlain by calcareous glacial drift.

In a typical profile the surface layer is friable, black silt loam about 8 inches thick. Just below is firm, black silty clay loam about 4 inches thick. The subsoil is about 14 inches thick. It is firm, dark-gray silty clay loam in the upper 11 inches and friable, gray light silty clay loam in the remaining 3 inches. Below is friable, gray silt and silty clay loam that is stratified and is mottled with yellowish brown.

These soils have high available moisture capacity and moderately slow permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is high. The soils generally are alkaline in the upper three layers and are slightly calcareous to strongly calcareous below.

Most areas of Pella soils have been drained and are cropped intensively. A few areas are used as pasture, woodland, or wildlife habitat.

Typical profile of a nearly level Pella silt loam in a cultivated area (SW¼SW¼ sec. 31, T. 10 N., R. 21 E.):

Ap—0 to 8 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A1—8 to 12 inches, black (10YR 2/1) silty clay loam; moderate, fine, angular blocky structure; firm; many roots; moderately alkaline; clear, smooth boundary.

B2g—12 to 23 inches, dark-gray (5Y 4/1) silty clay loam; moderate, medium, prismatic structure that breaks to moderate, fine, angular blocky; firm; a few roots; a few, fine, distinct, yellowish-brown (10YR 5/6) mottles; a few very dark gray (5Y 3/1) organic stains on ped surfaces; moderately alkaline; clear, wavy boundary.

IIB3g—23 to 26 inches, gray (5Y 5/1) light silty clay loam; moderate, medium, angular blocky structure; friable; many, coarse, prominent, yellowish-brown (10YR 5/6) mottles; a few thin silt seams; slightly calcareous; clear, wavy boundary.

IICg—26 to 48 inches +, gray (5Y 5/1) silt and silty clay loam; stratified; friable; many, coarse, distinct, yellowish brown (10YR 5/6) mottles; strongly calcareous.

In color the A horizon ranges from black (10YR 2/1) to very dark brown (10YR 2/2) and very dark gray (10YR 3/1). Thickness of the A horizon ranges from 8 to 14 inches. The B horizon ranges from clay loam to silty clay loam in texture. Thickness of the solum ranges from 24 to 36 inches. The underlying material ranges from silty clay loam to silt loam and silt in texture. The upper three layers are neutral to alkaline, and the material below is calcareous.

Pella soils are deeper to glacial material than the Brookston soils. They have a lower content of sand than the Colwood soils.

Pella silt loam (0 to 2 percent slopes) (Ph).—This is the only Pella soil mapped in the county. The areas are either long and narrow or roughly circular in shape.

Included with this soil in mapping are small areas that have a surface layer that is partly peat or muck. Also included are small areas of Brookston and Colwood soils.

Runoff is very slow on Pella silt loam. The water table is at or near the surface most of the year, and water is likely to stand in ponds on the areas in spring and after a heavy rain. Capability unit IIw-1; recreation group 7; planting group 5.

Poygan Series

Poygan series consists of nearly level, loamy soils that are very poorly drained. Most areas are in depressions and drainageways near Manawa soils in the eastern half of the county, but some areas are scattered throughout the western half. The soils formed in lake-laid, reddish silty clay loam and in redeposited lake-laid materials. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, black silty clay loam about 11 inches thick. The subsoil is about 24 inches thick. It is firm, dark-gray silty clay loam in the upper 9 inches and very firm, gray silty clay in the next 12 inches. The remaining 3 inches is firm, gray and reddish-brown silty clay loam that has brownish-yellow mottles and a few pebbles. Below is firm, reddish-brown silty clay loam that is mottled with brownish yellow and gray and contains a few pebbles.

These soils have high available moisture capacity and are slowly permeable. The water table is at or near the surface for most of the year. Internal drainage is slow. Fertility is moderate, but the soils are not suited to deep-rooted plants unless they are drained. The soils are mildly alkaline in the upper three layers and are calcareous below a depth of about 32 inches.

Most areas of these soils are drained and are used for crops. The remaining acreage is in small woodlots.

Typical profile of a nearly level Poygan silty clay loam in a cultivated area (NE¼NW¼ sec. 30, T. 11 N., R. 22 E.):

Ap—0 to 11 inches, black (10YR 2/1) silty clay loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1g—11 to 20 inches, dark-gray (10YR 4/1) silty clay loam; moderate, medium, subangular blocky structure; firm; many roots; very dark gray (10YR 3/1) organic stains on peds; a few, fine, faint mottles; mildly alkaline; clear, wavy boundary.

B2g—20 to 32 inches, gray (10YR 5/1) silty clay; moderate, medium, angular blocky structure; very firm; a few roots; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, wavy boundary.

B3g—32 to 35 inches, gray (10YR 5/1) and reddish-brown (5YR 4/3) silty clay loam in equal parts; moderate, medium, subangular blocky structure; firm; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; a few dolomitic pebbles; calcareous; clear, wavy boundary.

C—35 to 60 inches +, reddish-brown (5YR 4/3) silty clay loam; massive; firm; a few, medium, faint, brownish-yellow (10YR 6/6) and gray (10YR 5/1) mottles; a few dolomitic pebbles; strongly calcareous.

The A horizon ranges from 7 to 14 inches in thickness, but it is thicker where material washed from surrounding uplands has accumulated. It is black (10YR 2/1) or very dark brown (10YR 2/2) in color. Thickness of the solum ranges from 18 to 36 inches. Texture of the Bg horizon ranges from silty clay loam to clay, and the amount and intensity of mottles in this horizon ranges from few and faint to many and distinct. The C horizon ranges to 7.5YR in hue. The silty clay loam in this horizon is coarser textured than is typical for the series. It is weakly stratified in places and contains stratified thin silt and fine sand. In some areas a few cobblestones are in the profile. In the western part of the county, the C horizon is stratified silty clay that contains thin layers of silt and lacks pebbles and cobblestones.

Poygan soils are a drainage associate of the well-drained Kewaunee soils and the somewhat poorly drained Manawa soils. They are redder (5YR hue) in the lower part than Ashkum soils.

Poygan silty clay loam (0 to 2 percent slopes) (Py).—This is the only Poygan soil mapped in the county. The areas generally are small and irregular in shape.

Included with this soil in mapping are some small areas that have a surface layer of silt loam and some areas that have a thicker surface layer than this soil because material washed from surrounding uplands has accumulated on them. Also included are small areas that are underlain by silt and silty clay and are free of pebbles. Still other included small areas have a surface layer of peat and muck. Another included area in the village of Belgium is underlain by sand at a depth of about 5 feet.

Water is likely to pond on Poygan silty clay loam in spring and during a heavy rain. If this soil is cultivated when wet, clods form in it. Some areas along Sauk Creek near Belgium and Holy Cross are susceptible to flooding when the stream overflows. Capability unit IIw-1; recreation group 7; planting group 5.

Radford Series

Radford soils are nearly level or very gently sloping, loamy, and somewhat poorly drained. The areas are scattered throughout the county, in drainageways or in low areas, and receive material washed from surrounding uplands. These soils formed in recent deposits of medium-textured alluvium and colluvium laid down on a loamy, poorly drained soil.

The first 24 inches in a typical profile is friable, very dark grayish-brown silt loam that is mottled in the lower part. Below is an old buried horizon consisting of firm, very dark gray silt loam that also is mottled. The subsoil is an old buried subsoil and is about 22 inches thick. It is very firm, mottled, dark-gray silty clay loam in the upper 4 inches and firm, dark-gray clay loam in the next

6 inches. The remaining 12 inches is firm, dark-gray sandy clay loam underlain by loose, gray sand.

These soils have high available moisture capacity and moderate permeability. Internal drainage is slow because of a temporary high water table. Fertility is high. The soils generally are mildly alkaline to a depth of about 50 inches and calcareous below.

Most areas of the Radford soils are cropped intensively. A few areas, however, are in permanent pasture.

Typical profile of a nearly level Radford silt loam in a cultivated area (NE¼NW¼ sec. 4, T. 11 N., R. 22 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, wavy boundary.

A1—8 to 24 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine and medium, subangular blocky structure; friable; many roots; common, fine, prominent, dark reddish-brown (5YR 3/4) mottles; mildly alkaline; clear, smooth boundary.

A1bg—24 to 28 inches, very dark gray (10YR 3/1) heavy silt loam; moderate, medium, subangular blocky structure; firm; a few roots; a few, fine, prominent mottles; mildly alkaline; clear, smooth boundary.

B21bg—28 to 32 inches, dark-gray (10YR 4/1) silty clay loam; moderate, medium, prismatic structure that breaks to weak, medium, angular blocky; very firm; a few roots; a few, fine, prominent mottles; mildly alkaline; clear, smooth boundary.

B22bg—32 to 38 inches, dark-gray (10YR 4/1) clay loam; weak, coarse, prismatic structure that breaks to weak, coarse, angular blocky; firm; fragments of peat; a few thin clay films; mildly alkaline; gradual, smooth boundary.

B3bg—38 to 50 inches, dark-gray (10YR 4/1) sandy clay loam; weak, coarse, prismatic structure; firm; common, medium, prominent, reddish-brown (5YR 4/4) mottles; a few thin clay films; lenses of sand; mildly alkaline; diffuse, smooth boundary.

Cbg—50 to 60 inches, gray (N 5/0) sand; single grain; loose; calcareous.

The A horizon ranges from very dark gray (10YR 3/1) to dark brown (10YR 3/3) in color. Thickness of the recently deposited material ranges from 20 to 30 inches. The buried soil may be any poorly drained, loamy soil mapped in the county. Textures and colors are variable below a depth of 36 inches. Depth to mottles ranges from 8 to 24 inches. The underlying material varies in texture, but it generally is loamy till or is sand and gravel. The soils are neutral to calcareous.

Radford silt loam, 0 to 3 percent slopes (RaA).—This is the only Radford soil mapped in the county. It is in drainageways, and material washed from soils in the uplands has accumulated on the areas. The areas generally are long and narrow.

Included with this soil in mapping are small areas that are well drained or moderately well drained. Also included are a few areas that have a surface layer that is more clayey than that in this soil and some small areas of Manawa silt loam, 1 to 3 percent slopes.

This Radford soil has a temporary high water table 1 to 3 feet from the surface and receives runoff from surrounding higher areas. In spring and after a heavy rain, runoff water accumulates and water stands in ponds on the areas for short periods. Capability unit IIw–2; recreation group 6; planting group 4.

Ritchey Series

The Ritchey series consists of nearly level to moderately steep, loamy soils that are well drained. These soils are scattered mainly throughout the western half of the county. They are formed partly in silt and partly in glacial drift 10 to 20 inches thick over limestone bedrock.

In a typical profile the surface layer is friable, dark grayish-grown silt loam about 6 inches thick. Just below is about 3 inches of friable, brown silt loam. The subsoil is friable, yellowish-brown heavy silt loam in the upper 3 inches and firm, dark yellowish-brown silty clay loam that feels gritty in the next 3 inches. The remaining 2 inches is very firm, brown to dark-brown clay loam that contains a few pebbles. Below is pale-brown dolomitic limestone bedrock.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. Root depth is moderately limited. Reaction ranges from acid to alkaline.

About a third of the acreage of the Ritchey soils is cultivated. The remaining acreage is in permanent pasture or is used as woodland.

Typical profile of a nearly level Ritchey silt loam (NE¼NW¼ sec. 9, T. 9 N., R. 21 E.):

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium to coarse, granular structure; friable; many roots; material from the A2 horizon has been mixed with this horizon by worms; mildly alkaline; clear, wavy boundary.

A2—6 to 9 inches, brown (10YR 5/3) silt loam; moderate, thin to medium, platy structure; friable; many roots; slightly acid; clear, wavy boundary.

B1—9 to 12 inches, yellowish-brown (10YR 5/4) heavy silt loam; moderate, thick, platy structure that breaks to moderate, fine, subangular blocky; friable; a few roots; neutral; clear, wavy boundary.

IIB21t—12 to 15 inches, dark yellowish-brown (10YR 4/4) silty clay loam that feels gritty; strong, medium, subangular blocky structure; thick continuous clay films; firm; a few weathered pebbles; mildly alkaline; clear, wavy boundary.

IIB22t—15 to 17 inches, brown to dark-brown (7.5YR 4/2) heavy clay loam; strong, fine, subangular blocky structure; very firm; clay films on ped faces; a few, fine, black organic stains; a few pebbles; mildly alkaline; gradual, wavy boundary.

IIR—17 inches +, pale-brown (10YR 6/3) dolomitic limestone bedrock.

The A1 horizon ranges from dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4) in color. Texture of the B horizon ranges from heavy silt loam to silty clay loam. In some areas the upper part of the bedrock is fractured.

Ritchey soils are similar to Knowles soils, but unlike them are less than 20 inches deep to bedrock.

Ritchey silt loam, 0 to 6 percent slopes (RkB).—This soil has the profile described for the series. Nearly three-fourths of the acreage is gently sloping; the rest is nearly level. Bedrock is near the surface, and the areas are roughly circular.

Included with this soil in mapping are small areas where bedrock crops out and some small areas that are only about 8 inches thick over bedrock. In these areas, root depth is severely limited and available moisture capacity is low. Also included are small areas that are more than 20 inches thick over bedrock.

On the nearly level areas of this Ritchey soil, runoff is slow. On the gently sloping areas, runoff is medium and the hazard of water erosion is slight. Capability unit IIIe–4; recreation group 4; planting group 2.

Ritchey silt loam, 6 to 20 percent slopes, eroded (RkD2).—Areas of this soil are either oblong or irregular in shape. Bedrock is near the surface. The soil is a few inches shallower to limestone bedrock, but the profile otherwise is similar to the one described for the series.

Included with this soil in mapping are small areas where bedrock crops out and some small areas that have a dark-brown surface layer and are only about 8 inches thick over bedrock. In these areas, root depth is limited and available moisture capacity is low. Also included are a few small areas that are slightly steeper than this soil and some small areas that are more than 20 inches deep to bedrock.

Depending on the steepness of the slope, runoff is medium to rapid on this Ritchey soil and the hazard of water erosion is moderate to severe. Capability unit VIe-4; recreation group 4; planting group 2.

Rodman Series

Soils of the Rodman series are excessively drained, sloping to very steep, and loamy. These soils are on eskers and in kettle moraines, where water from melting glaciers removed the fine-textured material and left only coarse-textured material. The soils formed in a thin layer of loamy material over loose, gravelly and cobbly glacial outwash that contained much limestone.

In a typical profile the surface layer is very friable, very dark brown sandy loam about 8 inches thick. The subsoil is very friable, brown sandy loam in the upper 3 inches and loose, brown loamy sand in the remaining 2 inches. Pale-brown, loose coarse sand, gravel, and cobblestones are at a depth of about 13 inches.

These soils have low available moisture capacity, rapid permeability, and rapid internal drainage. They are droughty and fertility is low. The soils are moderately alkaline in the surface layer and upper part of the subsoil and are calcareous below.

Rodman soils are mostly pastured or are used as woodland. In this county they are closely intermixed with areas of Casco soils and are mapped only in complexes with those soils. The complexes are described under the Casco series.

Typical profile of moderately steep Rodman sandy loam in an undisturbed area (NE¼NE¼ sec. 17, T. 12 N., R. 21 E):

A1—0 to 8 inches, very dark brown (10YR 2/2) sandy loam; weak, medium, granular structure; very friable; many roots; a few pebbles; moderately alkaline; clear, smooth boundary.

B2—8 to 11 inches, brown (10YR 5/3) sandy loam; weak, medium, subangular blocky structure; very friable; many roots; a few pebbles; moderately alkaline; gradual, wavy boundary.

B3—11 to 13 inches, brown (10YR 5/3) loamy sand; weak, medium, subangular blocky structure; loose; a few roots; many pebbles; calcareous; gradual, wavy boundary.

C—13 to 60 inches, pale-brown (10YR 6/3), stratified coarse sand, gravel, and cobblestones; single grain; loose; calcareous.

The surface layer is dominantly loam or sandy loam in texture, but it ranges from loam to gravelly sandy loam within a short distance. Thickness of the surface layer ranges from 6 to 10 inches, and color ranges from very dark brown (10YR 2/2) to dark grayish-brown (10YR 4/2). In disturbed areas the color is very dark grayish brown (10YR 3/2). The B horizon ranges from 3 to 7 inches in thickness. In places the C horizon is dominantly fine sand that includes some gravel and cobblestones.

Rodman soils are shallower to free carbonates than the Casco soils and unlike them lack an argillic B horizon.

Rollin Series

In the Rollin series are nearly level organic soils that are very poorly drained. These soils are on low flats and in beds of old glacial lakes. The areas are mainly near Spring Lake in the northwestern part of the county. Rollin soils consist of the remains of sedges, grasses, reeds, and other fibrous plants. They are underlain by marl at a depth of less than 5 feet.

The surface layer in a typical profile is friable, black mucky peat about 13 inches thick. It is underlain by friable, dark-brown peat about 15 inches thick. Below is friable, dark-gray and light-gray marl.

These soils have high available moisture capacity and moderate permeability above the marl and moderately slow permeability in the marl. Internal drainage is very slow because of an almost permanent high water table. Fertility is low. The organic material is mildly alkaline, and the marl is strongly calcareous.

Nearly all areas of the Rollin soils have sparse stands of tamarack, low shrubs, sedges, cattails, and other natural vegetation on them and provide habitat for wildlife. A few areas are in permanent pasture.

Typical profile of a nearly level Rollin mucky peat in a marshy area (NW¼NW¼ sec. 2, T. 12 N., R. 21 E.):

1—0 to 13 inches, black (10YR 2/1) mucky peat; disintegrated; friable; many roots; mildly alkaline; gradual, smooth boundary.

2—13 to 28 inches, dark-brown (7.5YR 3/2) peat; partly decomposed; friable; a few roots; mildly alkaline; clear, smooth boundary.

IICca—28 to 60 inches +, mixed dark-gray (5Y 4/1) and light-gray (5Y 7/1), weathered marl that is partly disintegrated; friable; many snail and mussel shells are in the upper foot of this horizon; strongly calcareous.

In color the surface layer is black (10YR 2/1) or very dark brown (10YR 2/2). The organic material generally is mucky peat, but it ranges to peaty muck and muck in some places. The underlying marl contains varying amounts of snail and mussel shells, and in places it also contains sedimentary peat. Depth to the marl ranges from 24 to 42 inches.

Rollin soils are similar to other organic soils in the county but are underlain by marl. The organic material is not so thick as in the Houghton soils.

Rollin mucky peat (0 to 2 percent slopes) (Rw).—This is the only Rollin soil mapped in the county. The areas are roughly circular.

Included with this soil in mapping are a few areas where marl is at a depth of as little as 12 inches. Also included are a few areas that have a surface layer of muck.

The water table is at or near the surface of Rollin mucky peat for most of the year. Water is ponded on the areas in spring and after a heavy rain. In drained areas the hazards of erosion and subsidence are serious. Capability unit IVw-7; recreation group 8; planting group 6.

Rough broken land (30 to 60 percent slopes) (Ry) consists of reddish-brown silty clay loam glacial till. The areas are mostly long and narrow and are on the bluff along Lake Michigan.

Rapid and continuing geologic erosion has removed soil material from areas of this land type before a soil profile could develop. About half the areas consist of raw soil material, and the other half has a cover of vegetation. The soil material generally is silty clay loam, but it ranges from silt loam to silty clay in texture. It is mildly alkaline to calcareous. Seepage and soil slipping are common. Runoff is very rapid, and the hazard of erosion is very severe.

Rough broken land is used mainly for wildlife habitat and for recreation. Capability unit VIIIs–10; recreation group 10; planting group not assigned.

Sandy and gravelly land (Sf) consists of cut and filled areas that are mainly in and around urban areas in the county.

In cut or borrow areas, the original soil material has been removed by man and raw, fairly inert soil material is exposed. The banks of cut areas have been sloped and graded. As a result the areas blend in with adjacent, relatively undisturbed soil areas and can be used as sites for buildings and highways or other kinds of transportation facilities.

In filled areas the fill material ranges from 1 to about 5 feet in thickness. Originally, the areas generally consisted of mineral soils that were somewhat poorly drained to very poorly drained. Some of the areas however originally contained well-drained mineral soils, and some other areas consisted of organic soils.

The soil material in this land type is mainly sand or gravel, but it generally is a mixture of the two and contains very little fine material. In cut areas the material generally is stratified sand and gravel. In filled areas the soil material is more variable and includes some cinders, boulders, inorganic trash, and rubble.

The water-holding capacity is lower in Sandy and gravelly land than in Clayey land or in Loamy land. Capability unit VIIIs–10; recreation group 1; planting group 2.

Sandy lake beaches (2 to 6 percent slopes) (Sfb) consists of light-gray and very pale brown sand deposited by water. It is gently sloping and occupies a long narrow area bordering Lake Michigan. The width of the area varies between 100 and 300 feet, depending on the water level of the lake.

The sand that makes up this land type is medium in size. It is slightly acid. Part of the sand is continually washed and rewashed by wave action. The part that is not being washed is droughty and is susceptible to blowing.

Sandy lake beaches are used mainly for recreation. Vegetation seldom grows on the areas. Capability unit VIIIs–10; recreation group 10; planting group not assigned.

Saylesville Series

The Saylesville series consists of nearly level to gently sloping, loamy soils that are well drained and moderately well drained. These soils are in the higher parts of old lakebeds in the western part of the county. They formed in lake-laid silt and clay. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, dark grayish-brown silt loam about 9 inches thick. The subsoil is firm, dark reddish-brown clay in the upper 8 inches and firm, brown silty clay in the remaining 4 inches. Below is firm, brown, stratified silt and silty clay.

These soils have high available moisture capacity and slow permeability. Internal drainage is medium, and fertility is high. The soils are mildly alkaline to a depth of about 17 inches and are slightly calcareous to strongly calcareous below.

Nearly all areas of Saylesville soils are cultivated and are cropped intensively.

Typical profile of a nearly level Saylesville silt loam in a cultivated area (SE¼SE¼ sec. 7, T. 12 N., R. 21 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B2t—9 to 17 inches, dark reddish-brown (5YR 3/4) clay; moderate, fine, angular blocky structure; firm; many roots; dark reddish-brown (5YR 3/2) clay flows and organic flows are along root channels and on the surface of some peds; mildly alkaline; clear, wavy boundary.

B3t—17 to 21 inches, brown (7.5YR 5/3) silty clay; moderate, medium, angular blocky structure; firm; a few roots; segregated lime coatings on peds; slightly calcareous; clear, wavy boundary.

C—21 to 60 inches +, brown (7.5YR 5/3) silt and silty clay; stratified; firm; segregated lime; strongly calcareous.

In color the surface layer is dark grayish brown (10YR 4/2) and dark brown (10YR 4/3). Texture of the B2t horizon is silty clay or clay. In places mottles are in the B3t horizon and below. Thickness of the solum ranges from 15 to 30 inches. In places the amount of silt increases below a depth of 30 inches and thin strata of fine sand occur.

Saylesville soils are a drainage associate of the somewhat poorly drained Martinton soils. They are finer textured than Sisson soils.

Saylesville silt loam, 0 to 2 percent slopes (ShA).—This soil has the profile described for the series. The areas generally are oblong or irregular in shape.

Included with this soil in mapping are small areas that have a surface layer of silty clay loam. Also included are small areas of somewhat poorly drained Martinton silt loam, 1 to 3 percent slopes, and of well-drained Sisson fine sandy loam, 1 to 6 percent slopes, eroded.

The lower layers of this Saylesville soil are clayey, and runoff is slow. As a result, the soil warms and dries slowly in spring and after a heavy rain. Capability unit IIs–7; recreation group 3; planting group 3.

Saylesville silt loam, 2 to 6 percent slopes, eroded (ShB2).—This soil occupies rises in old lakebeds. The areas generally are oblong or irregular in shape. The soil is slightly shallower to underlying silt and silty clay and has a slightly thinner surface layer, but otherwise its profile is similar to that described for the series.

Included with this soil in mapping are some small areas that are more sloping than this soil and some small areas that have a thicker surface layer. Also included are small areas of Sisson fine sandy loam, 1 to 6 percent slopes, eroded.

On this Saylesville soil, runoff is medium and the hazard of water erosion is slight. Capability unit IIe–6; recreation group 3; planting group 3.

Sebewa Series

Nearly level, loamy, poorly drained soils are in the Sebewa series. These soils are on low flats and in depressions on outwash terraces throughout the county. They formed partly in loamy material and partly in calcareous outwash sand and gravel.

In a typical profile the surface layer is friable, black silt loam about 10 inches thick. The subsoil is about 19 inches thick. It is firm, gray heavy silty clay loam in the upper 8 inches. The next 8 inches is friable, gray silty clay loam that feels gritty, and the remaining 3 inches is gray and brown loam. These last two layers are mottled with yellowish brown. Below is loose, pale-brown, stratified sand and gravel that also is mottled with yellowish brown.

These soils have medium available moisture capacity and moderate permeability. Internal drainage is very slow because of an almost permanent high water table. Fertility is moderate. The upper two layers are mildly alkaline.

Most areas of the Sebewa soils are drained and are cropped intensively. Areas undrained are used as permanent pasture or as woodland and also provide habitat for wildlife.

Typical profile of a nearly level Sebewa silt loam in a cultivated area (SE¼SE¼ sec. 30, T. 9 N., R. 21 E.):

Ap—0 to 10 inches, black (10YR 2/1) silt loam; weak, fine, subangular blocky structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B21tg—10 to 18 inches, gray (5Y 5/1) heavy silty clay loam; moderate, very fine, angular blocky structure; thick continuous clay films; firm; a few roots; a few organic stains; mildly alkaline; clear, smooth boundary.

IIB22tg—18 to 26 inches, light-gray to gray (5Y 6/1) silty clay loam that feels gritty; moderate, fine, angular blocky structure; thin patchy clay films; friable; a few roots; common, medium, distinct, yellowish-brown (10YR 5/6 and 5/8) mottles; a few pebbles and sand spots; neutral; clear, wavy boundary.

IIB3g—26 to 29 inches, heavy loam that is 40 percent gray (5Y 6/1) and 60 percent brown (10YR 5/3); weak, medium, subangular blocky structure; friable; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; many pebbles; moderately alkaline; clear, wavy boundary.

IIC—29 to 60 inches +, pale-brown (10YR 6/3) medium sand and gravel; stratified; single grain; loose; a few, coarse, faint, yellowish-brown (10YR 5/6) mottles; strongly calcareous.

The A horizon ranges from 9 to 12 inches in thickness. Texture of the B2 horizon is sandy clay loam, clay loam, or silty clay loam that feels gritty. Thickness of the solum ranges from 24 to 36 inches.

Sebewa soils are a drainage associate of the well-drained Dresden soils and the somewhat poorly drained Matherton soils. Their solum is thicker than that of the Mussey soils.

Sebewa silt loam (0 to 2 percent slopes) (Sm).—This is the only Sebewa soil mapped in the county. The areas are either long and narrow or are circular.

Included with this soil in mapping are small areas that have a surface layer of loam. Also included are small areas of the somewhat poorly drained Matherton soils. Other included small areas have a surface layer of peat or muck.

The water table is at or near the surface of Sebewa silt loam for most of the year. Water is likely to pond on the areas for fairly long periods in spring and after a heavy rain. Capability unit IIw–5; recreation group 7; planting group 5.

Sisson Series

The Sisson series consists of nearly level to steep, loamy soils that are well drained. These soils are mainly in the western part of the county in the beds of old glacial lakes or are on benches. Some of the nearly level to gently sloping areas, and all of the steeper areas, are closely intermixed with areas of Casco and Hochheim soils. Sisson soils formed in lake-laid silt and fine sand. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, dark grayish-brown fine sandy loam about 9 inches thick. It overlies friable, brown very fine sandy loam about 3 inches thick. The subsoil is about 12 inches thick. It is friable, brown very fine sandy loam in the upper 4 inches and firm, dark-brown clay loam in the remaining 8 inches. Below is friable, pale-brown silt and fine sand.

These soils have high available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. The surface layer and the subsoil are alkaline, and the underlying material is calcareous.

Most areas of the Sisson soils are cultivated intensively.

Typical profile of a gently sloping Sisson fine sandy loam in a cultivated area (NW¼SW¼ sec. 11, T. 12 N., R. 21 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—9 to 12 inches, brown (10YR 5/3) very fine sandy loam; weak, medium, platy structure; friable; many roots; mildly alkaline; clear, smooth boundary.

B1—12 to 16 inches, brown (7.5YR 5/4) very fine sandy loam; moderate, fine, subangular blocky structure; friable; many roots; mildly alkaline; clear, smooth boundary.

B2t—16 to 24 inches, dark-brown (7.5YR 4/4) light clay loam; moderate, medium, subangular blocky structure; firm; a few roots; dark-brown (7.5YR 3/2) clay coatings on ped surfaces; mildly alkaline; clear, smooth boundary.

C—24 to 60 inches, pale-brown (10YR 6/3), stratified silt, very fine sand, and fine sand; friable; strongly calcareous.

The surface layer is dark grayish brown (10YR 4/2) or brown (10YR 4/3) in color. Thickness of the solum ranges from 24 to 30 inches. In some places mottles occur below a depth of 24 inches. The proportion, sequence, and color of the silt and very fine sand in the stratified C horizon vary. Thin strata of clay are common.

Sisson soils are a drainage associate of the somewhat poorly drained variants from the Darroch series and the poorly drained Colwood soils. They are coarser textured throughout the profile than Saylesville soils, which formed in lake-laid silt and clay, and are sandier in the upper part of the profile than Zurich soils.

Sisson fine sandy loam, 1 to 6 percent slopes, eroded (SrB2).—This is the only Sisson soil mapped in the county. The areas are irregular or long and narrow in shape.

Included with this soil in mapping are small areas that have slightly steeper slopes than this soil. Also included are small areas in which the lower part of the second layer is mottled and small areas where the second layer is very thin or is lacking. In many places, where the surface layer is lacking the second layer is calcareous.

Runoff is slow on this Sisson soil. The hazard of water erosion is slight. Capability unit IIe–1; recreation group 1; planting group 3.

Theresa Series

Gently sloping, loamy soils that are well drained are in the Theresa series. These soils are in the western part of the county in the uplands on side slopes and ridges. They formed in loamy glacial till that had a capping of silt 12 to 18 inches thick.

The surface layer in a typical profile is friable, dark grayish-brown silt loam about 9 inches thick. It overlies friable, brown silt loam about 3 inches thick. The subsoil is firm, is dark brown to brown, and is about 18 inches thick. It is silty clay loam in the upper 4 inches and clay loam in the remaining 14 inches. Below is friable, yellowish-brown loamy glacial till.

These soils have high available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. The upper layers are mildly alkaline, and the underlying till is strongly calcareous.

Most areas of the Theresa soils are cultivated. Corn, oats, and alfalfa are the common crops.

Typical profile of a gently sloping Theresa silt loam in a cultivated area (NE¼NE¼ sec. 8, T. 9 N., R. 21 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

A2—9 to 12 inches, brown (10YR 5/3) silt loam; moderate, medium, platy structure; friable; many roots; mildly alkaline; gradual, irregular boundary.

B1t—12 to 16 inches, dark-brown (10YR 4/3) silty clay loam; moderate, fine, subangular blocky structure; firm; many roots; mildly alkaline; clear, wavy boundary.

IIB2t—16 to 22 inches, dark-brown (7.5YR 4/4) heavy clay loam; moderate to strong, fine, subangular blocky structure; firm; many roots; continuous, conspicuous clay films; a few pebbles and cobblestones; mildly alkaline; abrupt, wavy boundary.

IIB3t—22 to 30 inches, brown (10YR 4/3) sandy clay loam; moderate, fine, subangular blocky structure; firm; a few roots; some pebbles and cobblestones; moderately alkaline; gradual, irregular boundary.

IIC—30 to 60 inches +, yellowish-brown (10YR 5/4) loamy glacial till; massive to weakly stratified in places; friable; many pebbles and cobblestones; strongly calcareous.

The surface layer ranges from very dark brown (10YR 2/2) to a depth of 3 to 5 inches in undisturbed areas to dark brown (10YR 4/3) in cultivated areas. Thickness of the solum ranges from 24 to 36 inches. The underlying glacial till ranges from silt loam that feels gritty to sandy loam in texture. It ranges from 10YR to 7.5YR in hue in the northwestern corner of the county. Pebbles and cobblestones are common in the profile. Undisturbed areas have a few stones on the surface.

Theresa soils have a thicker capping of silt and a thicker solum than Hochheim soils.

Theresa silt loam, 2 to 6 percent slopes (ThB).—This is the only Theresa soil mapped in the county. The areas are irregular or roughly circular in shape.

Included with this soil in mapping are small nearly level areas and small moderately eroded areas. Also included are small areas of Hochheim soils.

Runoff is medium on this Theresa soil. The hazard of water erosion is slight. Capability unit IIe–1; recreation group 2; planting group 3.

Wasepi Series

Wasepi soils are nearly level, loamy, and somewhat poorly drained. They are on sandy outwash terraces along streams and drainageways throughout the county. The soils formed in sandy outwash underlain by calcareous sand that contained some gravel.

In a typical profile the surface layer is very friable, very dark grayish-brown sandy loam about 8 inches thick. The subsoil is about 22 inches thick and has strong-brown, grayish-brown, and yellowish-brown mottles. It is very friable, dark-brown sandy loam in the upper 7 inches and friable, dark yellowish-brown to brown sandy clay loam in the 8 inches below. The remaining 7 inches is very friable, dark yellowish-brown loamy sand. Below is loose, pale-brown sand and gravel that is stratified and contains yellowish-brown mottles.

These soils have medium available moisture capacity and moderately rapid permeability. The water table is less than 1 foot from the surface for short periods. Internal drainage is slow. Fertility is low. The soils are mildly alkaline to neutral to a depth of about 30 inches and calcareous below. Most areas are cultivated.

Typical profile of a gently sloping Wasepi sandy loam in a cultivated area (NE¼NW¼ sec. 26, T. 10 N., R. 21 E.):

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, crumb structure; very friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1—8 to 15 inches, dark-brown (10YR 4/3) sandy loam; weak, medium to coarse, subangular blocky structure; very friable; many roots; common, fine, faint, strong-brown (7.5YR 5/6) mottles; neutral; clear, smooth boundary.

B21t—15 to 19 inches, dark yellowish-brown (10YR 3/4) sandy clay loam; weak to moderate, medium, subangular blocky structure; thick continuous clay films; friable; a few roots; common, weak, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, wavy boundary.

B22t—19 to 23 inches, brown (10YR 5/3) sandy clay loam; weak to moderate, medium, subangular blocky structure; thick continuous clay films; friable; a few roots; common, fine, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, wavy boundary.

B3—23 to 30 inches, dark yellowish-brown (10YR 4/4) coherent loamy sand; weak, medium, subangular blocky structure; very friable; common, fine, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) mottles; mildly alkaline; clear, wavy boundary.

C—30 to 60 inches, pale-brown (10YR 6/3) medium sand that includes some gravel; stratified; single grain; loose; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; calcareous.

The surface layer is very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) in color. In places the B horizon is partly degraded and a weak Birh horizon has formed. Texture of the B2t horizon ranges from sandy loam to sandy clay loam that is less than 10 inches thick. Thickness of the solum ranges from 24 to 40 inches. In places gravel occurs throughout the profile.

Wasepi soils are a drainage associate of the well-drained Boyer soils. They have a deeper solum than the Fabius soils and a coarser textured solum than the Matherton soils.

Wasepi sandy loam, 1 to 3 percent slopes (WmA).—This is the only Wasepi soil mapped in the county. It occupies the lower parts of sandy outwash terraces along drainageways. The areas are oblong or are long and narrow.

Included with this soil in mapping are a few small areas that have a surface layer of loam or loamy sand and some small gently sloping areas. Some of these areas lack a B horizon. Also included are a few small areas that are mottled at a greater depth than this soil. In other included areas, the third and fourth layers are thicker than 10 inches. Still other included small areas are underlain by silty clay loam at a depth of 30 to 60 inches.

Runoff is very slow on this Wasepi soil. The hazard of soil blowing is slight. Capability unit IIw–5; recreation group 6; planting group 4.

Wet alluvial land (0 to 3 percent slopes) (Ww) consists dominantly of silt loam soil material, but it ranges to sandy loam and in places contains thin sandy layers. The surface layer is black and is about 8 inches thick. Gray mottles are immediately below. The soil material is neutral to alkaline.

Included with this land type, west of State Highway 57 and north of Thiensville, is an area underlain by dolomitic limestone bedrock at a depth of about 18 inches. Also included are some areas of Marsh that are too small to be mapped separately.

Wet alluvial land has a permanent high water table and is subject to frequent flooding when the streams overflow. The areas are used for permanent pasture, as woodland, or as wildlife habitat. Capability unit Vw–14; recreation group 9; planting group not assigned.

Yahara Series

The Yahara series consists of nearly level to gently sloping, loamy soils that are somewhat poorly drained. These soils are in the western half of the county in old glacial lakebeds and drainageways and on foot slopes. They formed in lake-laid silt and fine sand.

In a typical profile the surface layer is friable, very dark gray very fine sandy loam about 10 inches thick. The subsoil is friable, yellowish-brown loam that is about 6 inches thick and has strong-brown mottles. Just below is friable, pale-brown, laminated silt and fine sand that has grayish-brown and brownish-yellow mottles.

These soils have high available moisture capacity and moderate permeability. The water table temporarily occurs 1 to 3 feet from the surface, and internal drainage is slow. The surface layer and the upper part of the subsoil are mildly alkaline, and the material below is calcareous. Fertility is moderate.

Most areas of Yahara soils are drained and are used for crops. Areas undrained remain in pasture or woods.

Typical profile of a nearly level Yahara very fine sandy loam in a cultivated area (NW¼SE¼ sec. 16, T. 12 N., R. 21 E.):

Ap—0 to 10 inches, very dark gray (10YR 3/1) very fine sandy loam; weak, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.

B1—10 to 12 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable; a few roots; common, medium, distinct, strong-brown (7.5YR 5/8) and grayish-brown (10YR 3/2) mottles; contains seams of silt and fine sand; mildly alkaline; clear, wavy boundary.

B2—12 to 16 inches, yellowish-brown (10YR 5/4) loam; medium to coarse, subangular blocky structure; friable; a few roots; common, medium, distinct, strong-brown (7.5YR 5/8) and grayish-brown (10YR 3/2) mottles; contains seams of silt and fine sand; calcareous; clear, wavy boundary.

C—16 to 60 inches +, pale-brown (10YR 6/3) laminated silt and fine sand; friable; common, medium, distinct, grayish-brown (10YR 5/2) and brownish-yellow (10YR 6/8) mottles; strongly calcareous.

In color the surface layer is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). Thickness of the B horizon ranges from 3 to 12 inches. Depth to free carbonates ranges from 0 to 15 inches. Mottling begins at a depth between 8 and 14 inches. In places the underlying material includes thin, clayey strata.

Yahara soils are the drainage associate of the poorly drained Keowns soils. They are deeper to free carbonates than the variants from the Darroch series and are coarser textured than Martinton soils, but they lack the argillic horizon that is typical of those soils.

Yahara very fine sandy loam, 1 to 3 percent slopes (YhA).—This is the only Yahara soil mapped in the county. The nearly level areas are in old lakebeds, and the very gently sloping areas are on the edges of drainageways. The areas are irregular or are long and narrow in shape.

Included with this soil in mapping are small areas that are more sloping than this soil. Also included are small areas that have a surface layer of loam or silt loam and some small areas that have clayey material at a depth of 30 to 60 inches. Other included small areas consist of poorly drained Keowns silt loam.

Runoff is slow on this Yahara soil. Water is likely to pond on the nearly level areas during wet seasons. The hazard of water erosion is slight on the very gently sloping areas. Capability unit IIIw–3; recreation group 6; planting group 4.

Zurich Series

The Zurich soils are nearly level to gently sloping, loamy, and well drained. They occur mainly in the western part of the county in old glacial lakebeds and on benches. These soils formed in lake-laid silt and fine sand. Some areas, however, have a thin capping of silt on them.

In a typical profile the surface layer is friable, dark grayish-brown silt loam about 9 inches thick. The subsoil is firm, brown to dark-brown silty clay loam about 14 inches thick. Below is friable, pale-brown, stratified silt and fine sand that has brownish-yellow mottles.

These soils have high available moisture capacity and moderate permeability. Internal drainage is medium, and fertility is moderate. The surface layer and subsoil are mildly alkaline, and the underlying silt and fine sand are calcareous.

Zurich soils are used mainly for farming, and most areas are cultivated intensively.

Typical profile of a nearly level Zurich silt loam in a cultivated area (NW¼NW¼ sec. 32, T. 10 N., R. 21 E.):

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, granular structure; friable; many roots; mildly alkaline; abrupt, smooth boundary.
B1t—9 to 14 inches, brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; friable; many roots; mildly alkaline; clear, smooth boundary.
B2t—14 to 21 inches, brown (10YR 4/3) silty clay loam; moderate, medium, angular blocky structure; firm; many roots; continuous, dark-brown (10YR 3/3) clay films on ped surfaces; mildly alkaline; clear, wavy boundary.
B3t—21 to 23 inches, brown (10YR 4/3), stratified silty clay loam and silt; moderate, medium, subangular blocky structure; firm; a few roots; a few, fine, faint mottles; mildly alkaline; clear, wavy boundary.
C—23 to 60 inches, pale-brown (10YR 6/3), stratified silt and fine sand; friable; common, medium, distinct, brownish-yellow (10YR 6/5 and 6/6) mottles; strongly calcareous.

The surface layer is dark grayish brown (10YR 4/2) or brown (10YR 4/3) in color. Thickness of the solum ranges from 15 to 30 inches. In places mottles occur in the B3t horizon and below. The proportion, sequence, and color of the silt and fine sand in the stratified C horizon vary. Thin clayey strata are common.

Zurich soils are a drainage associate of the somewhat poorly drained Darroch soils and the poorly drained Colwood soils. They are coarser textured in the B and C horizons than Saylesville soils, which formed in lacustrine silt and clay.

Zurich silt loam, 0 to 2 percent slopes (ZuA).—This soil has the profile described for the series. The areas are roughly circular.

Included with this soil in mapping are small areas that have mottles in the lower part of the second layer and a few small areas where the second layer is very thin or is lacking. In areas where the second layer is lacking, the surface layer is calcareous in many places.

Runoff is slow on this Zurich soil. Capability unit I–1; recreation group 1; planting group 3.

Zurich silt loam, 2 to 6 percent slopes, eroded (ZuB2).—Areas of this soil are irregular or are long and narrow. The soil is a few inches shallower to silt and fine sand, but otherwise its profile is like that described for the series.

Included with this soil in mapping are small areas that are slightly steeper than this soil. Also included are small areas that have mottles in the lower part of the second layer and some small areas where the second layer is very thin or is lacking. In areas where the second layer is lacking, the surface layer is calcareous in many places.

Runoff on this Zurich soil is medium, and the hazard of water erosion is slight. Capability unit IIe–1; recreation group 1; planting group 3.

Use and Management of the Soils

This section explains the system of classification used by the Soil Conservation Service and the basic practices of management that apply to all of the soils. Next management of the soils by capability units is described and predicted average acre yields of the principal crops are given. Then management of the soils for woodland, for wildlife, for engineering, and for nonfarm purposes is described.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops having special requirements. The soils are classified according to degree and kinds of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible major reclamation.

In the capability system all soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest grouping, are designated by Roman numerals, I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.
Class II soils have some limitations that reduce the choice of plants or require moderate conservation practices.
Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.
Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.
Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

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 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, but not in Ozaukee County, 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 can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subjected to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

Basic Practices of Management[2]

In the paragraphs that follow, basic practices of management for all soils of Ozaukee County suitable for tilled crops and pasture are discussed. The chief problems in farming the soils are maintaining fertility, providing drainage, and controlling erosion. Technical assistance in planning and applying practices suitable for the soils on a particular farm can be obtained from local representatives of the Soil Conservation Service and the Extension Service.

Practices that fit all of the soils that are suitable for crops and pasture are summarized in the paragraphs that follow. In addition suitability of the soils for pasture renovation are discussed. All of these are to be considered along with the practices suggested in each capability unit.

Maintaining fertility.—Fertility can be improved by choosing a cropping system that adds organic matter to the soils. On the dairy farms a diversified cropping system is used and barnyard manure is added. Where truck farming is practiced or other special crops are grown intensively, green-manure crops are needed and all crop residues must be returned to the soil.

Commercial fertilizer gives good response for all crops. The mineral soils in Ozaukee County generally are medium to high in potassium and medium to low in phosphorus. Examples are soils of the Hochheim, Kewaunee, and Ozaukee series. Organic soils are low in both phosphorus and potassium and require regular applications of both elements for good growth of crops. All of the soils contain adequate to large amounts of lime, and pH generally is 6.5 to 7.5. In many of the soils, the subsoil is alkaline. The fertilizer and lime should be applied in the rates and amounts indicated by results of soil tests.

Drainage.—Many of the soils in this county are wet because of runoff from adjacent areas, a slowly permeable subsoil, a fluctuating high water table, or a combination of these. In some places diversions can be used to remove runoff from adjacent areas. In other places random or parallel, shallow field ditches are needed to lead the water to main natural waterways or to deep, open ditches. If shallow ditches are used, tillage generally is planned so that furrows or rows cross the ditches. Similar practices can be used where the subsoil is unstable and where deep ditches and tile drains are difficult to maintain. Examples of such soils are the Colwood, Mussey, and Yahara, which are underlain by silt and very fine sand, by sand and gravel, and by silt and fine sand, respectively.

In loamy and clayey soils, such as the Manawa, Pella, and Poygan in depressions and along drainageways, subsurface water, or a combination of surface and subsurface water, causes wetness. The excess water can be removed by tile drains.

Where outlets are available, low, nearly level, wet areas of mineral and organic soils can be drained by deep ditches and by tile. If the organic soils are properly drained, they can be farmed intensively.

In some of the soils, such as the Brookston and Nenno, a perched water table or hillside seepage is common. Tile can be used in such areas to provide drainage.

Erosion control.—Large areas of soils in Ozaukee County are eroded or severely eroded. Examples are soils of the Hochheim, Kewaunee, and Ozaukee series. Except for ravines and gullies that empty directly into Lake Michigan, most soil losses are the result of sheet and rill erosion. In addition, however, loamy sands and sandy loams, such as those of the Boyer series, are susceptible to soil blowing. Wind stripcropping and shelter belts can be used to help control soil blowing.

Irregular slopes make use of conservation cropping systems the most common means of controlling erosion on the steeper soils. A conservation cropping system is one that includes a high proportion of close-growing crops. The nearly level and gently sloping soils can be used more intensively under management that includes use of contour stripcropping and terracing for control of erosion (fig. 7). When conservation cropping systems are used, other practices that can be used to control erosion are installing grassed waterways and tile drains; practicing contour stripcropping where feasible; and building diversions and constructing terraces (fig. 8).

Grassed waterways commonly are used along with a conservation cropping system for erosion control. In many areas they are needed to dispose of water from hillside seeps. Tile drains also can be used to stabilize the waterways and to obtain a good cover of sod.

Contour stripcropping is suitable for all well-drained and excessively drained soils. If they are installed on a grade of 0.5 to 1 percent toward waterways, contour strips also can be used on sloping soils that are moderately well drained and somewhat poorly drained to lead runoff into nearby grassed waterways. Contour strips can be used on slopes up to 16 percent. They can range from 60 to 100 feet in width, depending on the degree of slope.

[2] By Myron E. Johansen, work unit conservationist, Soil Conservation Service, Port Washington, Wis.

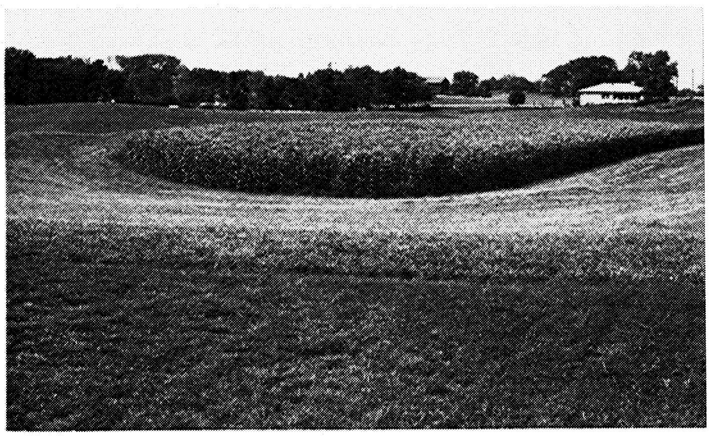

Figure 7.—**Hay crops on sloping soils and row crops on gently sloping and nearly level soils.**

Diversion terraces or ditches are needed to channel water away from critical areas and to reduce the length of the slope. Installing these at the base of steep slopes protects soils on slopes below and also protects wetland soils from runoff from higher areas. The channels can be protected from siltation by controlling erosion in areas above or by placing filter strips of sod above the diversion channel.

Terraces are the most effective measure for control of erosion but are suitable only for soils that have regular slopes. They generally are used on uniform slopes up to 8 percent, but they can be used on slopes of as much as 12 percent. The loams and silt loams of the Hochheim, Kewaunee, and Ozaukee series are examples of soils suited to terracing. In some of the soils, the soil layers are too thin for terrace construction. Examples of these are the Casco soils. Terraces also are effective if installed on sloping, poorly drained and very poorly drained soils. In such areas terraces protect the soils from erosion and provide for uniform disposal of water. The soils can be cropped more intensively after terraces are installed.

Pasture renovation.—Most forage in the county is obtained from strips of hay grown in the cropping system. Grazing is done in the last year of the rotation. On some farms the hay is cut green and fed to the animals or is fed dry.

Figure 8.—**Contour stripcropping and diversion terraces on a sloping Hochheim soil that is well drained.**

About 12,000 acres in the county is in permanent hay or pasture. Of this acreage, about half consists of soils in classes II, III, and IV that are kept in pasture because of the shape of the field or because they are wet or stony. In addition, about a thousand acres consists of soils in class V, which are not practical to drain. Also, approximately 5,000 acres are soils in class VI and class VII, which are too steep or droughty for the crops generally grown.

Most pastures in the uplands on well-drained soils in classes II, III, IV, and VI provide more grazing after renovation. A good seedbed is needed. Preparing of the seedbed generally is started in fall and completed by May of the next year. After renovation a suitable mixture of grasses and legumes to use is alfalfa and bromegrass or timothy, or birdsfoot trefoil and bromegrass. The pasture mixture can be seeded with a companion crop of oats to provide a protective cover the first season and to help control erosion.

Applying large amounts of phosphorus and potassium at the time of seeding assures rapid growth of the pasture mixtures. Nitrogen also can be applied as a topdressing, particularly if grasses are dominant in the pasture. On the steep soils, and on the sandier soils, controlled grazing helps to maintain a good cover of plants and also reduces soil losses by erosion.

Pastures on soils in class V are subject to flooding, and the water table is high in these soils. Tillage therefore is not practical, and renovation is not feasible. Soils in class V generally are kept in meadows of reed canarygrass or bromegrass. Grazing the areas only in dry seasons is a way of keeping hummocks, which hinder surface drainage, from developing.

Pastures on steep soils in class VI are difficult to renovate, and soils in class VII are not suitable for renovation. On such soils tillage is not practical, and the pastures generally are kept in native grasses. Controlling grazing and adding commercial fertilizer are ways of maintaining fertility.

Management by Capability Units

In the following pages the capability units in Ozaukee County are described and suggestions for use and management for all the soils of each unit are given. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all soils of a given series appear in the unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

Capability unit I–1

This unit consists of deep, nearly level, loamy soils of the Casco, Hochheim, Sisson, and Zurich series. These soils are moderately permeable and have medium to high available moisture capacity. They are easy to manage and to keep in good tilth.

These soils are used for corn, potatoes, beans, peas, and other row crops. They also are suitable for hay and pasture, for trees, for wildlife habitat, and for similar less intensive uses. Row crops can be grown continuously if minimum tillage is used, fertility and content of organic matter are kept high, and good tilth and soil structure are maintained.

Capability unit IIe-1

In this unit are deep, gently sloping, loamy soils of the Casco, Hochheim, Sisson, Theresa, and Zurich series. These soils are moderately permeable and have medium to high available moisture capacity. Fertility is moderate. Good tilth is easy to maintain. The hazard of water erosion is slight, and some of the soils are eroded.

These soils are used mainly for corn, potatoes, peas, and other row crops. They also are suitable for small grains, hay, and other less intensive uses.

Capability unit IIe-2

Moderately deep, gently sloping soils of the Fox and Knowles series are in this unit. These soils have a surface layer of loam or silt loam and are underlain by sand and gravel or bedrock. They are moderately permeable and have medium available moisture capacity. They are slightly droughty during dry periods. The hazard of water erosion is slight, and the Knowles soil is eroded. The soils are easy to keep in good tilth. They generally are slightly acid unless they have been limed.

These soils are used mostly for row crops, small grains, and hay. They also are suitable for pasture, for use as woodland, or for similar less intensive uses.

Crops on these soils respond well to irrigation, especially in years when rainfall is lower than normal or is poorly distributed.

Capability unit IIe-6

This unit consists of deep, gently sloping soils of the Hebron, Kewaunee, Ozaukee, and Saylesville series. These soils have a surface layer of loam, silty clay loam, or loam, and the subsoil is slowly permeable. Available moisture capacity is high, and fertility is moderate to high. Permeability is moderately slow to slow. Consequently, considerable water runs off the areas during periods of heavy rain, and some of the soils are eroded.

The soils of this unit are difficult to work. Good tilth is hard to maintain, especially in eroded areas where tillage extends into the clayey subsoil. The soils also are sticky when wet and hard when dry, and tillage must be done at the proper moisture content. Water erosion is a slight hazard on all except the nearly level areas of the Hebron soil.

These soils are used mainly for corn or other row crops and for small gains and alfalfa (fig. 9). They also are suitable for permanent pasture, trees, and other less intensive uses.

Capability unit IIw-1

This unit consists of poorly drained, nearly level and gently sloping silt loams and silty clay loams of the Ashkum, Brookston, Navan, Pella, and Poygan series. These soils have very slow internal drainage, moderate to slow permeability, and high available moisture capacity. Fertility is moderate to high. The water table is high in these soils for most of the year. The soils also are subject to flooding and ponding in spring and after a heavy rain. In addition, the Brookston soil is subject to slight erosion, and the Poygan soil becomes cloddy if cultivated when wet.

Drained areas of these soils are used for corn and vegetable crops. The corn commonly is grown in a rotation that includes oats followed by alfalfa. Undrained areas are suitable for permanent pasture, trees, or wildlife habitat.

Surface drains and tile drains can be used on these soils to dispose of excess water. Diversion ditches can be used to intercept and dispose of surface water flowing from higher lying areas.

Capability unit IIw-2

In this unit are somewhat poorly drained, nearly level to gently sloping soils of the Aztalan, Manawa, Martinton, Mequon, Nenno, and Radford series. These soils have a surface layer of loam or silt loam and are underlain by loamy material. They are moderately to slowly permeable and have medium to high available moisture capacity. Internal drainage is slow, and the soils therefore warm and dry slowly in spring and after a rain. The water table is seasonally high, and runoff from higher areas ponds on the nearly level areas in spring and after a heavy rain. The gently sloping areas also have a slight hazard of water erosion.

Corn, other row crops, oats, and alfalfa are the crops commonly grown. Unless excess water is removed, however, growth is poor and alfalfa is likely to winterkill. The soils also are suitable for permanent pasture, trees, and other less intensive uses.

Surface drains or tile drains can be used on these soils to remove excess water from the root zone. Diversions can be used, along with natural waterways, to intercept and dispose of surface water flowing from higher areas. On the gently sloping areas, terracing or contour stripcropping can be used for control of water erosion. The contour lines need to be established on a slight grade toward waterways.

Capability unit IIw-5

Nearly level to gently sloping soils of the Fabius, Matherton, Mussey, Sebewa, and Wasepi series and of the variant from the Knowles series are in this unit. These soils have a surface layer of loam, silt loam, or sandy loam and are underlain by sand and gravel or bedrock. The Mussey and Sebewa soils are poorly drained, and the other soils are somewhat poorly drained. The water table is seasonally high in all of the soils. In spring and after a heavy rain, runoff flowing from higher areas is a problem. Internal drainage is slow to very slow. As a result, water ponds on the nearly level areas for short periods. Gently sloping areas also are subject to a slight hazard of water erosion.

Corn, oats, alfalfa, and certain vegetables are the crops commonly grown. Unless excess water is removed, however, growth is poor and alfalfa is likely to winterkill. Undrained areas of the somewhat poorly drained soils have limited use for forage and small grains, but they are better suited to permanent pasture and trees. Undrained areas of the poorly drained soils are suitable for permanent pasture, for woodland, and for wildlife habitat.

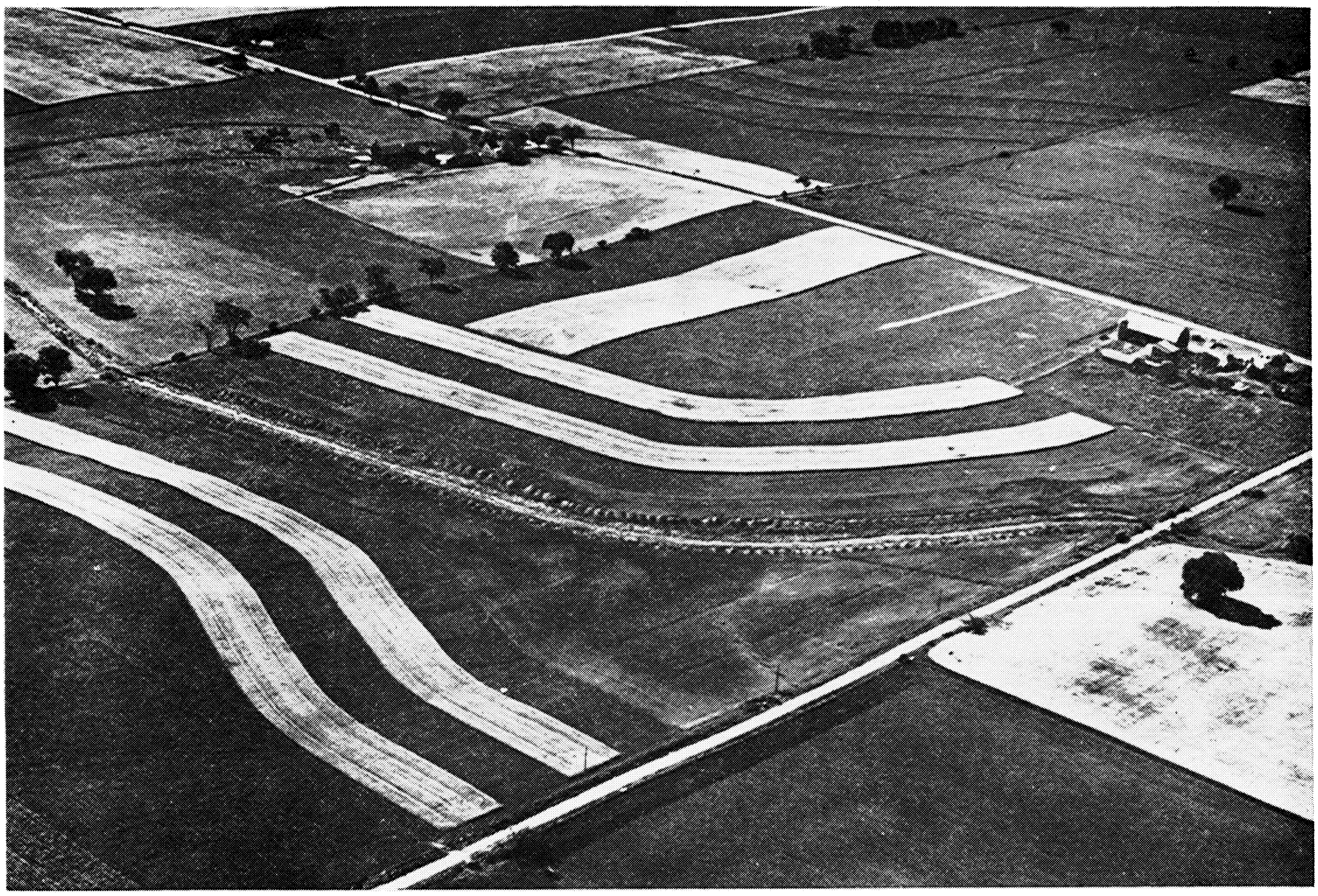

Figure 9.—**Crops on soils of capability unit IIe–6; the crops are grown in strips for control of erosion.**

Surface ditches can be used to remove excess surface water from these soils. Deep, open ditches or tile are needed for removing excess water from the root zone. Open ditches are difficult to maintain, however, and blinding and other special practices are needed when installing tile drains. Onsite investigation is needed before deep ditching or tiling is done in areas underlain by bedrock. Such areas generally are limited to surface drainage systems. Diversions and waterways can be used to intercept and dispose of excess surface water flowing from higher lying areas.

Capability unit IIw–8

Palms mucky peat is the only soil in this unit. It is a moderately deep, nearly level, very poorly drained, organic soil that is underlain by loamy material. This soil has an almost permanent high water table and is subject to ponding in spring and after a heavy rain. Internal drainage is very slow, permeability is moderate, and available moisture capacity is high. Fertility is low. The hazard of soil blowing is slight in areas that are drained and cultivated.

About one-third of the acreage of this soil is drained and cropped intensively. Corn and vegetables are the crops commonly grown. Undrained areas are suitable for permanent pasture, for woodland, or for wildlife areas.

Excess water can be removed from the root zone of these soils by use of open ditches or tile drains. About 2 years before tile is placed, open ditches should be installed for control of subsidence. Installing a system that controls or raises the water table helps to reduce subsidence. It also helps to maintain an adequate supply of moisture in the root zone during dry periods.

Capability unit IIw–13

This unit consists only of Alluvial land, which is made up of somewhat poorly drained and poorly drained silty and sandy sediment on flood plains. Alluvial land has a seasonal high water table and is subject to stream flooding in spring and after a heavy rain. Internal drainage is slow to very slow. Fertility is high, and available moisture capacity is moderate. The areas are subject to streambank cutting.

Corn is the chief crop in areas drained and protected from flooding. Unimproved areas are suitable for permanent pasture, for trees, and for wildlife habitat.

Open ditches can be used to remove excess water from the areas after a flood. Constructing embankments along the edges of streams helps to prevent flooding. Diversions can be used to divert excess surface water flowing from higher lying areas.

Capability unit IIs–1

This unit consists of moderately deep, nearly level soils of the Dresden, Fox, and Knowles series. These soils have a surface layer of loam or silt loam and are underlain by sand and gravel or bedrock. They are moderately permeable and have medium internal drainage. Available moisture capacity is medium. The soils are easy to work, but they are slightly droughty during long dry periods in summer. They generally are slightly acid unless they have been limed.

Corn and other row crops, followed by oats and alfalfa, are commonly grown. The soils also are suitable for trees and for wildlife areas. Row crops can be grown continuously if the soils are irrigated and if intensive management is used.

Capability unit IIs–7

Deep, nearly level silt loams of the Kewaunee, Ozaukee, and Saylesville series are in this unit. These soils have a clayey subsoil. Permeability is moderately slow to slow, and available moisture capacity is high. Fertility is moderate to high. The soils dry slowly in spring and after a heavy rain. As a result, normal tillage operations are delayed.

Most areas of these soils are cultivated and planted to row crops, but in many places small grains and alfalfa are grown. The soils also are suitable for other less intensive uses. Row crops can be grown continuously if minimum tillage is used, fertility is kept high, good tilth is maintained, and all crop residues are returned to the soils. Installing a system that removes surface water helps to speed up drainage and to dry the soils.

Capability unit IIIe–1

Sloping, deep, loamy soils of the Casco, Hochheim, and Sisson series are in this unit. These soils are eroded. They are moderately permeable and have medium to high available moisture capacity. Runoff is medium, and the hazard of water erosion is moderate. Favorable tilth is easy to maintain if good management is used.

These soils are used mainly for corn, oats, alfalfa, and similar crops. A few areas are used for permanent pasture, as woodland, or for wildlife habitat. Practices are needed that control erosion and that maintain fertility, tilth, and the content of organic matter.

Capability unit IIIe–4

Mostly gently sloping, somewhat droughty soils of the Boyer, Casco, Fox, and Ritchey series are in this unit. These soils have a surface layer of sandy loam, loam, or silt loam and are underlain by sand and gravel or bedrock. They are moderately permeable and have medium available moisture capacity. Internal drainage is rapid in the Boyer and Casco soils and medium in the Fox and Ritchey. Except for the Casco soils, reaction is slightly acid unless the soils have been limed. Soil blowing is a slight hazard on the sandy loams, and water erosion is a slight hazard on all except the nearly level areas of the Ritchey soil.

The soils in this unit are easy to till, and nearly all areas are cultivated. Corn, small grains, and alfalfa are the chief crops, but they are often damaged by lack of moisture in summer. Close-growing crops are needed on the sloping soils if practices are not used for control of erosion. The soils in this unit also are suitable for certain kinds of trees.

Crops on these soils respond well to irrigation, especially in years when rainfall is lower than normal or is poorly distributed.

Capability unit IIIe–6

Gently sloping and sloping, deep, eroded soils of the Kewaunee and Ozaukee series are in this unit. These soils have a surface layer of silty clay loam or loam, and their subsoil is slowly permeable.

Available moisture capacity is high in these soils, and fertility is moderate. Permeability is moderately slow to slow, and as a result, runoff is rapid during periods of heavy rain. Clayey material formerly in the subsoil has been mixed into the remaining surface layer by plowing. Consequently, the soils are hard to work and are difficult to keep in good tilth. These soils also are sticky when wet and hard when dry. Tillage therefore must be done at the proper moisture content. Further erosion is a serious hazard.

Most areas of these soils are cultivated. Alfalfa and small grains are the main crops, though row crops are grown in a few places. The soils also are suitable for permanent pasture, for woodland, and for other less intensive uses.

Capability unit IIIw–3

This unit consists of nearly level to gently sloping soils of the Colwood, Keowns, and Yahara series and of variants from the Darroch series. These soils have a surface layer of fine sandy loam, silt loam, or very fine sandy loam and a subsoil of silt and fine sand. The Colwood and Keowns soils are poorly drained, and the other soils are somewhat poorly drained. The water table is seasonally high in all of the soils, and internal drainage is slow to very slow. In spring and after a heavy rain, the soils also are likely to be flooded by water flowing from higher areas and then ponding on the soils for short periods. The gently sloping soils are susceptible to slight erosion.

Corn, oats, alfalfa, and certain vegetables are the crops commonly grown. Unless excess water is removed, however, growth of most crops is poor and alfalfa is likely to winterkill. Undrained areas of the somewhat poorly drained soils have limited use for forage and small grains. They are better suited, however, to permanent pasture and to use as woodland and as wildlife habitat.

Surface ditches can be used to remove excess water from these soils. Deep open ditches or tile drains generally are not suitable. The silt and fine sand in the lower part of the soil flow readily when wet and clog ditches and tile lines quickly unless special practices are used. Also, the silt and fine sand retain water, and the system used must be spaced more closely and would be costly. Diversions and waterways can be used to intercept and dispose of surface water flowing from higher areas.

Capability unit IIIw-9

In this unit are nearly level, moderately deep or deep, very poorly drained mucky peats or mucks of the Houghton, Muskego, and Ogden series. Permeability is moderate, and internal drainage is very slow. Fertility is low. The water table is high for most of the year. The soils also are subject to ponding in spring and after a heavy rain. If these soils are drained, subsidence and soil blowing are serious hazards.

About half the acreage of these soils is drained and cropped intensively to corn, truck crops, and canning crops. Undrained areas are in permanent pasture or are in wetland woods and also provide habitat for wildlife.

Open ditches or tile drains can be used to remove excess of water from these soils. The ditches should be installed about 2 years before tile is laid for control of subsidence. Installing a system that controls or raises the water table helps to reduce subsidence. This practice also helps to maintain an adequate supply of moisture in the root zone during dry periods.

Capability unit IIIs-2

Nearly level, somewhat droughty soils of the Boyer and Lorenzo series are in this unit. These soils have a surface layer of sandy loam or loam and are underlain by sand and gravel. Permeability is moderate, internal drainage is rapid, and available moisture capacity is medium. Fertility is low. The soils generally are slightly acid unless they have been limed. They are easy to cultivate, but crops often are damaged by lack of moisture in summer. Soil blowing is a slight hazard on the Boyer soil.

These soils are suited to cultivated crops and to certain kinds of trees. Corn, oats, and alfalfa are the main crops grown. Row crops can be grown continuously if the soils are irrigated and if all crop residues are returned to the soils.

Capability unit IVe-1

In this unit are deep, moderately steep, loamy soils of the Casco, Hochheim, and Sisson series. These soils are eroded. Permeability is moderate, and available moisture capacity is medium to high. Runoff is rapid, and the hazard of water erosion is severe. Tilth is fairly easy to maintain. The soils are easy to cultivate, but cultivated areas require careful management.

Small grains, grasses, and legumes are the main crops grown on these soils, but corn is grown in a few places. The soils are suited to use as permanent pasture, woodland, and wildlife areas.

Capability unit IVe-4

This unit consists of sloping, somewhat droughty soils of the Casco series. These soils have a surface layer of loam or sandy loam and are underlain by sand and gravel at a depth of less than 20 inches from the surface. Permeability is moderate, available moisture capacity is medium, and internal drainage is medium. The hazard of water erosion is moderate in all areas, but soil blowing is a hazard on the sandy loam. The soils are easy to cultivate, but cultivated areas require careful management. Crops on these soils often are damaged by shortage of moisture in summer.

Small grains, grasses, and legumes are the main crops grown on these soils, but corn is grown in a few places. The soils also are suitable for permanent pasture, for trees, and for other less intensive uses.

Crops on these soils respond well to irrigation, especially in years when rainfall is lower than normal or is poorly distributed.

Capability unit IVe-6

Sloping to moderately steep soils of the Kewaunee and Ozaukee series are in this unit. These soils have a surface layer of silty clay, silt loam, or clay loam. They are eroded or severely eroded.

Available moisture capacity is high in these soils, and permeability is moderately slow to slow. Runoff is rapid to very rapid during periods of heavy rain. Clayey material formerly in the subsoil has been mixed with the remaining surface layer by plowing. As a result, the soils are hard to work and tilth is difficult to maintain. The soils also are sticky when wet and hard when dry. Tillage, therefore, must be done at the proper moisture content. Because the hazard of further erosion is severe, careful management is required.

Small grains, grasses, and legumes are the main crops grown on these soils. Corn is grown in a few places, however. The soils also are suitable for use as permanent pasture, as woodland, and as wildlife areas.

Capability unit IVe-9

Boyer loamy sand, 6 to 20 percent slopes, eroded, is the only soil in this unit. It is underlain by sand and is droughty. Permeability is moderate, and available moisture capacity is medium. The soil dries rapidly and is highly susceptible to soil blowing and to water erosion if left unprotected.

This soil is better suited to permanent pasture or to use as woodland and wildlife areas than to cultivated crops. Most areas are cultivated, however, and are used for the crops commonly grown. Moisture generally is lacking, and growth of crops is poor. Pine trees have been planted on some areas that once were cultivated.

Crops on these soils respond well to irrigation. Planting shelterbelts and contour stripcropping are ways of controlling erosion and of protecting cultivated areas from warm, drying winds in summer.

Capability unit IVw-5

Granby loamy sand, loamy substratum, is the only soil in this unit. It is a nearly level, poorly drained soil that is underlain by loose sand. Runoff is very slow, and the soil is subject to flooding and ponding in spring and after a heavy rain. The water table is at or near the surface for most of the year, and internal drainage is very slow. Fertility and available moisture capacity are low. The hazard of soil blowing is serious if this soil is drained and cultivated.

Most areas of this soil are idle. Row crops can be grown, however, if drainage is provided and the soil is protected from the wind. Undrained areas are better suited to permanent pasture, trees, or wildlife habitat than to other uses.

Shallow field ditches can be used to remove excess surface water. Deep ditches are needed to remove water from the root zone, but they are difficult to maintain in this loose, sandy soil. Tile drains are costly and also are difficult to maintain. If deep ditches are used, the level of water must be controlled because this soil becomes droughtly when drained. Soil blowing can be controlled by using wind stripcropping, planting shelterbelts, and growing cover crops. Plowing under all crop residues is a way to help maintain the content of organic matter.

Capability unit IVw-7

Moderately deep, nearly level, very poorly drained soils of the Adrian and Rollin series are in this unit. These soils consist of mucky peat underlain by sand and gravel or by marl. The water table is high for most of the year, and available moisture capacity is medium to high. Internal drainage is very slow. As a result, water is likely to stand in ponds in spring and after a heavy rain. Fertility is low. Subsidence and soil blowing are serious hazards in areas that are drained and cultivated.

Most areas of these soils are undrained and are in wetland woods or have sparse stands of native plants on them. Tamarack, low shrubs, sedges, and cattails are the main kinds of plants. A few areas, however, are in permanent pasture. A few other areas are drained and are used for the crops commonly grown in the county. Row crops can be grown continuously if the soils are drained and if fertility is kept high.

Open ditches generally can be used to provide drainage, but in a few places tile drains can be used. Installing a system that controls or raises the water table helps to reduce subsidence. This practice also helps to maintain an adequate supply of moisture in the root zone during dry periods.

Capability unit IVs-3

Boyer loamy sand, 1 to 6 percent slopes, eroded, is the only soil in this unit. It is underlain by sand and is droughty. Permeability is moderate, and available moisture capacity is medium. Fertility is low. In all areas soil blowing is a serious hazard, and in gently sloping areas water erosion is a slight hazard. Unless the soil has been limed, reaction commonly is acid.

This soil is easy to till, and most areas are cultivated. Crops often are damaged however because of lack of moisture in summer. This soil also is suitable for trees and for other less intensive uses.

Crops on this soil respond well to irrigation, especially when rainfall is low or is poorly distributed. Row crops can be grown continuously in nearly level areas if the soil is irrigated and protected from the wind and if management otherwise is good. Planting shelterbelts and contour stripcropping are ways of controlling erosion and of protecting cultivated areas from warm, drying winds in summer.

Capability unit Vw-14

This unit consists only of Wet alluvial land, which is made up of shallow to deep, poorly drained, loamy material on flood plains along streams. Wet alluvial land has a high water table most of the time and is subject to frequent flooding in spring and after a heavy rain. Internal drainage is very slow. Generally fertility is moderate and available moisture capacity is high, but they are variable. In some areas stones are on the surface and bedrock is near the surface.

Wet alluvial land is not suited to row crops. The areas are used mainly for pasture, woodland, or wildlife habitat, to which they are well suited. Drainage generally is not feasible.

Capability unit VIe-1

This unit consists only of Hochheim-Sisson-Casco complex, 20 to 35 percent slopes. These soils are deep and are loamy. They are moderately permeable and have medium to high available moisture capacity. Runoff is rapid to very rapid, and the hazard of further erosion is severe.

Most areas of this complex are in pasture or hay, but a few areas are in trees. The soils are better suited to pasture or trees than to other uses, but hay crops can be grown on the less steep areas. The steep areas are suitable for use as woodland, wildlife, or recreation areas.

All areas of this complex are too steep and too erodible for row crops. If the less steep areas are used for forage, practices are needed that maintain fertility and the content of organic matter. Such practices also improve structure and tilth of the surface layer and movement of water into the soils, and especially in the severely eroded areas. Renovation can be done no more often than every 5 years, and preferably on the contour. Wooded areas should be kept in trees, and open areas ought to be planted to trees.

Capability unit VIe-4

Sloping to moderately steep, somewhat droughty, loamy soils of the Casco, Ritchey, and Rodman series are in this unit. These soils are eroded. The Casco and Rodman soils are underlain by sand and gravel. The Ritchey soils, however, are underlain by dolomitic limestone bedrock, which limits the root depth of plants. All of these soils are more droughty than less steep soils because runoff is more rapid and less water enters the soils. Water erosion is a severe hazard, and gullies are likely to form if the areas are not protected.

Most areas of these soils are in pasture or are wooded. A few of the less steep areas are cultivated. Wooded areas should be kept in trees, and open areas ought to be planted to trees.

All areas that have slopes of more than 12 percent should be kept in meadow or pasture or should be left in trees or used as wildlife habitat. Keeping a protective cover of plants on the areas helps to keep gullies from forming. Once gullies have formed in these soils, they quickly become bigger and are hard to control. Some areas of the Ritchey soil are not suitable for cultivation, because bedrock crops out on the surface.

Capability unit VIe-6

In this unit are moderately steep to steep soils of the Kewaunee and Ozaukee series. These soils have a surface layer of silty clay, silt loam, or clay loam. Some of the soils are severely eroded.

The soils in this unit have high available moisture capacity. Permeability is moderately slow to slow. As a result, runoff is very rapid during periods of heavy rain. The hazard of water erosion is very severe. In severely eroded areas, the soils are in poor tilth and are difficult to till.

The moderately steep areas of these soils are cultivated and are cropped occasionally. Steeper areas are used as permanent pasture or woodland. A cover of pasture plants, trees, or other permanent vegetation should be kept on all areas. The areas also are suitable for wildlife habitat.

Where slopes are less than 20 percent, the areas can be renovated about once in 5 years and used for forage. Areas that have slopes of more than 20 percent can be used as permanent pasture, but such areas are better suited to use as woodland. Wooded areas should be kept in trees, and open areas ought to be planted to trees.

Capability unit VIIe-4

This unit consists only of Casco-Rodman complex, 20 to 35 percent slopes, eroded. These soils are loamy and are somewhat droughty. They are underlain by sand and gravel. The hazard of further water erosion is very severe, and some areas are cut by gullies. Internal drainage is rapid. Fertility is low. Maintaining fertility and the content of organic matter is difficult.

The soils in this unit are better suited to use as woodland or as wildlife habitat than to other uses.

Capability unit VIIIw-15

This unit consists only of Marsh, which is made up of very poorly drained organic soils intermixed with mineral material of various kinds. The areas are flooded most of the time and are suitable only for wildlife habitat.

Marsh generally is not suited to any kind of drainage system. Level ditching or diking can be used, however, to improve the habitat for wildlife.

Capability unit VIIIs-10

This unit consists of areas that have been cut and filled, of lake bluffs that are rough and broken, and of areas that are sandy and gravelly or that consist of infertile beach sand.

In the cut areas the original soil has been removed and raw soil material is exposed. The filled areas consist of variable mineral soil material. The bluffs in the rough broken areas are very steep. Water runs off these bluffs very rapidly, and the hazard of water erosion is very severe. Seepage and slipping are major problems in controlling erosion on the bluffs. Some of the beach areas are constantly washed and rewashed by waves, and others are dry and droughty and are subject to blowing.

The beach areas and the bluffs are along Lake Michigan. Consequently, they are used mainly for recreation. Little vegetation grows on the beaches. About half of the lake bluffs have a cover of some kind of vegetation, mainly brush, that is suitable for wildlife habitat. The cut and filled areas are in and near communities.

All vegetation on the beaches and bluffs should be maintained and encouraged to grow. Planting low growing, spreading, dense plants, such as emerald crown vetch, helps to stabilize raw, eroded areas. Diversion terraces can be used to carry excess runoff away from the bluffs. The cut and filled areas are readily accessible to transportation and for use as building sites.

Predicted Yields

In table 2 are predicted average acre yields for the principal crops grown in Ozaukee County. These yields are based on interviews with farmers, on results obtained by the agricultural experiment station on experimental test plots, and on observations made by soil surveyors and other agricultural workers who are familiar with

TABLE 2.—*Predicted average acre yields of principal crops under two levels of management* [1]

[Miscellaneous land types and complexes that have slopes of more than 20 percent are not listed in this table. Dashes indicate the soil is not suitable for the crop or that the crop ordinarily is not grown]

Soil	Corn		Silage corn		Oats		Alfalfa hay	
	Average	High	Average	High	Average	High	Average	High
	Bu.	Bu.	Tons	Tons	Bu.	Bu.	Tons	Tons
Adrian mucky peat	-------	100	-------	16	-------	-------	-------	-------
Alluvial land	65	100	10	16	50	70	2.0	4.0
Ashkum silt loam	65	105	11	16	50	70	-------	4.0
Aztalan loam, 1 to 3 percent slopes	60	105	10	16	55	65	2.5	4.5
Boyer loamy sand, 1 to 6 percent slopes, eroded	45	60	7	11	40	55	1.5	2.5
Boyer loamy sand, 6 to 20 percent slopes, eroded	35	50	6	9	35	45	1.25	2.0
Boyer sandy loam, 0 to 3 percent slopes	50	70	9	12	45	60	1.75	2.5
Boyer sandy loam, loamy substratum, 1 to 6 percent slopes	50	70	9	12	45	60	1.75	2.5
Brookston silt loam, 0 to 3 percent slopes	65	105	11	16	50	70	-------	4.0
Casco loam, 2 to 6 percent slopes, eroded	45	70	7	12	40	60	1.75	2.5
Casco loam, 6 to 12 percent slopes, eroded	40	65	6	12	40	55	1.5	2.0
Casco sandy loam, 1 to 6 percent slopes, eroded	40	65	6	12	40	55	1.5	2.5
Casco sandy loam, 6 to 12 percent slopes, eroded	35	60	6	11	35	50	1.5	2.0
Casco-Rodman complex, 12 to 20 percent slopes, eroded	-------	-------	-------	-------	-------	-------	1.5	2.0
Colwood silt loam	60	100	10	16	50	65	-------	4.0
Darroch fine sandy loam, neutral variant, 0 to 3 percent slopes	60	95	10	15	50	70	2.5	4.0

See footnote at end of table.

TABLE 2.—*Predicted average acre yields of principal crops under two levels of management* [1]—Continued

Soil	Corn		Silage corn		Oats		Alfalfa hay	
	Average	High	Average	High	Average	High	Average	High
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Tons*	*Tons*
Darroch silt loam, neutral variant, 0 to 3 percent slopes	65	100	11	16	55	75	2.5	4.0
Dresden silt loam, 1 to 3 percent slopes	60	95	10	15	55	70	2.5	3.5
Fabius loam, 1 to 3 percent slopes	50	75	8	13	50	65	2.5	3.5
Fox loam, 0 to 2 percent slopes	60	95	10	15	50	65	2.5	3.0
Fox loam, 2 to 6 percent slopes	60	95	10	15	50	65	2.5	3.0
Fox sandy loam, 1 to 6 percent slopes	55	80	9	14	45	60	2.0	3.0
Granby loamy sand, loamy substratum	40	55	6	10	45	55	---	3.0
Hebron loam, 1 to 6 percent slopes	65	100	11	16	60	75	3.0	4.5
Hochheim loam, 0 to 2 percent slopes	65	105	11	16	55	70	3.0	4.5
Hochheim loam, 2 to 6 percent slopes, eroded	65	105	11	16	55	70	3.0	4.5
Hochheim loam, 6 to 12 percent slopes, eroded	60	100	10	16	50	65	2.5	4.0
Hochheim loam, 12 to 20 percent slopes, eroded	55	90	9	15	45	60	2.5	3.5
Hochheim-Sisson-Casco complex, 0 to 2 percent slopes	65	105	11	16	55	70	3.0	4.5
Hochheim-Sisson-Casco complex, 2 to 6 percent slopes, eroded	55	80	9	14	45	60	2.0	3.0
Hochheim-Sisson-Casco complex, 6 to 12 percent slopes, eroded	50	85	9	14	45	65	2.5	4.0
Hochheim-Sisson-Casco complex, 12 to 20 percent slopes, eroded	45	75	8	14	40	60	2.0	3.0
Houghton mucky peat	---	110	---	16	---	---	---	---
Keowns silt loam	55	80	9	14	40	55	---	3.5
Kewaunee silt loam, 0 to 2 percent slopes	60	100	10	16	55	85	2.5	4.0
Kewaunee silt loam, 2 to 6 percent slopes	60	100	10	16	55	85	2.5	4.0
Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	50	90	8	15	45	70	2.5	4.0
Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	50	90	8	15	45	75	2.0	3.5
Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	50	90	8	15	40	65	2.0	3.0
Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	---	---	---	---	---	---	2.0	2.5
Knowles silt loam, 0 to 2 percent slopes	60	90	10	15	55	75	2.5	4.0
Knowles silt loam, 2 to 6 percent slopes, eroded	60	90	10	15	55	75	2.5	4.0
Knowles silt loam, mottled subsoil variant, 0 to 2 percent slopes	65	95	11	15	60	80	2.5	4.0
Lorenzo loam, 1 to 3 percent slopes	45	70	7	12	45	60	1.75	2.5
Manawa silt loam, 1 to 3 percent slopes	60	100	10	16	50	75	2.5	4.0
Martinton silt loam, 1 to 3 percent slopes	70	105	12	16	55	70	3.0	4.0
Matherton loam, 0 to 2 percent slopes	65	100	11	16	50	70	2.5	4.0
Matherton silt loam, 1 to 3 percent slopes	65	100	11	16	50	70	2.5	4.0
Mequon silt loam, 1 to 3 percent slopes	65	105	11	16	50	70	2.5	4.0
Muskego muck	---	105	---	16	---	---	---	4.0
Mussey loam	50	80	8	14	45	65	---	3.5
Navan silt loam	65	105	11	16	50	70	---	4.0
Nenno silt loam, 1 to 3 percent slopes	70	105	12	16	55	70	2.5	4.0
Ogden mucky peat	---	105	---	16	---	---	---	---
Ozaukee silt loam, 0 to 2 percent slopes	65	105	11	16	55	75	2.5	4.0
Ozaukee silt loam, 2 to 6 percent slopes	65	105	11	16	55	75	2.5	4.0
Ozaukee silt loam, 2 to 6 percent slopes, eroded	60	100	10	16	50	70	2.5	4.0
Ozaukee silt loam, 6 to 12 percent slopes, eroded	55	95	8	15	45	65	2.0	3.5
Ozaukee silt loam, 12 to 20 percent slopes, eroded	45	90	7	15	40	60	2.0	3.0
Ozaukee silt loam, 20 to 30 percent slopes	---	---	---	---	---	---	2.0	2.5
Ozaukee clay loam, 6 to 12 percent slopes, severely eroded	50	85	8	14	40	60	2.5	4.0
Ozaukee clay loam, 12 to 20 percent slopes, severely eroded	---	---	---	---	---	---	2.0	2.5
Palms mucky peat	---	105	---	16	---	---	---	---
Pella silt loam	65	105	11	16	50	70	---	4.0
Poygan silty clay loam	65	105	11	16	50	70	---	4.0
Radford silt loam, 0 to 3 percent slopes	70	105	12	16	60	75	3.0	4.0
Ritchey silt loam, 0 to 6 percent slopes	40	55	6	10	45	60	1.75	2.5
Ritchey silt loam, 6 to 20 percent slopes, eroded	---	---	---	---	---	---	1.5	2.0
Rollin mucky peat	---	105	---	16	---	---	---	---
Saylesville silt loam, 0 to 2 percent slopes	65	100	11	16	55	70	3.0	4.5
Saylesville silt loam, 2 to 6 percent slopes, eroded	65	100	11	16	55	70	3.0	4.5
Sebewa silt loam	65	105	11	16	50	70	---	4.0
Sisson fine sandy loam, 1 to 6 percent slopes, eroded	60	90	10	15	50	70	2.5	4.0
Theresa silt loam, 2 to 6 percent slopes	65	105	11	16	55	70	3.0	4.5
Wasepi sandy loam, 1 to 3 percent slopes	55	75	9	13	40	55	2.5	3.5
Yahara very fine sandy loam, 1 to 3 percent slopes	55	90	10	15	50	70	2.5	4.0
Zurich silt loam, 0 to 2 percent slopes	65	95	11	15	55	75	3.0	4.5
Zurich silt loam, 2 to 6 percent slopes, eroded	65	95	11	15	55	75	3.0	4.5

[1] Average yields are predictions of yields under management used by most farmers in the county; high yields can be expected under management suggested in this survey. Under average management wet soils are assumed to have minimum drainage required for cultivating. Under high management wet soils have excellent artificial drainage and are protected from overflow.

the soils and crops of the county. Miscellaneous land types and soil complexes that have slopes of more than 20 percent are not listed in the table, because they are not suitable for the crops grown.

The yields given in table 2 are for two levels of management. The columns marked "Average" give yields to be expected under the kind of management most farmers were practicing at the time the soil survey was made. The columns marked "High" give yields to be expected under the kind of management used by some farmers in the county.

For corn grown under average management, about 12,000 plants of hybrid corn per acre are grown. Barnyard manure and commercial fertilizer are applied as a starter. For seedings of oats or alfalfa-bromegrass, little or no fertilizer is applied. No special practices are used in preparing the seedbed or in cultivating. Hay is cut twice each year, and the field is grazed in fall.

The management used to obtain the yields in the columns marked "High" is better than that used to obtain average yields. For corn, it includes (1) adding large amounts of manure and returning all crop residues to the soil; (2) applying commercial fertilizer according to the needs of the crop to be grown; (3) adding lime in the amounts indicated by the results of soil tests; (4) growing about 18,000 plants per acre on the best soils and fewer plants on the more droughty soils; and (5) using a suitable conservation cropping system and seeding, spraying, and cultivating at the right time.

For oats, management needed for obtaining the yields in the columns marked "High" consists of planting good seed of a variety suited to the soil and of applying commercial fertilizer according to the results of soil tests. For alfalfa, especially alfalfa grown in long rotations, it includes (1) adding lime according to the needs indicated by the results of soil tests, (2) planting varieties that are suited to the soil and that are resistant to wilt and to winterkill, (3) cutting at the right time so that two and sometimes three crops can be harvested during an average growing season, (4) allowing little or no grazing in fall, and (5) topdressing each fall with manure or a commercial fertilizer, such as 0–10–30 or 0–10–30 with boron. If the fertilizer is applied according to the results of soil tests and supplementary management practices suggested in the subsection "Basic Practices of Management" are used, high yields can be expected.

Estimates of yields are not given in table 2 for pasture, because most pasture in the county is on cropland that is pastured for 1 year or more of the crop rotation. General management practices for pasture are discussed in the subsection "Basic Practices of Management." Expected yields of pasture generally are expressed in animal-unit-days. By animal-unit-days is meant the number of days during a normal growing season that 1 acre will provide grazing for an animal unit (one cow, horse, or steer; five hogs; or seven sheep) without injury to the sod. Rotation pasture in the county produces about 50 cow-acre-days of pasture per ton of alfalfa hay expected. If the alfalfa is chopped when green and fed to the cattle away from the field, as much as 100 cow-acre-days of pasture per ton of alfalfa hay can be expected.

The figures in table 2 can be used to check on the adequacy of the present system of management. If the average yields an operator has obtained during the past 5 or 10 years are less than those given in table 2, the management practices and cropping systems used on this specific soil should be compared with the suggestions given in the description of the capability unit to which the soil belongs. By applying the practices suggested, yields can be increased.

Even higher yields than those shown in table 2 are possible. Large amounts of fertilizer would be required, however, and careful management would be needed. The county agent or personnel of the agricultural experiment station can be consulted about testing the soils and about the kinds and amounts of seeding mixtures to use and the kinds and amounts of fertilizer and lime to apply.

Woodland [3]

Before settlement, Ozaukee County was almost entirely covered by trees. Most of these have been removed, and today only about 10 percent of the county is wooded. The woodland is in two main areas—the uplands and the wetlands.

Wetland woods make up the largest acreage in trees, and the Cedarburg Bog is the largest single wooded area. The soils in the bog, and in many other lowland woods, are predominantly organic. Some areas, however are on Brookston, Mussey, Poygan, Sebewa, and other mineral soils. All of the soils in wetland woods have a high water table and are somewhat poorly drained to poorly drained. They have not been drained for use as cropland, because outlets are not available or because the cost of clearing and of draining the areas is greater than the value of the land for crops.

The predominant trees in wetland woods are cedar, elm, ash, and soft maple. Tamarack, white birch, and yellow birch are marketed for posts from some of the farms, but the other trees have little economic value. Many of the trees in wetland woods are mature.

Because of a fluctuating and almost permanent high water table, the roots of trees in wetland woods are very shallow. In areas where the trees are exposed to wind, many trees are blown down. Therefore, when thinning or harvesting is done, care must be taken to keep from exposing the trees to wind.

Many of the soils in the wetland woods are in class IIw and class IIIw. If land values increase, these soils may be drained. If drained, these soils would support intensive cropping.

Upland woods in the county consist mostly of soils in classes IV and VI. The areas generally are 3 to 10 acres in size. The soils have not been developed for crops or pasture, because they are too steep or the acreage is too small. Native trees in upland woods are such hardwoods as maple, ash, oak, basswood, hickory, elm, beech, and ironwood. Some Norway pine and white pine have been established by planting.

[3] By MYRON E. JOHANSEN, work unit conservationist, Soil Conservation Service.

The upland woodlots have more value for recreation or esthetic use, or for future sites for residences, than they have for timber. Many of the wooded areas surround cropland, and they could be improved as wildlife areas by planting shrubs along their borders. The plantings also reduce the drying effects of wind on the woodlots and loss of leaf mulch by blowing.

Woodlots in the uplands can be improved by protecting them from grazing and fire and by selective cutting. Reseeding of native trees generally is by natural regeneration, rather than by planting. Pine must be planted. Norway pine is susceptible to damage by the pine-shoot moth if it is planted near Lake Michigan and should be planted only in the western part of the county.

Use of the Soils for Wildlife

The soils of Ozaukee County produce vegetation that provides suitable habitat for many kinds of wildlife. Desirable kinds of game in the county are Hungarian partridge, ring-necked pheasant, waterfowl, cottontail rabbit, squirrel, and deer. In addition many kinds of nongame birds depend upon farmland for food, water, and shelter.

Wildlife resources in the county are important chiefly for the recreational opportunities they provide for hunting and fishing and for those who like to watch and photograph wildlife. Many species of wildlife, however, are also beneficial in control of undesirable rodents, insects, and weeds. Wildlife can be encouraged to live in a particular area if suitable practices are used in managing the soils, plants, and water. The benefits that result also help to protect the soil and conserve wildlife.

The kind of habitat needed varies with the particular kind of wildlife. Some species prefer to live in woodland; others prefer open farmland. Fish, ducks, and some other kinds of wildlife like a watery habitat. The kinds of habitat preferred by the principal species of wildlife in Ozaukee County are discussed in the paragraphs that follow.

Game birds, such as the pheasant, quail, and partridge, thrive in the uplands in the eastern and southwestern parts of the county. They like to range over the fields of grain and hay that include small, idle, grassy areas and waterholes. Suitable soils are the gently sloping Casco, Hochheim, Kewaunee, Ozaukee, and Sisson. Game birds prefer to feed in areas that are close to cover, such as stripcropped fields and shrubby hedgerows. Planting odd-shaped areas and steep areas to permanent grasses and legumes, or to evergreen trees, is a way of providing additional food and cover.

Cottontail rabbit and gray squirrel prefer brushy areas that are interspersed with grass. These animals like to feed in open areas of cropland from time to time. They can be encouraged to stay in an area by planting brush along the edges of small wooded areas near cropland. The brush helps to shelter the animals from predators. Bluffs along the lake, and adjacent gullies of Rough broken land, can be improved for wildlife by protecting and maintaining the present cover. Areas lacking a good cover of vegetation can be improved through selective planting and other good management.

Fox squirrel, raccoon, and deer are numerous along the major rivers and streams in areas of nearly level Casco and Fabius soils. They find shelter and food in the woodland and like to feed in nearby fields of corn and small grain. Fencing cattle out of woodland and selective cutting help to preserve hollow trees for den sites. These practices also help to provide openings for shrubby growth that protects the animals from predators. The more hilly Casco soils in kettle moraines in northwestern Fredonia Township, marked by wet potholes and wooded hills, also make good deer country. Deer can be encouraged here by managing the areas as woodland and providing protection from fire.

Muskrats, ducks, and other waterfowl are most numerous in Cedarburg and Saukville Townships. Here they find excellent food and cover in the marshes and on wet organic soils, such as the Adrian and Houghton. Muskrats like to build their homes in areas where the water is shallow and the cover of plants is dense. Ducks and other waterfowl prefer the many potholes, lakes, and creeks in the area. The habitat can be preserved by protecting these wet areas from drainage and from burning and filling. Additional food can be provided by introducing aquatic plants, and nesting sites can be preserved by maintaining grass borders around the wet areas.

The farm ponds developed by landowners throughout the county are good resting and feeding areas for wild ducks. They also are stocked with various kinds of fish. Plantings of shrubs and vines near the ponds provide shelter for many other kinds of wildlife. Shrubs and trees for this purpose can be obtained in many areas from local 4–H Clubs or from local government agencies.

Engineering Uses of the Soils

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, and pipelines, the foundations of buildings, facilities for storing water, structures for controlling erosion, drainage systems, and systems for disposing of sewage. The properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Also important are depth to water table, flooding hazard, depth to bedrock or to sand and gravel, and relief. Such information is made available in this section. Engineers can use it to—

1. Make soil and land use studies that will aid in selecting and developing sites for industries, businesses, residences, and recreational areas.
2. Assist in planning and designing erosion and flood control structures, drainage improvements, farm ponds, irrigation systems, diversion terraces, and other structures for conservation of soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning more detailed surveys for the selected locations.
4. Locate probable sources of sand, gravel, and other materials suitable for construction needs.

5. Correlate performance of engineering structures with mapping units to develop information for overall planning that will be useful in designing and maintaining certain engineering practices and structures.
6. Determine the suitability of soil types for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

It should be emphasized that the interpretations made in this soil survey may not eliminate the need for sampling and testing needed at a site chosen for a specific engineering work that involves heavy loads or at a site where excavations are to be deeper than the depths of layers here reported. Also, engineers should not apply specific values to the estimates for bearing capacity given in this survey. Nevertheless, by using this survey, an engineer can select and concentrate on those soil units most important for his proposed kind of construction, and in this manner, reduce the number of samples taken for laboratory testing and complete an adequate soil investigation at minimum cost.

The soil mapping units shown on the maps in this survey may include small areas of a different soil material. These included soils may be as much as 2 acres in size. They are too small to be mapped separately and generally are not significant to the agriculture in the area but may be important in engineering planning.

Information of value in planning engineering work is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation, Morphology, and Classification of Soils."

TABLE 3.—*Engineering test data for*

[Tests performed by the State Highway Commission of Wisconsin in cooperation with the U.S. Department of Commerce, Bureau of Public formation was not available

Soil name and location	Parent material	Depth	Moisture density	
			Maximum dry density	Optimum moisture
		Inches	*Lb. per cu. ft.*	*Pct.*
Colwood silt loam: NW¼NE¼ sec. 21, T. 10 N., R. 21 E	Stratified silt and fine sand.	11–20	110	16
		27–48	115	15
Hochheim loam: NW¼SE¼ sec. 15, T. 10 N., R. 21 E	Thin layer of silty material over loamy till.	12–19	109	17
		21–48	131	9
Kewaunee silt loam: NE¼NE¼ sec. 24, T. 11 N., R. 21 E	Silty material over silty clay to silty clay loam.	7–20	----	----
		23–42	----	----
Ozaukee silt loam: SW¼SE¼ sec. 21, T. 9 N., R. 21 E	Thin layer of silty material over clay loam to silty clay loam till.	7–12	99	22
		19–42	120	14
Pella silt loam: SW¼SW¼ sec. 31, T. 10 N., R. 21 E	Silty material over silt, clay, and fine sand.	12–23	108	16
		26–48	111	16
Poygan silty clay loam: NE¼NW¼ sec. 30, T. 11 N., R. 22 E	Silty material over silty clay loam to clay.	20–32	----	----
		35–48	----	----
Saylesville silt loam: SE¼SE¼ sec. 7, T. 12 N., R. 21 E	Stratified silt and clay.	9–17	98	23
		21–48	111	18
Zurich silt loam: NW¼NW¼ sec. 32, T. 10 N., R. 21 E	Stratified silt and fine sand.	14–21	103	20
		23–48	125	12

[1] According to AASHO Designation: T 88–57 (*1*). Results by this procedure frequently differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2

Some of the terms used by the scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, and sand—may have a special meaning in soil science. These and other special terms used in the soil survey are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 3, 4, 5, and 6.

Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture classify soils according to texture. In some ways this system of naming textural classes is comparable to the systems most commonly used by engineers for classifying soils; that is, the system of the American Association of State Highway Officials (AASHO) and the Unified system.

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1 (gravelly soils having high bearing capacity, the best soils for subgrade) to A–7 (clayey soils have low strength when wet, the poorest soils for subgrade). Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best materials to 20 for the poorest. The group index number is shown in parentheses after the soil group symbol in table 3.

Some engineers prefer to use the United Soil Classification System (*8*). In this system soil materials are identified as coarse grained, 8 classes; fine grained, 6 classes; and highly organic. The last column of table 3 gives the classification of the tested soils according to the Unified system.

representative soils, Ozaukee County, Wis.

Roads, in accordance with standard procedures of the American Association of State Highway Officials (AASHO). Dashes indicate in- or does not apply]

Mechanical analysis [1]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve [2]—				Percentage smaller than [2]—						AASHO [3]	Unified [4]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
---	---	100	89	85	65	34	27	36	17	A–6(11)	CL.
---	---	---	97	92	53	21	14	20	2	A–4(8)	ML.
100	97	90	64	61	50	35	29	42	21	A–7–6(10)	CL.
86	80	70	41	37	25	13	9	19	4	A–4(1)	SM.
---	100	98	87	85	75	57	48	52	30	A–7–6(18)	CH.
97	95	92	81	79	67	48	36	38	20	A–6(12)	CL.
---	100	98	87	85	76	55	45	54	30	A–7–6(18)	CH.
95	93	90	81	79	63	39	26	31	14	A–6(10)	CL.
---	---	100	99	97	82	50	36	40	21	A–6(12)	CL.
---	---	100	97	95	80	48	33	34	16	A–6(10)	CL.
---	100	98	82	79	70	53	43	41	24	A–7–6(14)	CL.
---	100	96	84	80	69	45	34	29	15	A–6(10)	CL.
---	100	99	97	97	96	76	62	57	32	A–7–6(19)	CH.
---	---	100	99	99	98	73	52	39	21	A–6(12)	CL.
---	100	99	76	73	61	43	36	46	26	A–7–6(16)	CL.
---	100	99	70	53	32	18	12	19	3	A–4(7)	ML.

millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

[2] Based on total material. Laboratory test data corrected for amount discarded in field sampling.

[3] Based on AASHO Designation: M 145–49 (*1*).

[4] Based on the Unified Soil Classification System (*8*).

TABLE 4.—*Estimated engineering*

[Absence of information in a column indicates information is not

Soil series and map symbols	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Inches			
Adrian (Ak).	0–32	Mucky peat	Pt	----------
	32–60	Sand	SM–SP	A–3
Ashkum (As).	0–7	Silt loam	ML	A–4
	7–10	Silty clay loam	CH	A–7
	10–21	Silty clay loam to silty clay	CH	A–7
	21–60	Silty clay loam	CH	A–7
Aztalan (AzA).	0–9	Loam	ML	A–4
	9–20	Sandy clay loam	CL	A–6
	20–60	Silty clay loam	CH	A–6
Boyer:				
(BnA, BmB2, BmD2).	0–16	Sandy loam	SM	A–2
	16–32	Sandy clay loam	SC	A–6
	32–60	Sand	SP–SM	A–3
(BoB).	0–16	Sandy loam	SM	A–2
	16–32	Sandy clay loam	SC	A–6
	32–46	Sand	SP–SM	A–3
	46–60	Silty clay loam	CL	A–6
Brookston (BsA).	0–11	Silt loam	ML	A–4
	11–22	Heavy loam	CL	A–6
	22–60	Loam	ML	A–4
Casco (CeB2, CeC2, CcB2, CcC2, CrD2, CrE2). (For properties of Rodman soil in mapping units CrD2 and CrE2, refer to Rodman series in this table.)	0–7	Loam	ML	A–4
	7–18	Clay loam	CL	A–6
	18–60	Sand and gravel	GP–GM	A–1
Colwood (Cw).	0–9	Silt loam	ML	A–4
	9–27	Silty clay loam	CL	A–6
	27–60	Silt and very fine sand	ML	A–4
Darroch, neutral variant (DcA, DaA).	0–10	Silt loam	ML	A–4
	10–25	Clay loam	CL	A–6
	25–60	Silt and fine sand	ML	A–4
Dresden (DsA).	0–13	Silt loam	ML	A–4
	13–28	Clay loam	CL	A–6
	28–60	Sand and gravel	GP–GM	A–1
Fabius (FaA).	0–10	Loam	ML	A–4
	10–19	Clay loam	CL	A–6
	19–60	Sand and gravel	GP–GM	A–1
Fox (FoA, FoB, FmB).	0–14	Loam	ML	A–4
	14–36	Clay loam	CL	A–6
	36–60	Sand and gravel	GP–GM	A–1
Granby (Ge).	0–7	Loamy sand	SM	A–2
	7–60	Sand	SP	A–3
Hebron (HeB).	0–14	Loam	ML	A–4
	14–21	Sandy clay loam	CL	A–6
	21–60	Silty clay loam	CL	A–6
Hochheim (HmA, HmB2, HmC2, HmD2, HsA, HsB2, HsC2, HsD2, HsE2). (For properties of Sisson soil and of Casco soil in mapping units HsA through HsE2, refer to Sisson and Casco series, respectively, in this table.)	0–12	Loam	ML	A–4
	12–19	Clay loam	CL	A–7–6
	19–60	Loam	ML	A–4
Houghton (Hu).	0–60	Mucky peat	Pt	----------

See footnotes at end of table.

properties of the soils

available or does not apply; >=more than, and <=less than]

Percentage passing sieve [1]— No. 4 (4.7 mm.)	Percentage passing sieve [1]— No. 10 (2.0 mm.)	Percentage passing sieve [1]— No. 200 (0.07 mm.)	Permeability	Available water capacity [2]	Reaction	Shrink-swell potential
			Inches per hour	*Inches per inch of soil depth*	*pH value*	
-----	-----	-----	0.63–2.0	>0.20	6.1–7.8	
100	100	5	6.3–20.0	.04	7.4–8.4	Very low.
100	100	90	0.63–2.0	.20	7.4–7.8	Low.
100	95	90	0.2–0.63	.20	7.4–7.8	High.
95	90	90	0.2–0.63	.20	7.9–8.4	High.
100	95	90	0.2–0.63	.20	7.9–8.4	High.
100	95	55	0.63–2.0	.16	6.6–7.8	Low.
100	85	55	0.63–2.0	.14	6.6–7.8	Moderate.
100	95	95	0.06–0.63	.18	7.9–8.4	High.
100	85	30	2.0–6.3	.09	6.1–7.8	Low.
95	90	35	0.63–2.0	.14	6.1–7.8	Low.
95	90	5	>20.0	.04	7.9–8.4	Very low.
100	85	30	2.0–6.3	.09	6.1–7.8	Low.
95	90	35	0.63–2.0	.14	6.1–7.8	Low.
95	90	5	>20.0	.04	7.9–8.4	Very low.
100	100	90	0.2–0.63	.20	7.9–8.4	Moderate.
100	100	95	0.63–2.0	.22	7.4–7.8	Low.
100	100	75	0.63–2.0	.18	7.4–8.4	Moderate.
100	75	55	0.63–2.0	.10	7.9–8.4	Low.
95	85	55	0.63–2.0	.16	7.4–7.8	Moderate.
95	85	70	0.63–2.0	.18	7.4–7.8	Moderate.
50	45	5	>20.0	.02	7.9–8.4	Very low.
100	100	80	0.63–2.0	.20	7.4–7.8	Low.
100	100	90	0.63–2.0	.20	7.4–7.8	Moderate.
100	100	95	0.63–2.0	.16	7.9–8.4	Low.
100	100	85	0.63–2.0	.18	6.6–7.8	Low.
100	100	75	0.63–2.0	.18	6.6–7.8	Moderate.
100	100	65	0.63–2.0	.16	7.9–8.4	Low.
100	90	60	0.63–2.0	.18	6.1–7.8	Low.
95	85	70	0.63–2.0	.18	6.1–7.8	Moderate.
50	45	5	>20.0	.02	7.9–8.4	Very low.
95	85	60	0.63–2.0	.16	7.4–7.8	Moderate.
95	85	40	0.63–2.0	.18	7.4–7.8	Moderate.
50	45	5	>20.0	.02	7.9–8.4	Very low.
100	90	60		.16	6.1–7.3	Moderate.
95	35	70	0.63–2.0	.18	6.1–7.3	Moderate.
50	45	5	>20.0	.02	7.9–8.4	Very low.
100	100	25	2.0–6.3	.08	6.6–7.8	Very low.
100	100	4	6.3–20.0	.04	7.9–8.4	Very low.
100	95	75	0.63–2.0	.18	6.6–7.8	Low.
100	85	55	0.63–2.0	.16	6.6–7.8	Moderate.
100	100	95	0.06–0.20	.18	7.9–8.4	Moderate.
95	95	55	0.63–2.0	.18	6–6–7.8	Low.
100	95	65	0.63–2.0	.18	6.6–7.8	Moderate.
90	80	55	0.63–2.0	.16	7.9–8.4	Low.
-----	-----	-----	0.63–2.0	>.20	6.1–7.8	

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification: Dominant USDA texture	Unified	AASHO
	Inches			
Keowns (Km).	0–7	Silt loam	ML	A–4
	7–14	Very fine sandy loam	SM	A–2
	14–60	Silt and very fine sand	ML	A–4
Kewaunee:				
(KnA, KnB).	0–7	Silt loam	ML	A–4
	7–20	Silty clay	CH	A–7–6
	20–60	Silty clay loam	CL	A–6
(KoB2, KoC2, KrC3, KrD3).[3]	0–7	Silty clay loam or silty clay	CL	A–7
	7–20	Silty clay	CH	A–7–6
	20–60	Clay loam	CL	A–7–6
Knowles (KwA, KwB2).	0–15	Silt loam	ML	A–4
	15–28	Silty clay loam	CL	A–6
	28–60	Dolomitic limestone bedrock		
Knowles, mottled subsoil variant (KyA).	0–12	Silt loam	ML	A–4
	12–24	Silty clay loam	CL	A–6
	24–60	Dolomitic limestone bedrock.		
Lorenzo (LyA).	0–10	Loam	ML	A–4
	10–16	Sandy clay loam	CL	A–6
	16–60	Sand and gravel	GP–GM	A–1
Manawa (MaA).	0–12	Silt loam	ML	A–4
	12–27	Silty clay loam	CH	A–7–6
	27–60	Silty clay loam	CL	A–6
Martinton (MgA).	0–8	Silt loam	ML	A–4
	8–24	Silty clay	CH	A–7–6
	24–60	Stratified silt and silty clay	CL	A–6
Matherton (MkA, MmA).	0–9	Silt loam	ML	A–4
	9–28	Sandy clay loam	CL	A–6
	28–60	Sand and gravel	GP–GM	A–1
Mequon (MtA)	0–11	Silt loam	ML	A–4
	11–30	Silty clay loam to silty clay	CH	A–7
	30–60	Silty clay loam	CL	A–6
Muskego (Mzg).	0–30	Muck and peat	Pt	----------
	30–60	Sedimentary peat	Pt	----------
Mussey (Mzk).	0–8	Loam	ML	A–4
	8–13	Clay loam	CL	A–6
	13–60	Sand and gravel	GP–GM	A–1
Navan (Na).	0–9	Silt loam	ML	A–4
	9–20	Heavy sandy loam	ML	A–4
	20–60	Silt and silty clay loam	CL	A–6
Nenno (NnA).	0–8	Silt loam	ML	A–4
	8–16	Silty clay loam	CL	A–6
	16–60	Loam	ML	A–4
Ogden (Od).	0–36	Mucky peat	Pt	----------
	36–50	Silty clay	CH	A–7
Ozaukee (OuA, OuB, OuB2, OuC2, OuD2, OuE, OzC3, OzD3).	0–7	Silt loam	ML	A–4
	7–19	Silty clay	CH	A–7–6
	19–42	Silty clay loam	CL	A–6
Palms (Pc).	0–32	Mucky peat	Pt	----------
	32–42	Loam	ML	A–6

See footnotes at end of table.

properties of the soils—Continued

Percentage passing sieve [1]—			Permeability	Available water capacity [2]	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.07 mm.)				
			Inches per hour	*Inches per inch of soil depth*	*pH value*	
100	100	70	0. 63–2. 0	0. 20	7. 4–8. 4	Low.
100	100	40	0. 63–2. 0	. 16	7. 9–8. 4	Low.
100	100	60	0. 63–2. 0	. 16	7. 9–8. 4	Low.
100	100	95	0. 63–2. 0	. 20	7. 4–7. 8	Low.
100	100	90	0. 2–0. 63	. 18	7. 4–7. 8	High.
95	95	85	0. 06–0. 20	. 18	7. 9–8. 4	Moderate.
100	100	95	0. 63–2. 0	. 20	7. 4–7. 8	Moderate.
100	100	90	0. 20–0. 63	. 18	7. 4–7. 8	High.
95	95	75	0. 06–0. 20	. 16	7. 9–8. 4	Moderate.
100	95	85	0. 63–2. 0	. 18	5. 6–7. 3	Low.
95	90	85	0. 63–2. 0	. 16	5. 6–7. 3	Moderate.
100	95	85	0. 63–2. 0	. 20	7. 4–8. 4	Low.
95	90	85	0. 63–2. 0	. 16	7. 4–8. 4	
95	85	60	0. 63–2. 0	. 16	6. 6–7. 8	Low.
95	85	70	0. 63–2. 0	. 18	6. 6–7. 8	Moderate.
50	45	5	>20. 0	. 02	7. 9–8. 4	Very low.
100	95	85	0. 63–2. 0	. 20	7. 4–7. 8	Low.
95	95	80	0. 20–0. 63	. 18	7. 4–7. 8	High.
85	85	85	0. 06–0. 20	. 18	7. 9–8. 4	Moderate.
100	100	95	0. 63–2. 0	. 22	6. 6–7. 8	Low.
100	100	95	0. 20–0. 63	. 18	6. 6–8. 4	High.
100	100	95	0. 06–0. 20	. 18	7. 9–8. 4	Moderate.
100	90	70	0. 63–2. 0	. 16	6. 6–7. 8	Low.
95	85	45	0. 63–2. 0	. 16	6. 6–7. 8	Moderate.
50	45	5	>20. 0	. 02	7. 9–8. 4	Very low.
100	100	85	0. 63–2. 0	. 20	7. 4–7. 8	Low.
100	100	100	0. 20–0. 63	. 18	7. 4–7. 8	High.
100	100	85	0. 20–0. 63	. 16	7. 9–8. 4	Moderate.
---	---	---	2. 0–6. 3	>. 20	6. 6–7. 3	
---	---	---	0. 63–2. 0	>. 20	6. 6–7. 3	
95	85	60	0. 63–2. 0	. 16	7. 4–7. 8	Low.
95	85	60	0. 63–2. 0	. 18	7. 4–7. 8	Moderate.
50	45	5	>20. 0	. 02	7. 9–8. 4	Very low.
100	95	50	0. 63–2. 0	. 20	7. 4–7. 8	Low.
100	100	60	0. 63–2. 0	. 14	7. 4–8. 4	Moderate.
100	100	95	0. 06–0. 20	. 18	7. 9–8. 4	Moderate.
100	100	95	0. 63–2. 0	. 18	6. 6–7. 8	Low.
100	100	85	0. 20–0. 63	. 18	6. 6–7. 8	Moderate.
80	75	55	0. 63–2. 0	. 16	7. 9–8. 4	Low.
---	---	---	0. 63–2. 0	>. 20	6. 6–7. 8	
100	100	90	<0. 06	. 16	7. 9–8. 4	High.
100	100	85	0. 63–2. 0	. 20	6. 6–7. 3	Low.
100	100	90	2. 0–0. 63	. 18	6. 6–7. 8	High.
95	95	90	0. 20–0. 63	. 16	7. 9–8. 4	Moderate.
---	---	---	0. 63–2. 0	>. 20	6. 1–7. 8	
90	85	55	0. 63–2. 0	. 16	7. 9–8. 5	Moderate.

TABLE 4.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		Dominant USDA texture	Unified	AASHO
	Inches			
Pella (Ph).	0–8	Silt loam	ML	A–4
	8–26	Silty clay loam	CL	A–6
	26–48	Stratified silt and silty clay loam	CL	A–6
Poygan (Py).	0–20	Silty clay loam	CL	A–6
	20–32	Silty clay to clay	CL	A–7
	32–60	Silty clay loam	CL	A–6
Radford (RaA).	0–28	Silt loam	ML	A–4
	28–38	Silty clay loam	CL	A–6
	38–50	Sandy clay loam	CL	A–6
	50–60	Sand	SP–SM	A–3
Ritchey (RkB, RkD2).	0–9	Silt loam	ML	A–4
	9–17	Silty clay loam	CL	A–6
	17	Dolomitic limestone bedrock.		
Rodman. (Mapped only in complexes with Casco soils.)	0–13	Sandy loam	SM	A–2
	13–60	Stratified sand and gravel	GP–GM	A–1
Rollin (Rw).	0–28	Muck and peat	Pt	----------
	28–48	Marl	MH	A–7
Rough broken land (Ry).	(4)	Silty clay loam	CL	A–6
Saylesville (ShA, ShB2).	0–9	Silt loam	ML	A–4
	9–21	Clay	CH	A–7–6
	21–48	Stratified silt and silty clay	CL	A–6
Sebewa (Sm).	0–10	Silt loam	ML	A–4
	10–29	Silty clay loam	CL	A–6
	29–60	Sand and gravel	GP–GM	A–1
Sisson (SrB2).	0–16	Fine sandy loam	SM	A–4
	16–24	Clay loam	CL	A–7
	24–60	Silt and fine sand	ML	A–4
Theresa (ThB).	0–12	Silt loam	ML	A–4
	12–30	Clay loam	CL	A–6
	30–60	Loam	ML	A–4
Wasepi (WmA).	0–15	Sandy loam	SM	A–2
	15–23	Sandy clay loam	SC	A–6
	23–60	Sand	SP–SM	A–3
Yahara (YhA).	0–10	Very fine sandy loam	SM	A–2
	10–16	Loam	ML	A–4
	16–60	Silt and fine sand	ML	A–4
Zurich (ZuA, ZuB2).	0–9	Silt loam	ML	A–4
	9–23	Silty clay loam	CL	A–7–6
	23–60	Stratified silt and fine sand	ML	A–4

[1] The values for the percentage passing the various sieves are estimates of averages extrapolated from results of analyses such as given in table 3. The range in values is about plus or minus 5 percent of the value given.

[2] Estimated depths to seasonal high water table are given in the section "Descriptions of the Soils."

properties of the soils—Continued

Percentage passing sieve [1]—			Permeability	Available water capacity [2]	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.07 mm.)				
			Inches per hour	*Inches per inch of soil depth*	*pH value*	
100	100	100	2. 0 –6. 3	0. 20	7. 4–7. 8	Low.
100	100	95	0. 20–0. 63	. 18	7. 4–7. 8	Moderate.
100	100	95	0. 20–0. 63	. 18	7. 9–8. 4	Moderate.
100	100	90	0. 63–2. 0	. 20	7. 4–7. 8	Moderate.
100	100	90	0. 20–0. 63	. 18	7. 4–7. 8	High.
100	100	90	0. 06–0. 20	. 16	7. 9–8. 4	High.
100	95	90	0. 63–2. 0	. 20	6. 6–7. 8	Low.
100	95	90	0. 63–2. 0	. 18	6. 6–7. 8	Moderate.
100	90	55	0. 63–2. 0	. 16	7. 4–8. 4	Moderate.
90	85	5	>20. 0	. 02	7. 9–8. 4	Very low.
100	95	85	0. 63–2. 0	. 18	6. 1–8. 4	Low.
95	90	80	0. 63–2. 0	. 16	6. 1–8. 4	Moderate.
90	65	30	6. 3–20. 0	. 10	7. 4–7. 8	Very low.
40	30	5	>20. 0	. 02	7. 9–8. 4	Very low.
------------	------------	------------	0. 63–2. 0	>. 20	6. 6–7. 8	
100	100	90	0. 20–0. 63	. 16	7. 9–8. 4	Moderate.
95	95	80–90	0. 06–0. 20	. 16	7. 9–8. 4	Moderate.
100	100	100	0. 63–2. 0	. 20	7. 4–7. 8	Low.
100	100	95	0. 20–0. 63	. 16	7. 4–7. 8	High.
100	100	100	0. 06–0. 20	. 16	7. 9–8. 4	Moderate.
100	90	60	0. 63–2. 0	. 20	7. 4–7. 8	Low.
95	80	80	0. 63–2. 0	. 18	7. 4–7. 8	Moderate.
75	60	5	>20. 0	. 02	7. 9–8. 4	Very low.
100	100	45	0. 63–2. 0	. 14	7. 4–7. 8	Low.
100	100	80	0. 63–2. 0	. 18	7. 4–7. 8	Moderate.
100	100	70	0. 63–2. 0	. 16	7. 9–8. 4	Low.
100	100	95	0. 63–2. 0	. 20	6. 6–7. 8	Low.
100	100	80	0. 63–2. 0	. 18	6. 6–7. 8	Moderate.
90	80	55	0. 63–2. 0	. 16	7. 9–8. 4	Low.
100	85	30	2. 0–6. 3	. 09	6. 6–7. 8	Very low.
95	90	35	2. 0–6. 3	. 14	6. 6–7. 8	Low.
95	90	5	>20. 0	. 04	7. 9–8. 4	Very low.
100	100	45	0. 63–2. 0	. 16	7. 4–7. 8	Low.
100	90	55	0. 63–2. 0	. 16	7. 9–8. 4	Low.
100	100	65	0. 63–2. 0	. 16	7. 9–8. 4	Low.
100	100	80	0. 63–2. 0	. 20	7. 4–7. 8	Low.
100	100	85	0. 63–2. 0	. 18	7. 4–7. 8	Moderate.
100	100	70	0. 63–2. 0	. 16	7. 9–8. 4	Low.

[3] Mapping units KrC3 and KrD3 are severely eroded, and their surface layer is silty clay.
[4] Variable.

TABLE 5.—*Engineering*

Soil series, land types, and map symbols	Suitability as a source of—		Limitations for and factors affecting—
	Topsoil	Sand and gravel	Residential development
Adrian (Ak)	Poor; soil is erodible and oxidizes rapidly.	Fair; underlying sand varies greatly and contains fines in many places; high water table hinders excavation.	Very severe; almost permanent high water table.
Alluvial land (Am)	Surface layer fair, dark colored, thick; subsoil poor, variable in texture, and gravelly in places.	Unsuitable	Very severe; on flood plains and subject to frequent flooding.
Ashkum (As)	Surface layer good, dark colored, thick; subsoil poor, clayey; almost permanent high water table.	Unsuitable	Severe; almost permanent high water table and high shrink-swell potential; wet basements; subject to ponding.
Aztalan (AzA)	Surface layer good; subsoil fair to poor; the lower part of the subsoil is unstable on slopes; temporary high water table.	Unsuitable; in places thin layers of sand and gravel are in subsoil.	Moderate; slowly permeable underlying material; temporary high water table; basements subject to wetness.
Boyer:			
Loamy sands (BmB2, BmD2).	Both surface layer and subsoil are unsuitable; material is shallow over sand and gravel and is erodible.	Fair to good; poorly graded sand and pockets of gravel in some places.	Slight on slopes of 0 to 6 percent; severe on slopes of 12 to 20 percent; free draining; subject to wind and water erosion.
Sandy loams (BnA, BoB)	Fair in the surface layer; poor in the subsoil; material is shallow to sand and gravel and is erodible.	Fair; poorly graded sand; in some places pockets of gravel and layers of loamy material are in the substratum.	Slight; subject to water erosion
Brookston (BsA)	Surface layer good, thick, dark colored; subsoil fair to poor, clayey in many places; almost permanent high water table.	Unsuitable	Severe; basements are wet because of almost permanent high water table.
Casco (CcB2, CcC2, CeB2, CeC2, CrD2, CrE2). (For interpretations of Rodman soil in mapping units CrD2 and CrE2, refer to Rodman series in this table.)	Surface layer good; subsoil poor to unsuitable, clayey, and thin over gravel.	Good; underlying material contains poorly graded, stratified sand and gravel.	Slight on slopes of 0 to 6 percent, moderate on slopes of 12 to 20 percent, and severe on slopes of more than 20 percent; droughty; sloping areas are erodible.
Clayey land (Cv)	Poor; low fertility; crusts readily.	Not suitable	Severe; low stability; underlying material generally wet.
Colwood (Cw)	Surface layer good; subsoil fair, unstable on slopes, contains stratified lenses of sand; almost permanent high water table.	Poor; in places underlying material contains layers of poorly graded fine sand and a few lenses of silt and clay.	Severe; almost permanent high water table; flotation of pipes likely.

interpretations for nonfarm uses

Limitations for and factors affecting—Continued			Corrosion potential for conduits
Onsite sewage disposal systems	Commercial and light industrial development	Roads, railroads, and airports	
Very severe almost permanent; high water table; soil material shrinks and subsides on draining and is highly compressible.	Very severe; almost permanent high water table; soil material shrinks and subsides on draining and is highly compressible.	Very severe; almost permanent high water table; organic material is highly compressible and unstable.	For metal, high in the organic material and moderate in the sandy material; for concrete, high where the reaction of the material is less than pH 5.5 and low where it is more than pH 5.5.
Very severe; subject to frequent flooding.	Severe; liquefies when saturated; subject to frost heave; loses bearing strength when wet; subject to frequent flooding.	Severe; both the subsoil and underlying material have low stability and bearing capacity when wet; subject to frost heave.	Moderate for metal; low for concrete.
Very severe; almost permanent high water table and moderately slow permeability.	Severe; high shrink-swell potential; fair shear strength; moderate compressibility; almost permanent high water table; subject to ponding.	Severe; low bearing capacity; high shrink-swell potential.	Severe for metal; low for concrete.
Very severe; slowly permeable underlying material; temporary high water table.	Severe; high shrink-swell potential; high compressibility; poor shear strength; temporary high water table.	Severe; subsoil has low stability and bearing capacity when wet; underlying material is relatively unstable when the moisture content is high.	Moderate to high for metal; low to moderate for concrete.
Slight on slopes of 0 to 6 percent; moderate on slopes of 6 to 12 percent; free draining.	Slight on slopes of 0 to 6 percent; good shear strength; low shrink-swell potential and low compressibility.	Slight on slopes of 6 percent; high shrink-swell potential; good bearing strength; high stability; erodible; deep cuts are hard to vegetate.	Low for metal and concrete.
Slight on slopes of less than 6 percent; substratum is finer textured than overlying material; slow absorption.	Slight; underlying material has good shear strength; low compressibility; low shrink-swell potential.	Moderate; low shrink-swell potential; good bearing strength; underlying material is stable under wheel loads.	Low for metal and concrete.
Very severe; almost permanent high water table.	Severe; good shear strength; low compressibility; moderate bearing capacity; almost permanent high water table.	Severe; subsoil as moderate shrink-swell potential; low bearing capacity; elastic; underlying material has fair stability; almost permanent high water table.	High for metal; low for concrete.
Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, severe on slopes of 12 to 20 percent, and very severe on slopes of more than 20 percent; risk of ground water contamination.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of more than 12 percent; good shear strength.	Slight on slopes of less than 12 percent and moderate on slopes of more than 12 percent; subsoil has fair bearing capacity; underlying material is highly stable; good source of fill material.	Low for metal and concrete.
Severe; wet basements; low stability.	Severe	Severe	Variable.
Very severe; almost permanent high water table.	Severe; good shear strength; subject to frost heave; likely to liquefy and flow when wet; almost permanent high water table.	Severe; subsoil has moderate shrink-swell potential; low bearing strength; underlying material likely to liquefy and flow when saturated; almost permanent high water table.	High for metal; low for concrete.

TABLE 5.—*Engineering interpretations*

Soil series, land types, and map symbols	Suitability as a source of—		Limitations for and factors affecting—
	Topsoil	Sand and gravel	Residential development
Darroch (DcA, DaA)	Both surface layer and subsoil fair; temporary high water table.	Poor; temporary high water table.	Moderate; temporary high water table; liquefies readily; subject to frost heave.
Dresden (DsA)	Surface layer good; subsoil poor; in many places the lower part of the subsoil is gravelly and is slightly droughty.	Good; underlying material contains poorly graded, stratified sand and gravel.	Slight; in places receives runoff from slightly higher ground.
Fabius (FaA)	Surface layer good; subsoil poor to unsuitable, clayey, shallow over gravel; seasonal high water table.	Good; substratum contains poorly graded, stratified sand and gravel; seasonal high water table.	Moderate; in places a temporary, fluctuating high water table; basements are wet.
Fox:			
Loams (FoA, FoB)	Surface layer good; subsoil poor; lower part of the subsoil is gravelly and is droughty.	Good; the underlying material contains poorly graded, stratified sand and gravel.	Slight; erodible soils
Sandy loam (FmB)	Surface layer fair; subsoil poor; in many places the lower part of the subsoil is gravelly and is droughty.	Good; the underlying material contains poorly graded, stratified sand and gravel.	Slight; slightly droughty; erodible soil.
Granby (Ge)	Surface layer poor; subsoil unsuitable; droughty; almost permanent high water table.	Good; underlying material is poorly graded sand; almost permanent high water table hinders excavation.	Severe; silty substratum; susceptible to frost heave; high water table; sand liquefies and runs when wet; basements are wet.
Hebron (HeB)	Surface layer good; subsoil fair to poor; the lower subsoil is unstable on slopes.	Unsuitable; in places thin layers of sand and gravel are in the subsoil.	Moderate; moderate shrink-swell potential; high compressibility; poor shear strength.
Hochheim (HmA, HmB2, HmC2, HmD2, HsA, HsB2, HsC2, HsD2, HsE2). (For interpretations of Sisson and Casco soils in mapping units HsA through HsE2, refer to Sisson and Casco series, respectively, in this table.)	Surface layer good, thin; subsoil fair to poor, clayey, and in places stony.	Poor; in places the underlying material contains pockets of well-graded sand and gravel.	Slight on slopes of less than 12 percent, moderate on slopes of 12 to 20 percent, and severe on slopes of 20 percent or more; erosion is a serious hazard in steep areas.
Houghton (Hu)	Poor; soil is erodible and oxidizes rapidly.	Unsuitable	Very severe; almost permanent high water table; highly compressible.
Keowns (Km)	Surface layer good, dark colored, thick; subsoil fair, unstable on slopes; high water table.	Poor; in underlying material are layers of poorly graded fine sand and silt; high water table.	Severe; high water table; subject to frost heave; liquefies readily.

for nonfarm uses—Continued

Limitations for and factors affecting—Continued			Corrosion potential for conduits
Onsite sewage disposal systems	Commercial and light industrial development	Roads, railroads, and airports	
Very severe; in places silt and fine sand enters tile lines and filter beds; system does not function when water table is temporarily high.	Severe; liquefies readily; poor shear strength; subject to frost heave; temporary high water table.	Severe; subsoil has moderate shrink-swell potential; low bearing capacity; subject to frost heave; underlying material is relatively unstable.	High for metal; low for concrete.
Slight	Slight; low compressibility; good shear strength.	Slight; subsoil has good bearing capacity if properly compacted; underlying material has high stability.	Low for metal and concrete.
Very severe; system does not function when water table is high.	Moderate; high shear strength; negligible compressibility; temporary high water table.	Slight; subsoil has fair bearing capacity and is relatively stable under wheel loads; underlying material has high bearing capacity.	High for metal; low for concrete.
Slight on slopes of less than 6 percent; free draining below a depth of 2 to 3 feet.	Slight on slopes of less than 6 percent; low compressibility; good shear strength.	Slight on slopes of less than 6 percent; subsoil has good bearing capacity; underlying material is highly stable.	Low for metal and concrete.
Slight on slopes of less than 6 percent; free draining below a depth of 2 to 3 feet.	Very slight on slopes of less than 6 percent; very low compressibility; good shear strength; low shrink-swell potential.	Slight on slopes of less than 6 percent; good bearing capacity; underlying material excellent; stable.	Low for metal and concrete.
Very severe; almost permanent high water table.	Severe; silty substratum liquefies readily and flows when excavated; low compressibility; good shear strength; high water table.	Severe; silty substratum is relatively unstable; subsoil has good stability; underlying material is stable under wheel loads when damp.	Moderate for metal; low for concrete.
Moderate; slowly permeable underlying material.	Severe; moderate shrink-swell potential; high compressibility; poor shear strength.	Severe; subsoil has low stability and bearing capacity; underlying material is relatively unstable.	Moderate for metal; low for concrete.
Slight on slopes of less than 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of more than 12 percent; soil material is moderately permeable.	Slight on slopes of less than 12 percent and severe on slopes of more than 12 percent; low compressibility; good shear strength.	Slight on slopes of less than 12 percent and moderate on steeper slopes; subsoil has moderate shrink-swell potential and low bearing strength.	Moderate for metal; low for concrete.
Very severe; almost permanent high water table.	Very severe; almost permeable high water table; highly compressible.	Very severe; almost permanent high water table; organic material is highly compressible and unstable.	High for metal; high for concrete where the reaction of the material is less than pH 5.5, and low where it is more than pH 5.5.
Very severe; almost permanent high water table.	Severe; almost permanent high water table; liquefies readily and flows when excavated; low compressibility.	Severe; subsoil and underlying material are relatively unstable at all moisture contents; almost permanent high water table; fill generally needed.	High for metal; low for concrete.

TABLE 5.—*Engineering interpretations*

Soil series, land types, and map symbols	Suitability as a source of—		Limitations for and factors affecting—
	Topsoil	Sand and gravel	Residential development
Kewaunee:			
Silt loams (KnA, KnB)	Surface layer good; subsoil unsuitable, clayey, plastic.	Unsuitable; clayey	Moderate; erodible soils; high shrink-swell potential.
Silty clays (KrC3, KrD3) and silty clay loams (KoB2, KoC2).	Surface layer poor, thin; subsoil unsuitable, clayey, plastic.	Unsuitable; clayey	Moderate on slopes of less than 12 percent and severe on steeper slopes; severe erosion hazard; high shrink-swell potential; moderate compressibility.
Knowles:			
Silt loams (KwA, KwB2)	Surface layer good; subsoil poor, shallow to bedrock.	Unsuitable; bedrock is at a depth of less than 42 inches.	Moderate; bedrock near the surface interferes with excavating basements.
Mottled subsoil variant (KyA).	Surface layer good; subsoil poor, shallow to bedrock.	Unsuitable; bedrock is at a depth of less than 42 inches.	Severe; bedrock near the surface; temporary high water table.
Loamy land (Lu)	Poor	Poor	Moderate
Lorenzo (LyA)	Surface layer good, dark colored, thin; subsoil poor to unsuitable, clayey, thin over gravel.	Good; underlying material contains poorly graded, stratified sand and gravel.	Slight; erodible soil
Manawa (MaA)	Surface layer good, thin; subsoil unsuitable, thin, plastic; seasonal high water table.	Unsuitable; soil material is clayey.	Moderate; basements generally are wet; temporary high water table.
Marsh (Mf)	Unsuitable	Unsuitable	Very severe; flooded most of the time.
Martinton (MgA)	Surface layer good, thick, dark colored; subsoil fair to poor, somewhat clayey, unstable on slopes.	Unsuitable; soil material consists of silt and clay.	Severe; temporary high water table; high shrink-swell potential; moderate compressibility.
Matherton (MkA, MmA)	Surface layer good; subsoil poor; in many places part of the subsoil is gravelly and is droughty; seasonal high water table.	Good; the underlying material is poorly graded, stratified sand and gravel; temporary high water table.	Moderate; temporary high water table; subject to ponding; basements are wet.
Mequon (MtA)	Surface layer fair to good, thin; subsoil poor, clayey.	Unsuitable	Moderate; temporary high water table and occasional ponding; basements are wet.
Muskego (Mzg)	Poor; soil material is erodible and oxidizes rapidly.	Unsuitable	Very severe; permanent high water table; shrinks and subsides when drained; highly compressible.

for nonfarm uses—Continued

Limitations for and factors affecting—Continued			Corrosion potential for conduits
Onsite sewage disposal systems	Commercial and light industrial development	Roads, railroads, and airports	
Severe on slopes up to 12 percent and very severe on steeper slopes; slowly permeable.	Moderate on slopes of less than 6 percent, severe on slopes of 6 to 12 percent, and very severe on steeper slopes; high shrink-swell potential; fair shear strength; moderate compressibility.	Severe; high shrink-swell potential; low bearing strength; erosion is a hazard on the steeper slopes.	Moderate for metal; low for concrete.
Severe on slopes of less than 12 percent and very severe on steeper slopes; slowly permeable.	Moderate on slopes of less than 12 percent, and very severe on steeper slopes; high shrink-swell potential; fair shear strength; moderate compressibility.	Severe; high shrink-swell potential; low bearing strength; erosion is a hazard on the steeper slopes.	Moderate for metal; low for concrete.
Severe; difficult to install a sewage system; seepage of effluent contaminates water supplies.	Moderate; bedrock near surface interferes with excavation.	Slight; subsoil has moderate shrink-swell potential; low bearing capacity; underlain by bedrock.	Low to moderate for metal; low for concrete.
Very severe; difficult to install a sewage system; effluent may contaminate water supplies; temporary high water table.	Severe; temporary high water table; bedrock near surface interferes with excavation.	Moderate; subsoil has low bearing capacity; underlying bedrock provides excellent support.	Low to moderate for metal; low for concrete.
------------------------------	Moderate	Moderate	Variable.
Slight; risk of ground water contamination.	Slight; good shear strength; negligible compressibility.	Slight; underlying material is stable.	Low for metal and concrete.
Very severe; slow permeability; temporary high water table.	Severe; high shrink-swell potential; fair shear strength; moderate compressibility; temporary high water table.	Severe; subsoil and underlying material have high shrink-swell potential; low bearing capacity; elastic.	High for metal; low for concrete.
Very severe; permanent high water table; flooded most of the time.	Very severe; permanent high water table; flooded most of the time.	Severe for metal; high for concrete where the material is acid, and low where the pH of the material is more than 5.5.	
Very severe; slowly permeable underlying material and temporary high water table.	Severe; high shrink-swell potential; fair shear strength; moderate compressibility; temporary high water table.	Severe; subsoil and underlying material have high shrink-swell potential; low bearing capacity when wet.	High for metal; low for concrete.
Very severe; the system does not function at times because of a temporary high water table.	Moderate; very low compressibility; good shear strength; temporary high water table; subject to ponding.	Slight when drained; subsoil has low bearing strength when wet; moderate shrink-swell potential; the underlying material is stable.	Moderate for metal; low for concrete.
Very severe; temporary high water table; permeability is moderately slow; at times system does not function.	Severe; high shrink-swell potential; fair shear strength; poor bearing capacity; occasional ponding and temporary high water table.	Severe; subsoil and underlying material have high shrink-swell potential; low bearing capacity when wet.	High for metal; low for concrete.
Very severe; permanent high water table.	Very severe; permanent high water table; shrinks and subsides when drained; highly compressible.	Very severe; permanent high water table; the organic material is highly compressible and is highly unstable.	High for metal; high for concrete, where the reaction of the soil material is less than pH 5.5 and low where it is more than pH 5.5.

TABLE 5.—*Engineering interpretations*

Soil series, land types, and map symbols	Suitability as a source of—		Limitations for and factors affecting—
	Topsoil	Sand and gravel	Residential development
Mussey (MzK)	Surface layer good, thin; subsoil poor to unsuitable, clayey, thin over gravel; almost permanent high water table.	Good; the underlying material contains poorly graded, stratified sand and gravel; seasonal high water table.	Severe; almost permanent high water table.
Navan (Na)	Surface layer good, thick, dark colored; subsoil fair to poor; almost permanent high water table.	Unsuitable; in places thin layers of sand and gravel are in the subsoil.	Very severe; almost permanent high water table; basements are wet.
Nenno (NnA)	Surface layer good; subsoil fair to poor, in places is gravelly in the lower part; temporary high water table.	Poor; in places pockets of well-graded sand and gravel are in the underlying material; temporary high water table.	Moderate; temporary high water table; basements are wet.
Ogden (Od)	Poor; soil is erodible and oxidizes rapidly.	Unsuitable	Very severe; permanent high water table; soil material shrinks and subsides on draining; highly compressible.
Ozaukee (OuA, OuB, OuB2, OuC2, OuD2, OuE, OzC3, OzD3).	Surface layer good; subsoil poor, clayey.	Unsuitable; clayey	Moderate on slopes of less than 6 percent, severe on slopes of 6 to 12 percent, and very severe on steeper slopes; water erosion is a hazard.
Palms (Pc)	Poor; soil is erodible and oxidizes rapidly.	Unsuitable	Very severe; almost permanent high water table; shrinks and subsides on draining; highly compressible.
Pella (Ph)	Surface layer good, thick, dark colored; subsoil poor, clayey; almost permanent high water table.	Very severe; installing and maintaining public utilities, access roads, and other facilities difficult; basements are wet.	Very severe; high water table; basements are wet.
Poygan (Py)	Surface layer fair, thin, dark colored, subsoil unsuitable, clayey; almost permanent high water table.	Unsuitable; clayey	Very severe; high shrink-swell potential; basements are wet.
Radford (RaA)	Surface layer good, thick; subsoil poor, thick; temporary high water table.	Poor; temporary high water table; in places underlying material contains pockets of sand and gravel.	Severe; high water table; occasional flooding.
Ritchey (RkB, RkD2)	Surface layer good; subsoil poor; shallow to bedrock.	Unsuitable; bedrock at a depth of less than 20 inches.	Severe; bedrock near surface.
Rodman (Mapped only in complexes with Casco soils.)	Surface layer and subsoil unsuitable; very thin, cobbly, and droughty.	Underlying material good; poorly graded sand and gravel; stratified; cobbly in places.	Moderate on slopes of 6 to 12 percent, severe on slopes of 12 to 20 percent, and very severe on steeper slopes; lawns are hard to establish.

for nonfarm uses—Continued

Limitations for and factors affecting—Continued			Corrosion potential for conduits
Onsite sewage disposal systems	Commercial and light industrial development	Roads, railroads, and airports	
Very severe; almost permanent high water table.	Severe; high shear strength; negligible compressibility; almost permanent high water table; subject to flooding and ponding.	Severe; high water table	High for metal; low for concrete.
Very severe; almost permanent high water table.	Severe; high shrink-swell potential; fair shear strength; moderate compressibility; almost permanent high water table.	Severe; subsoil has low stability and bearing capacity; underlying material is relatively unstable.	High for metal; low for concrete.
Very severe; at times system does not function because of a high water table.	Moderate; low compressibility; fair shear strength; moderate bearing capacity; temporary high water table.	Moderate; moderate shrink-swell potential; low bearing capacity; fair stability.	High for metal; low for concrete.
Very severe; permanent high water table.	Very severe; permanent high water table; shrinks and subsides on draining; highly compressible.	Very severe; permanent high water table; organic material is highly compressible and unstable.	High for metal; low for concrete where the reaction of the material is less than pH 5.5, and low where it is more than pH 5.5.
Severe; moderately slowly permeable.	Moderate on slopes of less than 6 percent, severe on slopes of 6 to 12 percent, and very severe on steeper slopes; high shrink-swell potential; fair shear strength; moderate compressibility.	Severe; high shrink-swell potential; low bearing strength; moderately slow permeability.	Moderate for metal; low for concrete.
Very severe; almost permanent high water table.	Very severe; almost permanent high water table; shrinks and subsides on draining; highly compressible.	Very severe; almost permanent high water table; organic material is highly compressible and unstable.	High for metal; high for concrete where the reaction of the material is less than pH 5.5, and low where it is more than 5.5.
Very severe; almost permanent high water table.	Severe; moderate shrink-swell potential; fair shear strength; moderate compressibility; almost permanent high water table.	Severe; subsoil and underlying material are plastic; moderate shrink-swell potential; low bearing strength.	High for metal; low for concrete.
Very severe; almost permanent high water table.	Severe; high shrink-swell potential; fair shear strength; moderate compressibility; almost permanent high water table.	Severe; subsoil and underlying material are elastic; high shrink-swell potential; low bearing strength.	High for metal; low for concrete.
Very severe; at times system does not function because of a temporary high water table; occasional flooding.	Severe; subsoil and underlying material are variable; temporary high water table.	Severe; subsoil and underlying material are variable.	Moderate for metal; low for concrete.
Very severe; shallow to bedrock; probable contamination of ground water.	Moderate where soil is shallow to bedrock.	Slight; subsoil has moderate shrink-swell potential; low bearing capacity; shallow to bedrock.	Low to moderate for metal; low for concrete.
Moderate on slopes of 6 to 12 percent, severe on slopes of 12 to 20 percent, and very severe on steeper slopes; droughty; lawns are hard to establish.	Moderate on slopes of 6 to 12 percent, severe on slopes of 12 to 20 percent, and very severe on steeper slopes; erodible if water concentrates on slopes.	Moderate; high stability; high bearing capacity.	Low for metal and concrete.

TABLE 5.—*Engineering interpretations*

Soil series, land types, and map symbols	Suitability as a source of—		Limitations for and factors affecting—
	Topsoil	Sand and gravel	Residential development
Rollin (Rw)	Poor; soil is erodible and oxidizes rapidly.	Unsuitable	Very severe; almost permanent high water table; shrinks and subsides on draining; highly compressible.
Rough broken land (Ry)	Unsuitable	Unsuitable	Severe; steep slopes are unstable.
Sandy and gravelly land (Sf)	Unsuitable	Fair	Moderate
Sandy lake beaches (Sfb)	Both the surface layer and subsoil are unsuitable.	Fair; poorly graded sand that in some places contains gravel.	Very severe; subject to wave action.
Saylesville (ShA, ShB2)	Surface layer good; underlying material fair to poor; in places unstable on slopes.	Unsuitable; silt and clay	Moderate; high shrink-swell potential; moderate compressibility; water erosion is a hazard on slopes.
Sebewa (Sm)	Surface layer good, thick, dark colored; subsoil fair to poor, thin; almost permanent high water table.	Good; underlying material is poorly graded, stratified sand and gravel; almost permanent high water table.	Very severe; almost permanent high water table; basements are wet.
Sisson (SrB2)	Surface layer fair, droughty; subsoil fair, unstable on slopes.	Poor; substratum contains layers of poorly graded fine sand and silt.	Moderate; soil liquefies readily; subject to frost heave; low bearing capacity.
Theresa (ThB)	Surface layer good; subsoil poor; in places is clayey and stony.	Poor; in places the underlying material contains pockets of well-graded sand and gravel.	Slight; erosion is a hazard on slopes.
Wasepi (WmA)	Surface layer fair, somewhat droughty, erodible; subsoil poor, thin over sand and gravel; high water table.	Fair; underlying material contains poorly graded sand and some pockets of gravel; high water table.	Severe; in places a high water table causes wet basements.
Wet alluvial land (Ww)	Surface layer fair; subsoil poor, variable in texture, and gravelly in places; permanent high water table.	Unsuitable	Very severe; permanent high water table; subject to frequent flooding.
Yahara (YhA)	Surface layer good; subsoil fair; stable on slopes; temporary high water table.	Poor; in places poorly graded fine sand and layers of silt; temporary high water table.	Severe; temporary high water table; liquefies readily; subject to frost heave.
Zurich (ZuA, ZuB2)	Surface layer good; subsoil fair to poor; unstable on slopes.	Poor; poorly graded fine sand and silt in places.	Moderate; moderate bearing capacity; moderate stability.

for nonfarm uses—Continued

Limitations for and factors affecting—Continued			Corrosion potential for conduits
Onsite sewage disposal systems	Commercial and light industrial development	Roads, railroads, and airports	
Very severe; almost permanent high water table.	Very severe; almost permanent high water table; shrinks and subsides on draining; highly compressible.	Very severe; almost permanent high water table; organic material is highly compressible and highly unstable.	High for metal; low for concrete.
Very severe; seepage beds impractical on steep slopes.	Severe; moderate bearing capacity; moderate to high shrink-swell potential; unstable on steep slopes.	Severe; unstable on steep slopes; subject to landslides and severe erosion.	
	Moderate	Slight	Variable.
Very severe; subject to wave action.	Very severe; low compressibility; good shear strength; liquefies and flows when saturated; subject to wave action.	Very severe; negligible volume change; stable under wheel loads when moist; subject to wave action.	Low for metal and concrete.
Severe; slowly permeable	Moderate; high shrink-swell potential; fair shear strength; moderate compressibility.	Severe; high shrink-swell potential; low bearing capacity; slow permeability.	High for metal; low for concrete.
Very severe; almost permanent high water table.	Severe; high shear strength; almost permanent high water table.	Severe; subsoil has moderate shrink-swell potential; low bearing capacity; underlying material is stable; almost permanent high water table.	High for metal; low for concrete.
Moderate; maintaining filter fields is difficult.	Moderate; low bearing capacity; subject to frost heave, liquefaction, and piping; erodible on slopes.	Severe; low bearing capacity; subject to frost heave, liquefaction, piping, and slippage.	Moderate for metal; low for concrete.
Slight; moderately permeable	Slight; low compressibility; fair shear strength.	Slight; subsoil has moderate shrink-swell potential and low bearing strength; underlying material has good stability and low shrink-swell potential.	Moderate for metal; low for concrete.
Very severe; system does not function in places because of a high water table.	Severe; high water table	Moderate; subsoil and underlying material are stable under wheel loads.	Moderate for metal; low for concrete.
Very severe; permanent high water table; subject to frequent flooding.	Very severe; permanent high water table; subject to frequent flooding.	Very severe; permanent high water table; subject to frequent flooding.	High for metal; low for concrete.
Very severe; temporary high water table; system does not function at times; silt and sand clog filter beds.	Severe; liquefies readily; subject to frost heave; temporary high water table.	Severe; moderate stability; subject to frost heave; temporary high water table during wet seasons.	Moderate to low for metal; low for concrete.
Slight	Moderate; subject to frost heave; moderate bearing capacity; moderate stability.	Severe; moderate shrink-swell potential and bearing capacity.	Moderate to low for metal; low for concrete.

TABLE 6.—*Engineering*

Soil series, land types, and map symbols	Soil features affecting—	
	Reservoir areas	Embankments
Adrian (Ak)	Pervious; high water table; suitable for dug ponds.	Pervious; organic surface layer has low stability and is suitable for low embankments; underlying material has high stability but is susceptible to piping.
Alluvial land (Am)	Characteristics variable	Characteristics variable; onsite investigation required.
Ashkum (As)	Semipervious; high water table; suitable for dug ponds.	Impervious; low stability; high shrink-swell potential.
Aztalan (AzA)	Semipervious subsoil and underlying material.	Semipervious subsoil has high stability; underlying material has low stability and high shrink-swell potential.
Boyer:		
Loamy sands (BmB2, BmD2)	Very pervious subsoil and substratum	Pervious; high stability; susceptible to piping.
Sandy loam (BnA)	Very pervious subsoil; pervious substratum.	Pervious; high stability
Sandy loam, loamy substratum (BoB)	Very pervious material over semipervious substratum.	Loamy material is semipervious and highly stable; silty clay loam material is impervious and has moderate stability and shrink-swell potential.
Brookston (BsA)	Pervious; high water table; suitable for dug ponds.	Semipervious subsoil has low stability and moderate shrink-swell potential; underlying material has high stability.
Casco:		
Loams (CeB2, CeC2, CrD2, CrE2) (For interpretations of Rodman soil in mapping units CrD2 and CrE2, refer to Rodman series in this table.)	Pervious subsoil; very pervious substratum.	Subsoil is semipervious and has medium stability; underlying material is pervious and has high stability.
Sand loams (CcB2, CcC2)	Pervious subsoil; very pervious substratum.	Subsoil is semipervious; substratum is pervious; high stability.
Clayey land (Cv)	Semipervious	Low stability
Colwood (Cw)	High water table; suitable for dug ponds; sides of ponds very unstable when saturated.	Semipervious; low stability; susceptible to piping.
Darroch (DcA)	Pervious	Semipervious; medium stability; medium shrink-swell potential; underlying material has low stability; susceptible to piping.
Dresden (DsA)	Pervious subsoil; very pervious underlying material.	Semipervious; subsoil has medium stability and moderate shrink-swell potential; underlying material has high stability and is pervious.

interpretations for farm uses

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Rapid permeability; high water table; not suitable for drainage where peat is less than 24 inches thick.	Rapid rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Highly erodible soil; in many places wetness hinders construction; in places sand is exposed.
Variable texture; hazard of flooding.	Characteristics variable	Characteristics variable	Variable texture; in places wetness hinders construction; waterways generally not required.
Slow permeability; seasonal high water table.	Severe; moderate to slow rate of water intake; high water-holding capacity; adequate drainage difficult to obtain.	Not applicable; little or no runoff.	Hard to establish satisfactory seedbed in clayey subsoil.
Slow permeability	Moderate rate of water intake; high water-holding capacity; poorly drained.	In places wetness hinders construction.	In places wetness hinders construction.
Present drainage is excessive	Rapid rate of water intake; low water-holding capacity; susceptible to soil blowing.	Sandy throughout the profile; highly erodible.	Slopes; hard to establish and maintain vegetative cover.
Present drainage is somewhat excessive.	Rapid rate of water intake; low water-holding capacity; susceptible to soil blowing.	Sandy throughout the profile; highly erodible.	Hard to establish and maintain vegetative cover.
Present drainage is somewhat excessive.	Rapid rate of water intake; medium water-holding capacity.	Sandy throughout the profile; highly erodible.	Hard to establish and maintain vegetative cover.
Moderate permeability; high water table.	Moderate rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Hard to establish satisfactory seedbed because of clayey subsoil.
Present drainage is adequate	Moderate rate of water in-intake; medium water-holding capacity.	Shallow to underlying gravel or sand.	Slopes.
Present drainage is somewhat excessive.	Rapid rate of water intake; medium water-holding capacity; susceptible to soil blowing.	Sandy throughout the profile; susceptible to erosion.	Slopes; hard to establish and maintain vegetative cover.
Slow permeability	Slow permeability	Not applicable; little or no runoff.	Clayey material; unfavorable for plants.
Moderate permeability; high water table.	Moderate rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Highly erodible; in places wetness hinders construction.
Moderate permeability; seasonal high water table.	Moderate rate of water intake; high water-holding capacity; somewhat poorly drained.	Low stability	Highly erodible; in places wetness hinders construction.
Present drainage is adequate	Moderate rate of water intake	Underlying material is gravel or sand; hard to vegetate.	In places gravelly or sandy underlying material is exposed.

TABLE 6.—*Engineering*

Soil series, land types, and map symbols	Soil features affecting—	
	Reservoir areas	Embankments
Fabius (FaA)	Pervious subsoil; very pervious sub-substratum.	Semipervious; subsoil has moderate shrink-swell potential; pervious underlying material has high stability.
Fox:		
Loams (FoA, FoB)	Pervious subsoil; very pervious sub-substratum.	Impervious subsoil that has medium stability; underlying material has high stability and is very pervious.
Sandy loam (FmB)	Pervious subsoil; very pervious sub-substratum.	Semipervious; high stability; very pervious substratum.
Granby (Ge)	Pervious; not suitable for dug ponds	Pervious; high stability
Hebron (HeB)	Semipervious	Impervious; low stability; medium shrink-swell potential.
Hochheim (HmA, HmB2, HmC2, HmD2, HsA, HsB2, HsC2, HsD2, HsE2). (For interpretations of Sisson soil and of Casco soil in mapping units HsA through HsE2, refer to Sisson and Casco series, respectively, in this table.)	Semipervious subsoil; pervious substratum.	Impervious subsoil has medium stability; underlying material has high stability and is semipervious.
Houghton (Hu)	Very pervious; high water table; suitable for dug ponds; flotation of organic matter likely.	Pervious; low stability; can be used for low embankments.
Keowns (Km)	Pervious; high water table; suitable for dug ponds that have low side slopes.	Semipervious; low stability; susceptible to piping; banks very erodible.
Kewaunee (KnA, KnB, KoB2, KoC2, KrC3, KrD3)	Semipervious	Impervious; medium stability; high shrink-swell potential.
Knowles:		
Silt loams (KwA, KwB2)	Semipervious subsoil	Impervious subsoil that has medium stability; bedrock is at a depth between 20 and 42 inches.
Silt loam, mottled subsoil variant (KyA)	Semipervious subsoil	Semipervious subsoil that has medium stability; bedrock is at a depth between 20 and 42 inches.
Loamy land (Lu)	Semipervious; variable	Semipervious; variable
Lorenzo (LyA)	Pervious subsoil; very pervious substratum.	Semipervious subsoil has medium stability; very pervious underlying material has high stability.
Manawa (MaA)	Semipervious	Impervious; medium stability; high shrink-swell potential.
Marsh (Mf)	Characteristics variable	Characteristics variable
Martinton (MgA)	Semipervious	Impervious; medium stability; sandy layers in underlying material are susceptible to piping.

interpretations for farm uses—Continued

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Moderate permeability	Moderate rate of water intake; medium water-holding capacity; somewhat poorly drained.	Shallow to gravelly or sandy underlying material.	In places gravelly or sandy underlying material is exposed.
Present drainage is adequate	Moderate rate of water intake; medium water-holding capacity.	Underlying material is gravel or sand; hard to vegetate.	In places underlying gravel or sand is exposed.
Present drainage is adequate	Rapid rate of water intake; medium water-holding capacity.	Underlying material is sandy and susceptible to erosion.	In places underlying sandy material is exposed.
Moderate; rapid permeability; high water table.	Very rapid rate of water intake; low water-holding capacity.	Not applicable; little or no runoff.	Highly erodible; in places wetness hinders construction.
Present drainage is adequate	Moderate rate of water intake; high water-holding capacity.	No limiting factor	No limiting factor.
Present drainage is adequate	Moderate rate of water intake; medium water-holding capacity.	In places stones hinder construction.	Slopes; in places stones hinder construction.
Moderate permeability; high water table.	Rapid rate of water intake; very high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Highly erodible; in places wetness hinders construction.
Moderate permeability; high water table.	Moderate rate of water intake; high water-holding capacity; poorly drained.	Low stability for diversions; terraces not needed because soil is level and has poor drainage.	Highly erodible; in places wetness hinders construction.
Present drainage is adequate	Moderate to slow rate of water intake; high water-holding capacity.	No limiting factor	Subsoil is clayey and establishing a satisfactory seedbed is difficult.
Present drainage is adequate	Moderate rate of water intake; medium water-holding capacity.	In places stones and bedrock hinder construction.	In places bedrock is exposed.
Moderate permeability; seasonal high water table.	Moderate rate of water intake; medium water-holding capacity; somewhat poorly drained.	In places stones and bedrock hinder construction.	In places bedrock is exposed.
Variable	Variable	Not applicable	In places contains pockets of sand, gravel, or clayey material and debris.
Present drainage is adequate	Moderate rate of water intake; medium water-holding capacity.	Shallow to gravelly or sandy underlying material.	In places gravelly or sandy underlying material is exposed.
Slow permeability	Slow rate of water intake; high water-holding capacity; somewhat poorly drained.	In places stones and wetness hinder construction.	In places wetness hinders construction.
Drainage generally not feasible or too costly.	High water table most of the year; very poorly drained.	Not applicable; little or no runoff.	Difficult to establish and maintain vegetative cover.
Slow permeability; seasonal high water table.	Moderate to slow rate of water intake; high water-holding capacity.	No limiting factor	Subsoil is clayey and establishing a satisfactory seedbed is difficult.

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TABLE 6.—*Engineering*

Soil series, land types, and map symbols	Soil features affecting—	
	Reservoir areas	Embankments
Matherton (MkA, MmA)	Pervious subsoil; very pervious underlying material.	Semipervious subsoil has medium stability: underlying material is pervious and has high stability.
Mequon (MtA)	Semipervious	Impervious; low stability; high shrink-swell potential.
Muskego (Mzg)	Pervious; high water table; suitable for dug ponds.	Pervious
Mussey (Mzk)	Pervious subsoil; high water table; suitable for dug ponds.	Semipervious subsoil has medium stability; underlying material is very pervious and has high stability.
Navan (Na)	Pervious; high water table; suitable for dug ponds.	Semipervious; medium stability
Nenno (NnA)	Pervious	Impervious; subsoil has medium stability; underlying material has high stability.
Ogden (Od)	Pervious; high water table; suitable for dug ponds.	Pervious; low stability
Ozaukee (OuA, OuB, OuB2, OuC2, OuD2, OuE, OzC3, OzD3).	Semipervious	Impervious; low stability; high shrink-swell potential.
Palms (Pc)	Pervious; high water table; suitable for dug ponds; suitable for reservoirs if organic material is removed.	Pervious; low stability
Pella (Ph)	Pervious; high water table; suitable for dug ponds.	Semipervious; medium stability; susceptible to piping.
Poygan (Py)	Semipervious; high water table; suitable for dug ponds.	Impervious; medium stability; high shrink-swell potential.
Radford (RaA)	Frequent flooding	Semipervious; medium stability
Ritchey (RkB, RkD2)	Pervious above bedrock	Semipervious above bedrock; medium stability; depth to bedrock is less than 20 inches.
Rodman (Mapped only in complexes with Casco soils.)	Very pervious	Very pervious; high stability
Rollin (Rw)	Pervious; high water table; suitable for dug ponds.	Pervious; both organic material and marl have low stability.
Rough broken land (Ry)	Semipervious; rapid runoff and active geologic erosion.	Impervious; medium stability; high shrink-swell potential.

interpretations for farm uses—Continued

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Moderate permeability	Moderate rate of water intake; medium water-holding capacity; poorly drained.	Not applicable; little or no runoff.	In places underlying gravel or sand is exposed.
Moderately slow permeability	Slow rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Subsoil is clayey and establishing a satisfactory seedbed is difficult.
Moderate permeability; high water table.	Rapid rate of water intake; high water-holding capacity; adequate drainage difficult.	Not applicable; little or no runoff.	In places sedimentary peat is exposed; highly erodible; in some places wetness hinders construction.
Moderate permeability; high water table; gravelly or sandy underlying material.	Moderate rate of water intake; medium water-holding capacity; poorly drained.	Not applicable; little or no runoff.	In places wetness hinders construction.
Slow permeability; high water table.	Moderate rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	In places wetness hinders construction.
Moderate permeability	Moderate rate of water intake; medium water-holding capacity; somewhat poorly drained.	Slight; in places wetness hinders construction.	In places wetness hinders construction.
Moderate permeability; high water table.	Rapid rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Highly erodible; in many places wetness hinders construction.
Present drainage is adequate	Moderate rate of water intake; high water-holding capacity.	No limiting factor	Subsoil is clayey, and it is difficult to establish a satisfactory seedbed.
Moderate permeability; high water table.	Rapid rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Highly erodible; in many places wetness hinders construction.
Moderately slow permeability; high water table.	Moderate rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	In places wetness hinders construction.
Subsoil permeability; high water table.	Moderate rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Subsoil is clayey, and it is difficult to establish a satisfactory seedbed; in places wetness hinders construction.
Moderate permeability; seasonal high water table.	Moderate rate of water intake; high water-holding capacity; frequent flooding.	Not applicable; little or no runoff.	In places wetness hinders construction.
Present drainage is adequate	Moderate rate of water intake; medium water-holding capacity; shallow to bedrock.	Shallow to bedrock	Shallow to bedrock.
Present drainage is excessive	Very rapid rate of water intake; low water-holding capacity; in places cobblestones and irregular topography limit feasibility.	Gravelly and cobbly; topography limits construction.	Gravelly and cobbly; difficult to establish and vegetate.
Moderate permeability; high water table.	Severe; rapid rate of water intake; high water-holding capacity; poorly drained.	Not applicable; little or no runoff.	In places marl is exposed; highly erodible; in many places wetness hinders construction.
Present drainage is adequate	Steep topography	Steep slopes limit construction	Steep slopes limit construction.

TABLE 6.—*Engineering*

Soil series, land types, and map symbols	Soil features affecting—	
	Reservoir areas	Embankments
Sandy and gravelly land (Sf)	Very pervious	Very pervious
Sandy lake beaches (Sfb)	Very pervious	Very pervious; high stability
Saylesville (ShA, ShB2)	Semipervious	Impervious; medium stability
Sebewa (Sm)	Semipervious subsoil; high water table; suitable for dug ponds; substratum very pervious.	Semipervious subsoil has medium stability; pervious substratum.
Sisson (SrB2)	Semipervious	Semipervious; medium stability
Theresa (ThB)	Semipervious	Impervious subsoil has medium stability; underlying material has high stability.
Wasepi (WmA)	Very pervious; poorly drained	Semipervious subsoil; high stability
Wet alluvial land (Ww)	Characteristics variable and onsite investigation needed; permanent high water table; subject to frequent flooding; generally not used for crops.	
Yahara (YhA)	Pervious; in places suitable for dug ponds.	Semipervious; low stability; susceptible to piping; banks very erodible.
Zurich (ZuA, ZuB2)	Semipervious	Semipervious; medium stability

Engineering test data

Soil samples representing eight series in Ozaukee County were taken at representative locations and tested by the State Highway Commission of Wisconsin under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads. These samples were tested in accordance with the standard procedures of AASHO to help evaluate the soils for engineering purposes. The results of these tests and the classification of each soil sample according to both the AASHO and the Unified systems are given in table 3.

The samples tested do not represent the entire range of soil characteristics in Ozaukee County, or even within the soil series sampled. The results of the tests, however, can be used as a general guide in estimating the engineering properties of the soils in the county. Tests made were for moisture density relationships, grain-size distribution, liquid limit, and plasticity index.

In the *moisture density*, or compaction test, a sample of the soil material is compacted several times with a constant compactive effort, each time at a successively higher moisture content. The moisture content increases until the optimum moisture content is reached. After that the density decreases with increase in moisture content. The highest density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in construction, for as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The results of the mechanical analysis, obtained by combined sieve and hydrometer methods, may be used to determine the relative proportions of the different size particles that make up the soil sample. The percentage of fine-grained material, obtained by the hydrometer method, which generally is used by engineers, should not be used in determining textural classes of soils.

The tests to determine liquid limit and plastic limit measure the effect of water on consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the soil material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between liquid limit and plastic limit. It indicates the

interpretations for farm uses—Continued

Soil features affecting—Continued			
Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways
Present drainage is adequate	Variable	Variable	Difficult to establish vegetation.
Drainage impractical because of position in landscape.	Very rapid rate of water intake; low water-holding capacity; position in landscape undesirable.	Not applicable; little or no runoff.	Poor stability; difficult to establish and maintain vegetative cover.
Present drainage is adequate	Slow rate of water intake; high water-holding capacity.	No limiting factor	Subsoil is clayey, and it is difficult to establish a satisfactory seedbed.
Moderate permeability; high water table; gravelly underlying material.	Moderate rate of water intake; medium water-holding capacity; poorly drained.	Not applicable; little or no runoff.	In many places wetness hinders construction.
Present drainage is adequate	Moderate rate of water intake; high water-holding capacity.	Low stability; highly erodible	Slopes; highly erodible.
Present drainage is adequate	Moderate rate of water intake; high water-holding capacity.	In places stones hinder construction.	Slopes; in places stones hinder construction.
Moderately rapid permeability; seasonal high water table.	Rapid rate of water intake; medium water-holding capacity; poorly drained.	Not applicable; little or no runoff.	Hard to establish and maintain vegetative cover.
Characteristics variable and onsite investigation needed; permanent high water table; subject to frequent flooding; generally not used for crops.—Continued			
Moderate permeability; seasonal high water table.	Rapid rate of water intake; high water-holding capacity; somewhat poorly drained.	Not applicable; little or no runoff.	Highly erodible; in places wetness hinders construction.
Present drainage is adequate	Moderate; high water-holding capacity.	Low stability; highly erodible	Slopes; highly erodible.

range in moisture content within which a soil material is in a plastic condition.

Engineering properties

In table 4 the soil series and the map symbols for each are listed and estimates of properties significant in engineering are given. The information is based on test data in table 3 and on test data from similar soils in other counties. Where test data were not available, estimates were based on comparison with soils of like material that have been tested and by study of the soils in the field. Alluvial land, Clayey land, Loamy land, Marsh, Sandy and gravelly land, Sandy lake beaches, and Wet alluvial land are not listed in the table. These land types are too variable in characteristics to be rated or are otherwise not suitable for engineering uses.

The estimates in table 4 are for the soils as they occur in their natural state and are not for disturbed areas that have been altered by cut and fill operations.

The respective USDA, Unified, and AASHO classifications are shown in table 4. Also shown for each of the major soil horizons are the estimated percentages of material passing through the various sieves. The figures showing percentages have been rounded to the nearest 5 percent.

In the column showing permeability, the rate at which water moves through a saturated horizon is estimated. The ratings are given in inches per hour. Permeability is determined largely by texture, structure, and consistence. The rate of permeability for a soil profile generally is determined by the least permeable layer in the profile.

The estimated available water capacity is given in inch per inch of soil for the major soil horizons. Available water capacity refers to the amount of water that can be stored in the soil for the use of plants.

The column showing reaction indicates the estimated acidity or alkalinity of the soils and is expressed as the pH value. A pH value of 7 indicates a neutral soil, a pH value lower than 7 indicates acidity, and a pH value higher than 7 indicates alkalinity. A knowledge of the pH values of soil horizons is helpful in determining the need for liming and for determining the hazard of corrosion for metal conduits and the risk of deterioration of concrete tile.

Shrink-swell potential refers to the change in volume of the soil material that results from a change in moisture content. It is based on tests of volume change or on observance of other physical properties of the soils. The amount and kind of clay and the content of organic matter in the soils affect the shrink-swell potential. Soils in which illite clays are predominant, for example, have a lower shrink-swell ratio than soils, such as the Kewaunee, which contain an appreciable amount of montmorillonite clay.

Engineering interpretations

In tables 5 and 6 engineering interpretations for the soils of the county for nonfarm and farm uses, respectively, are given.

Table 5 gives suitability ratings of the soils as a source of topsoil and sand and gravel and lists features that affect the selection of a site, the design of a structure, or the application of measures to make the soils suitable for construction.

The ratings given the soils in table 5 as a source of topsoil and as a source of sand and gravel are *good*, *fair*, *poor*, and *unsuitable*. They refer specifically to the use of the soil material as a topdressing for the banks of roads and for parks, gardens, and lawns. The ratings are based on texture of the soil and on its content of organic matter.

In table 5 the column showing suitability of the soils as a source of sand and gravel indicates places where sand and gravel is within 5 feet of the surface. Some of the coarse-textured material contains an appreciable amount of finer material. For making determinations about the suitability of such material as a source of sand and gravel, it is necessary to dig individual test pits and to test samples in the laboratory.

The ratings given the soils in table 5 for selection of a residential site, the design of a structure, or the application of measures to make the soils suitable for construction are *slight*, *moderate*, *severe*, and *very severe*. A rating of *slight* means that the soil has no limitations or limitations for a given use are easy to overcome. A rating of *moderate* means that the soil has limitations for a given use that can be overcome by average management and careful design. A rating of *severe* means that the soil has limitations for a given use that are difficult to overcome, and a rating of *very severe*, that the soil has limitations that preclude its use for a given purpose.

Limitations affecting the use of the soils as sites for residential developments are based mainly on the slope, drainage, and texture of the soil, and the depth to bedrock. Steep soils, for example are more susceptible to erosion and land slippage than gently sloping soils. In some places runoff from higher areas, flooding, and a high water table cause flotation of sewage pipes and make installing and maintaining public utilities difficult. In such areas access roads also are difficult to install and maintain and basements are likely to be wet. Shrink-swell potential, susceptibility to liquefaction, and bearing capacity, all of which are important factors in considering a site for residential development, are based mainly on soil texture. Bedrock is a major limitation where the rock is near enough to the surface to impede excavation for public utilities or basements. Ratings for residential developments are made for houses with basements.

Limitations of the soils for onsite sewage disposal systems are determined by the ability of the soil to absorb and dispose of sewage effluent without contaminating the surrounding areas. Soils that have moderate or severe limitations require onsite investigation and appropriate tests are necessary before suitability can be determined.

Other factors that affect the suitability of a soil for disposing of the effluent from septic tanks are the structural stability, the level of the water table, depth of the soil material over a restricting layer, the kind of underlying material, the susceptibility to stream overflow, the slope, and the proximity of the site to wells, streams, and lakes. For a sewage disposal system to work well, the soil permeability should be moderate to rapid and the rate of percolation should be at least 60 minutes per inch.

A water table that rises as high as the subsurface tile forces the sewage effluent upward to the surface of the soil. As a result, an ill-smelling, unwholesome bog forms in the filter field. In most soils a layer of soil material 4 feet thick between the level reached by the seasonal high water table or between the hard rock and the bottom of the trench or filter bed provides adequate depth for filtering and purifying the effluent from the septic tank.

Generally, where slopes are steeper than 10 percent, a filter field is difficult to lay out and construct and a seepage bed is impractical. Where the slopes are very steep, the effluent is likely to flow laterally and seep out on the surface.

Estate type lots may be large enough to install a filter field that is big enough to compensate for slow soil permeability. In soils that are somewhat poorly drained and poorly drained, increased size of the filter field would be of little value. The larger lot, however, allows a wider selection, and possibly, the lot would include a better drained area in which to locate a filter field.

In table 5 the limitations of an undisturbed soil when used for commercial and light industrial developments are primarily for buildings no more than three stories high. The limitations depend mainly on the bearing capacity, shear strength, and shrink-swell potential of the soil substratum. The ratings are for buildings with basements.

Ratings of the limitations of the soils as a source of material to be used as subgrade for roads, railroads, and airports are based on characteristics of the subsoil and underlying material. The ratings are for undisturbed soil without artificial drainage. Some factors considered in the ratings are soil texture, presence and thickness of organic material, depth to bedrock, the amount of stones and boulders present, depth to the water table, and hazard of flooding. Also considered are susceptibility to frost heaving, stability of slopes, bearing capacity of the material, and the need for cut and fill material.

Also shown in table 5 is the corrosion potential of the soils for metal pipes laid underground and for concrete conduits. The corrosion potential of the soils for conduits is closely related to the soil reaction, to drainage, and to electrical conductivity of the soil solution. Most conduits are laid in the upper part of the soil material or in the underlying material. Generally, poor aeration and a high pH value, high rate of electrical conductivity, and a high content of moisture are characteristics of soils that are corrosive to metal conduits. Soils that have a low pH value are the most corrosive to concrete conduits. For either metal or concrete conduits, corrosion takes place rapidly when the content of moisture is high.

Table 6 gives soil features affecting both reservior areas and embankments for the development of farm ponds. It also lists soil features affecting use of the soils for agricultural drainage, irrigation, terraces and diversions, and grassed waterways.

Among the soil features that affect the suitability of the soils for reservoirs and embankments for farm ponds are the height of the water table, permeability, the presence of stones or depth to bedrock, strength and stability of the soil material, shrink-swell potential, and the content of organic matter.Unless otherwise specified, the entire soil profile is considered. The features considered for reservoir areas are for undisturbed soils, and those for embankments are for soil materials that have been disturbed. Controlled compaction of embankments commonly causes increased density and slower permeability. In the embankment column, the terms "subsoil" and "underlying material" refer to soil materials that have been removed from these horizons and placed in the embankments. In both the "reservoir areas" and "embankment" columns *very pervious*, *pervious*, *semipervious*, and *impervious* are used to express water permeability in feet per day as follows:

	Feet per day
Very pervious	More than 20.
Pervious	3 to 20.
Semipervious	0.003 to 3.
Impervious	Less than 0.003.

Agricultural drainage is affected by the rate at which water moves into and through the soil, by the presence of a restricting layer, by the depth to the water table, and by the topographic position. In table 6 both surface and subsurface drainage are considered.

For irrigation, some of the characteristics of the soils that are considered in evaluating the suitability of a soil for irrigation are the depth of the soil, water-holding capacity, permeability, natural drainage, and the rate of intake of water. A strong slope is a less serious limitation for a sprinkler system than for a gravitational system.

Also shown in table 6 are features of the soils that determine suitability for terraces and diversions. Suitability for terraces and diversions are based mainly on the soil material, on the number of stones in the soil, on bedrock near the surface, and on the topography. Where slopes are more than 12 percent, broad base terraces are not suitable. Diversions, however, can be used on these steeper slopes.

Suitability of the soils for grassed waterways is based mainly on the stability, texture, and thickness of the soil material. Also considered are steep slopes and the difficulty of establishing and maintaining a good cover of plants.

Nonfarm Uses of the Soils

This subsection has two parts. The first discusses use of the soils for various kinds of recreation, and the second provides a guide for planting trees, shrubs, and vines for landscaping and for attracting wildlife to the areas.

Ozaukee County is just north of Milwaukee, and its population is increasing rapidly because the suburbs of the city are steadily expanding into areas that formerly were farmed. As a result, the demand for schools, shopping centers, parks, golf courses, and other community developments is increasing. The rapidity with which such developments have expanded has caused many problems. These problems clearly indicate a need for careful planning and for a broad understanding of the economic and esthetic aspects involved when use of the land is changed.

In selecting a site for a home, a highway, or for recreational or industrial purposes, the suitability of the soils in each site for such use must be considered. A knowledge of the characteristics of the soils enables community planners to select soils for specific uses. For example, soils that are submarginal for farming generally can be used as building sites for homes or industries. The more fertile soils therefore can be reserved for farming. On the other hand, soils on flood plains, sloping and steep soils, and soils that are shallow to bedrock or to other restrictive material generally are better suited to recreation than to farming or to use as building sites. Such soils can be used for parks or for other recreational purposes within practical limits. Good examples are the Waubedonia County Park and the Hawthorn Hills County Park.

This survey can help landowners, community planners, and others in planning community developments and in solving problems that arise as use of the land changes. Useful information can be obtained from the soil maps, the text, and the tables in this survey. The detailed soil maps in the back of the survey are useful because they show the location of each of the soils in the county. The colored general soil map that precedes the detailed soil maps shows the pattern of the major soils in the county. All of the soils are discussed in detail in the section "Descriptions of the Soils." Tables in the subsection "Engineering Interpretations" give ratings and limitations of the soils for nonfarm uses and for farm uses.

Use of the soils for recreation

Many areas in Ozaukee County could be developed for recreation (fig. 10). Some of the soil properties that affect the use of the soils for this purpose are texture, permeability, steepness of slope, depth to bedrock, wetness, and the hazards of erosion and flooding. On the basis of these and related soil characteristics, soils having similar properties have been placed in groups and rated for specific recreational purposes. The ratings and soil limitations that influenced the ratings are given in table 7 for each recreation group. These ratings are for the soils as they occur in the landscape. They are general, and onsite investigation is needed for detailed planning and orderly development of recreational facilities. Ratings used are *slight*, *moderate*, *severe*, and *very severe*.

A rating of *slight* means that the soil has no limitation or has limitations for a given use that are easy to overcome; a rating of *moderate* indicates that the soil has limitations for a given use that can be overcome by average management and careful design; a rating of *severe* means that the soil has limitations for a given use that are difficult to overcome; and a rating of *very*

TABLE 7.—*Ratings and limitations of*

Recreation groups and map symbols	Intensive play areas	Extensive play areas
Group 1 (BnA, BoB, CcB2, CcC2, CeB2, CeC2, CrD2, CrE2, FmB, FoA, FoB, LyA, Sf, SrB2, ZuA, ZuB2).	Slight on slopes of 0 to 2 percent, moderate on slopes of 2 to 6 percent, and severe on slopes of 6 to 12 percent: erodible soils; sand and gravel are likely to be exposed if extensive leveling is done.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils.
Group 2 (HeB, HmA, HmB2, HmC2, HmD2, HsA, HsB2, HsC2, HsD2, HsE2, Lu, ThB).	Slight on slopes of 0 to 2 percent, moderate on slopes of 2 to 6 percent, and severe on slopes of 6 to 12 percent: erodible soils.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils.
Group 3 (KnA, KnB, KoB2, KoC2, KrC3, KrD3, OuA, OuB, OuB2, OuC2, OuD2, OuE, OzC3, OzD3, ShA, ShB2).	Moderate: erodible soils; slow permeability; the clayey subsoil is likely to be exposed if extensive leveling is done.	Moderate on slopes of 0 to 12 percent and severe on slopes of 12 to 20 percent: erodible soils; compact readily when wet.
Group 4 (KwA, KwB2, RkB, RkD2)	Slight on slopes of 0 to 2 percent, moderate on slopes of 2 to 6 percent, and severe on slopes of 6 to 20 percent: erodible soils; the underlying bedrock is likely to be exposed if extensive leveling is done.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils; rocky in places; compacts readily when wet.
Group 5 (BmB2, BmD2)	Moderate: soils are droughty and erodible; sand and gravel are likely to be exposed if extensive leveling is done.	Moderate: soils are droughty and erodible.
Group 6 (Am, AzA, Cv, DaA, DcA, DsA, FaA, KyA, MaA, MgA, MkA, MmA, MtA, NnA, RaA, WmA, YhA).	Moderate: seasonal high water table; erodible soils.	Moderate: seasonal high water table; erodible soils.
Group 7 (As, BsA, Cw, Ge, Km, Mzk, Na, Ph, Py, Sm).	Severe: high water table; kinds of vegetation soils can support is limited.	Severe: high water table; drainage needed; kinds of vegetation soils can support is limited.
Group 8 (Ak, Hu, Mzg, Od, Pc, Rw)	Very severe: high water table; low trafficability when wet; sod is easily damaged; erodible soils.	Very severe: high water table; low trafficability when wet; sod is easily damaged; erodible soils.
Group 9 (Mf, Ww)	Very severe: permanent high water table; flooded frequently.	Very severe: flooded frequently; permanent high water table.
Group 10 (Ry, Sfb)	Very severe: consist of loose sand or are very steep; lack vegetative cover.	Very severe: lack vegetative cover; consist of loose sand or are very steep.

the soils for recreational purposes

Paths and trails	Golf fairways	Recreational buildings	Campsites
Slight on slopes of 0 to 12 percent, moderate on slopes of 12 to 20 percent, and severe on slopes of 20 to 35 percent: erodible soils.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils; seepage of effluent is likely to contaminate ground water.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils.
Moderate on slopes of 0 to 12 percent and severe on slopes of 12 to 20 percent: muddy and slippery when wet; erodible soils.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: erodible soils.	Moderate on slopes of 0 to 6 percent and severe on slopes of 6 to 12 percent: surface stays wet and soft after a rain; compacts readily.
Moderate on slopes of 0 to 12 percent and severe on slopes of 12 to 20 percent: muddy and slippery when wet; erodible soils.	Moderate: erodible soils; slow permeability; turf easily damaged when wet.	Severe: slow permeability restricts movement of effluent; high shrink-swell potential; low bearing capacity when wet; erodible soils.	Moderate on slopes of 0 to 6 percent and severe on slopes of 6 to 12 percent: surface remains wet and soft after a rain; compacts readily.
Moderate on slopes of 0 to 12 percent and severe on slopes of 12 to 20 percent: muddy and slippery when wet; erodible soils.	Slight on slopes of 0 to 6 percent, moderate on slopes of 6 to 12 percent, and severe on slopes of 12 to 20 percent: rocky in places.	Severe: in places bedrock near the surface hinders excavation and the installing of sewage disposal systems; seepage of effluent is likely to contaminate ground water.	Moderate on slopes of 0 to 6 percent and severe on slopes of 6 to 12 percent: surface stays wet and soft after a rain; bedrock near the surface restricts use.
Moderate: erodible soils; poor stability; difficult to maintain.	Severe: erodible soils; droughty; difficult to maintain a good turf.	Moderate: soils are erodible and droughty; difficult to vegetate; seepage of effluent is likely to contaminate ground water.	Moderate: soils are erodible and droughty; hard to keep a cover of vegetation on the areas.
Slight: wet for short periods; erodible soils.	Moderate: seasonal high water table; erodible soils.	Very severe: because of the seasonal high water table, sanitary systems will not function; erodible soils.	Moderate: soils stay wet for short periods; erodible soils.
Severe: high water table; wet for long periods; muddy and slippery when wet.	Severe: high water table; turf is easily damaged when wet.	Very severe: because of the high water table, sanitary system will not function; liquefies readily; subject to frost heave.	Severe: soils stay wet and soft for long periods: poor trafficability when wet.
Very severe: high water table; low trafficability; difficult to maintain.	Severe: high water table; turf is easily damaged; low trafficability when wet.	Very severe: high water table; subject to shrinkage; erodible soils.	Very severe: soils stay wet and soft; poor trafficability.
Severe: flooded frequently; permanent high water table.	Severe: flooded frequently; permanent high water table; hard to establish turf.	Very severe: flooded frequently; sanitary systems will not function when the areas are flooded; low bearing capacity.	Very severe: flooded frequently; high water table.
Very severe: lack vegetative cover; consist of loose sand or are very steep.	Very severe: lack vegetative cover; consist of loose sand or are very steep.	Very severe: soil materials are subject to wave action or are very steep.	Very severe: soil materials are subject to wave action or are very steep.

***Figure 10.*—A pond developed in a Mussey soil, where the water table is high, provides varied recreational opportunities.**

severe indicates that the soil has limitations that generally preclude its use for a given purpose.

Not considered in the ratings in table 7 are such factors as nearness to lakes or streams or other esthetic qualities of a specific area, though these may be of prime importance in selecting a site. The ratings also do not apply to severely eroded soils but are for soils that range from not eroded through moderately eroded. In general, limitations for severely eroded soils are more severe than for similar less eroded soils. The degree of limitation is not given for all slopes, and it can be assumed that the next steeper slope range will have a more severe limitation than that given for the last slope range listed.

Only the major limitations are shown for each group. The ratings for the poorly drained soils are for soils in their natural state without adequate drainage. Soils subject to flooding vary considerable in their degree of limitation for recreational use, depending on how long the flood lasts and on the season when flooding occurs. Thus, the limitation is much less restricting if flooding occurs when the site normally is not used for recreation.

In the paragraphs that follow a discussion of selected recreational uses and of specific factors that affect the soils for those uses is given.

Intensive play areas are used for playgrounds and for baseball, football, tennis, and other organized games. The areas are assumed to be larger than 2 acres in size. They are used frequently and must withstand heavy foot traffic. Areas selected for intensive play generally are nearly level, have good drainage, have soil texture and consistence that give a firm surface, and are free of flooding. Also, the soils should be free of coarse fragments and hard rock, and where needed, have good potential for growth of vegetation. Suitability for a domestic sewage disposal system was not considered in the ratings. If such information is needed for an area, refer to the column, "Recreational buildings" in table 7.

Extensive play areas refer to such areas as picnic grounds and parks that are at least 3 acres in size. The requirements are similar to those for intensive play areas. Soils that are most desirable for extensive play areas are nearly level to gently sloping, have good drainage, have soil texture and consistence that give a firm surface, and support good plant cover. They also are free of flooding during the period of use and are free of rock fragments and of outcrops of rock. If service and utility buildings are needed in extensive play areas, refer to the column, "Recreation buildings" in table 7.

Paths and trails are areas used for cross-country hiking, bridle paths, and other nonintensive uses that allow for random movement of people. The areas are assumed to be for use as they occur in nature and need little soil excavation. The most desirable soils for paths and trails provide good footage. They are nearly level to sloping, are well drained, and are loamy in texture. They also have good stability, are not subject to erosion, and are free of rocks, stones, or other coarse fragments. Some soils rated as having severe soil limitations may have a scenic outlook that would make them desirable for paths and trails, but the areas would require much work in preparing and maintaining them for such use. The potential for plant growth was not considered in the ratings, though the plants bordering paths and trails are important. The path or trail itself generally is compacted and devoid of plants.

The ratings of the soils for *golf fairways* refer only to fairways because most golf greens are manmade. The soil material generally is transported to the area and is not influenced by the characteristics of the natural, undisturbed soil. Soils most suitable for golf fairways are well drained and firm. They are free of flooding during the period of use, are gently undulating, have good trafficability, and contain few stones or other coarse fragments. They also should be able to support a good turf and be suitable for growing many kinds of trees and shrubs. Loamy soils are better for golf fairways than other soils, but coarser textured soils are suitable if irrigated. Both mineral and organic soils that are poorly drained have severe limitations for golf fairways but can be used as pond sites to store water for maintaining the turf. Sandy soils can be used as hazards or as a source of sand for the greens.

Recreational buildings are those that are constructed for use as seasonal and year-round cottages, washrooms, bathhouses, picnic shelters, and service buildings. The ratings are for buildings where public sewer and water facilities are not available. Soils most suitable for recreational buildings are nearly level to gently sloping, have good drainage, and free of flooding, and are suitable for septic tank filter fields. They have low shrink-swell potential, have high bearing capacity, and are not subject to liquefaction or to frost heave. Suitable soils, in addition, have little or no erosion hazard, support a good cover of plants, and contain few stones or other coarse fragments. Also, hard bedrock is at a depth of 6 feet or more.

Campsites refer to areas suitable as sites for tents and small camp trailers and the accompanying activities of outdoor living. Such areas are used frequently during the camping season. They ought to require little preparation to be made suitable for unsurfaced parking for cars and camp trailers. The soils in the most suitable sites are nearly level to gently sloping, are well drained and loamy, have good trafficability, and are free of flooding during the period of use. They are not subject to erosion, are free of stones and other coarse fragments, and bedrock is at sufficient depth that it does not restrict use. In addition, the soils are suitable for many kinds of plants and maintaining an adequate cover of plants is easy. Not considered in the ratings are suitability of the soils for use as a filter field. If a sewage system is required, refer to the column "Recreational buildings" in table 7.

Planting guide [4]

The grounds around many homes and other buildings in new residential developments are treeless and lack shrubs or vines or have too many trees, shrubs, and vines for adequate landscaping. Also, many homeowners and farmers take pleasure in improving their surroundings so that wildlife will be attracted to the areas. For these reasons it is necessary to know the kinds of woody plants that can be planted for these purposes and that are also suitable for the soil.

A planting guide for common trees, shrubs, and vines suitable for the soils of Ozaukee County is given in table 8. In this table the soils are grouped according to their natural drainage and their ability to supply moisture for plants. The land types Marsh, Rough broken land, Sandy lake beaches, and Wet alluvial land are not listed in the table because they generally are kept in natural vegetation and new plantings seldom are made. The kinds of trees listed in the table are for use as shade trees; lawn trees; hedges, screens, and windbreaks; and for woodlots and fruit. Kinds of shrubs given are for fruit, landscaping, and wildlife habitat. The kinds of vines listed in the table are for landscaping or for wildlife habitat. Homeowners, farmers, and others can obtain additional planting information from local landscapers, from the county agent, and from bulletins published by the University of Wisconsin.

Formation, Morphology, and Classification of Soils

In this section the factors that affect the formation and the morphology of the soils in Ozaukee County are discussed. Then the current system of soil classification is explained and the soils are placed in higher categories. The soil series in the county, including a profile representative of each series, are described in the section "Descriptions of the Soils."

Formation of Soils

Soil is formed by weathering and other processes that act on the parent material. The characteristics of the soil at any given point are determined by parent material, climate, plants and animals, relief, and time.

Climate and plants and animals are the active forces of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into soil. All five factors come into play in the formation of every soil. The relative importance of each differs from place to place; sometimes one is more

[4] MICHAEL J. DROZD, county agent, helped prepare this section.

TABLE 8.—*Planting guide for*

Planting group and map symbols	Trees for—	
	Shade and lawns	Hedges, screens, and windbreaks
Group 1: Excessively drained and somewhat excessively drained soils (CrD2, CrE2).	Redcedar, black oak, red pine,[1] white pine.	Redcedar, white pine, red pine.[1]
Group 2: Somewhat excessively drained and well-drained soils (BmB2, BmD2, CcB2, CcC2, CeB2, CeC2, LyA, RkB, RkD2, Sf).	Red oak, white oak, redcedar, red maple, paper birch, ironwood, white pine.	Redcedar, white pine
Group 3: Well drained and moderately well drained soils: (BnA, BoB, DsA, FmB, FoA, FoB, HeB, HmA, HmB2, HmC2, HmD2, HsA, HsB2, HsC2, HsD2, HsE2, KnA, KnB, KoB2, KoC2, KrC3, KrD3, KwA, KwB2, Lu, OuA, OuB, OuB2, OuC2, OuD2, OuE, OzC3, OzD3, ShA, ShB2, SrB2, ThB, ZuA, ZuB2).	Sugar maple, red maple, red oak, white oak, white ash, mountain ash, basswood, American beech, blue beech, paper birch, aspen, ironwood, white pine.	Lombardy poplar, white-cedar, redcedar, white pine, white spruce, aspen.
Group 4: Somewhat poorly drained soils that have a water table at a depth below 3 feet except during wet seasons (Am, AzA, Cv, DaA, DcA, FaA, KyA, MaA, MgA, MkA, MmA, MtA, NnA, RaA, WmA, YhA).	Basswood, black ash, white ash, mountain ash, paper birch, red maple, weeping willow, cottonwood, aspen, hemlock, white spruce, black spruce, Norway spruce.	White-cedar, white spruce, Lombardy poplar, aspen.
Group 5: Poorly drained and very poorly drained soils that have a water table at a depth of less than 3 feet for most of the year (As, BsA, Cw, Ge, Km, Mzk, Na, Ph, Py, Sm).[3]	Swamp white oak, balsam poplar, silver maple, red maple, black ash, mountain ash, paper birch, yellow birch, weeping willow, cottonwood, white-cedar, balsam fir, white spruce, Norway spruce, black spruce.	White-cedar, white spruce. Norway spruce.
Group 6: Very poorly drained organic soils (Ak, Hu, Mzg, Od, Pc, Rw).[4]		Willow, cottonwood, or white-cedar can be used for windbreaks in areas that are drained and cropped.

[1] Rodman soils have severe limitations for red pine.
[2] Boyer, Dresden, and Fox soils have severe limitations for walnut.

important and sometimes another. In extreme cases one factor may dominate in the formation of a soil and fix most of its properties. In general, however, it is the combined action of the five factors that determines the present character of each soil.

Parent material

Most of the soils of Ozaukee County were derived from glacial till. In places the till has been reworked by wind or water and redeposited as outwash, as a capping of wind-laid silty material, or as lake-laid material. In addition, the parent material of some of the soils is organic material, and a few areas in the county consist of outcrops of bedrock.

The till in the western part of the county is loamy. It consists of rocky material ground by the glacier, and it contains varying amounts of dolomitic stones, gravel, quartz sand, and silt. Large stones are common on the surface (fig. 11). Soils of the Hochheim series are examples of soils that formed from calcareous loamy till.

In the eastern part of the county, the till is reddish silty clay loam. This material first was deposited as red clay in the basin of Lake Superior. It then was transported from this basin by water. Later the material was reworked by the last advance of glacial ice and mixed with small pebbles and stones. The Manawa and Ozaukee soils are examples of soils formed from this till.

Figure 11.—**Glacial stones picked from fields in the western part of Ozaukee County and piled along a fence.**

The outwash in the county consists of loose sand and gravel that have been transported by rapidly moving *common trees, shrubs and vines*

Trees for—Continued: Woodlots	Trees and shrubs for fruit	Shrubs for landscaping and wildlife habitat	Vines for landscaping and wildlife habitat
White pine, red pine [1]	Severely limited for fruit plantings.	Staghorn sumac, smooth sumac, indigobush, American hazelnut, juniper.	American bittersweet.
White pine, hickory	Use for fruit plantings is questionable.	Smooth sumac, rough-leaved dogwood, indigobush, American hazelnut, staghorn sumac, juniper.	American bittersweet, wild grape.
White ash, black walnut,[2] white pine, white spruce, hickory, bitternut.	Apple, pear, plum, sour cherry, black cherry, raspberry, blackberry, tame grape.	Lilac, highbush cranberry, gray dogwood, rough-leaved dogwood, silky dogwood, American hazelnut, nannyberry, raspberry, blackberry, currant, chokeberry, honeysuckle, wild plum, juniper, yew.	Trumpetcreeper, wild grape, tame grape, trailing raspberry, American bittersweet.
White ash, hemlock, white spruce.	Apple, pear, sour cherry, black cherry, raspberry, blackberry, wild grape.	Highbush cranberry, gray dogwood, silky dogwood, nannyberry, wild plum, wayfaring tree, raspberry, blackberry, red-osier dogwood, yew, juniper.	Trumpetcreeper, wild grape.
Yellow birch, white spruce, white-cedar, Norway spruce, black spruce.	Severely limited for fruit plantings.	Highbush cranberry, gray dogwood, silky dogwood, nannyberry, wayfaring tree, red-osier dogwood.	Severely limited for vine plantings.

[3] If the soil is artificially drained and the water table is at a depth below 3 feet in all except the wet seasons, the plants listed in group 5 can be planted.
[4] If not drained, leave in natural state.

water from melting ice of the glacier. The finer rock particles have been washed away. Most of the stones in the outwash have been made round and smooth by the rapidly moving water. Examples of soils formed from outwash are those of the Casco and Fox series.

Many areas in the county have a capping of wind-laid silty material on them. In such areas the surface layer is silt loam. Soils of the Theresa series are examples of soils that have a capping of wind-laid silty material.

The material laid down in lakes consists of stratified silt, clay, and fine sand that were deposited in slowly moving or stagnant water of temporary lakes. Some of the lakes were formed by ice barriers and others by the digging action of glaciers. The Saylesville and Zurich soils are examples of soils formed in lake-laid material.

Deposits of organic material occur throughout the county. These deposits consist of partly decomposed reeds, sedges, trees, and other organic material. Many of the deposits are deep. Soils of the Adrian and Houghton series are examples of soils that formed in deep deposits of organic material.

Climate

Ozaukee County has a humid-temperate, continental climate that is modified somewhat by the cooling and warming effects of Lake Michigan. As a result, the temperature within 2 or 3 miles of the lake is cooler in summer and warmer in winter than in areas farther back from the lake. The climate otherwise is fairly uniform throughout the county and causes few differences among the soils.

In general, climate affects the environment through the moisture and heat that it contributes. For example, as precipitation increases and the temperature rises, the content of clay in soils tends to increase. In this county the temperature and precipitation are favorable for growth of trees and for development of soils that have a surface layer that is thin or light colored and a subsoil in which clay has accumulated.

Plants and animals

Plants have been the principal biological factor in the formation of soils in this county, but bacteria, fungi, earthworms, insects, and rodents also have been important. Two of the chief functions of plant and animal life are to furnish organic matter and to bring plant nutrients from the lower to the upper horizons. Differences in the amount of organic matter, nitrogen, and plant nutrients in the soils and differences in soil structure and porosity are among those caused by plants and animals.

The most pronounced differences among the soils in the county are caused by vegetation. An example of the influence of vegetation on the characteristics of the soils is the contrast between the dark-colored Lorenzo soils that formed under grass and the lighter colored Casco soils that formed under trees.

Relief

Relief influences the formation of soils by controlling drainage, runoff, and erosion. Differences in relief in Ozaukee County reflect the influence of the underlying material and the work of rain, rivers, and winds on the material throughout long periods of time.

Elevations in the county range from 581 feet above sea level, at Lake Michigan, to about 800 feet above sea level, in Cedarburg Township. The eastern part of Ozaukee County is within the Lake Border moraines. This area, which is on red till, consists of broad, parallel ridges that have gentle side slopes. The ridges run from the north to the south parallel to the shore of Lake Michigan. In the troughs between the ridges are drainageways and low, wet, marshy areas. The general rise of the slope is from the lakeshore to the west, and the eastern slope of the ridge is longer than the western slope. The steepest slopes are between the ridges where erosion has deepened the troughs. Along the lakeshore much of the red till has been washed away and bedrock is exposed. Consequently, the thicl ıess of the till and the height of the bluffs vary.

On the bluffs that extend from the southern boundary of the county to about 6 miles north of Port Washington, red pebbly clay till and assorted, stratified drift that overlie the older loamy till are exposed. Farther north along the lakeshore in eastern Belgium Township, an old sandy lake terrace overlies the red pebbly clay. This area is overgrown with vegetation, and the bluffs are obscured. A faintly developed remnant of an old shoreline is about a mile inland on top of the red clay till. Soils of the Boyer series have formed in this part of the county.

In the northwestern part of the county, the relief is steep and choppy in some places. These areas, which are mainly in Fredonia Township, have a distinct kettle moraine relief that formed between the Lake Michigan and Green Bay glaciers as they moved side by side. Soils of the Rodman series are in these areas.

Two eskers are conspicuous features in the county. One is between Little Kohler, and the other is southeast of the village of Saukville. These eskers are narrow and are about 1 mile long. The one near Saukville is steep and contains sand and gravel.

West of Saukville around the Cedarburg Bog, the relief is rough and pitted. These areas are on outwash, and the pits, or potholes, in them were formed as glacial ice blocks that were buried in the sand and gravel were melted. Casco soils are in these areas.

Along the Milwaukee River and other major streams in the county are gently sloping terraces. These areas consist of outwash sand and gravel that probably was deposited by water flowing from the front of the glacier as it stood on the west ridge of the red clay area. Examples of the soils in this area are those of the Fabius and Mussey series.

Many depressional areas and nearly level basins occur in the county. In these low areas are such organic soils as those of the Adrian and Houghton series.

Time

Time is required by active agents of soil development to form soils from parent material. Some soils form rapidly, and others form slowly. The length of time required for a particular kind of soil to form depends on the other factors involved.

Most of the materials in which the soils of Ozaukee County have formed or are now forming probably were deposited during and after the Wisconsin glaciation. The last of these glaciers moved into the county about 11,000 years ago, and it was probably at this time that the soils began to form.

When soils begin to form, the soil material has characteristics almost identical to those of the parent material and the soils are said to be immature. Among such immature soils are those of the Sebewa series. These soils are along streams, and their parent material has been deposited recently in relation to most parent materials in the county. In these soils little horizon development has taken place, though there may be some layering. Over a long period of time these soils may go through successive stages of immaturity, maturity, and old age.

A soil is said to be mature when it has well-developed horizons and is nearly in equilibrium with its present environment. At that time, the soil-forming factors no longer effect changes in the soil material. Not all soil components, however, mature at the same rate, nor is there a reliable method of determining accurately when a soil is in equilibrium with its environment. Theresa soils are examples of soils in this county that have a well-developed profile. These soils are acid in reaction. Clay from the upper part of the profile has accumulated in the subsoil, and the underlying material contains carbonates leached from the profile.

Morphology of Soils

Soil morphology in Ozaukee County generally is expressed by prominent horizons within the solum. In a few of the soils, however, development is in the early stages and the horizons in the profile are faint or indistinct. For example, well-drained soils that formed in medium-textured or fine-textured material in the uplands generally have distinct horizons. The Kewaunee soils are examples of these. In contrast, the Granby soils, formed from sandy glacial drift, and the Rodman soils, formed from gravelly and cobbly glacial outwash, have faint horizons.

The differentiation of horizons in soils of the county is the result of accumulation of organic matter, the leaching of carbonates and salts, the reduction and transfer of iron, the accumulation of silicate clay minerals, or of more than one of these processes.

In most of the soils, some organic matter has accumulated in the uppermost layers to form an A1 horizon. Much of the organic matter is in the form of humus. The quantity is small in some soils but fairly large in others.

Leaching of carbonates and salts has occurred in nearly all of the soils, though in many the leaching is only to a depth between 10 and 30 inches. The effects of leaching have been indirect, in that the leaching permitted the subsequent translocation of silicate clay minerals in some soils, such as the Hochheim. Carbonates and salts have been carried almost completely out of the profiles of most of the well-drained soils. Some soils, such as the wet Yahara, are not leached enough, however, to permit translocation of minerals. Leaching of wet soils is slow because movement of water through the profile is slow.

In many soils of the county, the accumulation of silicate clay minerals has contributed to the development of horizons. Nearly all of the soils in an advanced stage of development have illuvial horizons in which clay has accumulated. In some soils an accumulation of silicate clay is expressed in illuvial B horizons that contain more total clay than the horizons above or below. Clay films occur in most soils that have blocky structure. The films occur as thin layers in the pores and on the surfaces of peds.

The reduction and transfer of iron has occurred in all of the very poorly drained, poorly drained, and somewhat poorly drained mineral soils of the county. In these naturally wet soils, this process, called gleying, is of importance in the differentiation of horizons. The gray colors in the deeper horizons of wet soils indicate the reduction and loss of iron oxides. In some of the wet soils, iron has been segregated within the deeper horizons to form reddish-brown mottles and concretions.

The C horizon, or underlying material, is relatively little affected by soil-forming processes.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*5*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study (*3*, *7*). Therefore, readers interested in developments of the current system should search the latest literature available. In table 9 the soil series of Ozaukee County are placed in some categories of the current system.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar origin are grouped together. The classes of the current system are briefly defined in the following paragraphs.

ORDERS. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The four orders in Ozaukee County are Alfisols, Histosols, Inceptisols, and Mollisols.

Alfisols formed mostly under trees, but some have formed under grass. They are light colored and have a base saturation of more than 35 percent. The base saturation increases with increasing depth.

Histosols are highly organic, and their classification has not been completed beyond the order.

Inceptisols are mineral soils in which horizons have definitely started to develop. They generally are on young, but not recent, land surfaces.

Mollisols have formed mostly under grass. They have a thick, friable, dark-colored surface layer. Base saturation is more than 50 percent.

SUBORDERS. Each order is subdivided into groups (suborders) that are based mostly on soil characteristics that seem to produce classes having the greatest similarity from the standpoint of their genesis. Suborders narrow the broad climatic range of soils that are in the orders.

Soil characteristics used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences produced through the effects of climate or vegetation. The names of suborders have two syllables, the last syllable of which indicates the order. An example is Udalf (Ud, meaning humid, and alf, from Alfisol).

GREAT GROUPS. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and other features. The horizons used as a basis for distinguishing between great groups are those in which (1) clay, iron, or humus has accumulated; (2) a pan has formed that interferes with growth of roots, movement of water, or both; or (3) a thick, dark-colored surface horizon has formed. The other features commonly used are the self-mulching properties of clay, temperature of the soil, major differences in chemical composition (mainly the bases calcium, magnesium, sodium, and potassium), or the dark-red or dark-brown colors associated with soils formed in material weathered from basic rocks.

Names of the great groups have three or four syllables. They are made by adding a prefix to the name of the suborder. An example is Hapludalf (Hapl, meaning usual; ud, for humid; and alf, from Alfisol). The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

TABLE 9.—*Soil series classified according to the current system of classification* [1]

Series	Family	Subgroup	Order
Adrian	(2)	(2)	Histosols.
Ashkum	Fine, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Aztalan	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Brookston	Fine-loamy, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols.
Casco	Fine-loamy over sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Colwood	Fine-loamy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Darroch	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Dresden	Fine-loamy over sandy-skeletal, mixed, mesic	Mollic Hapludalfs	Alfisols.
Fabius	Fine-loamy over sandy-skeletal, mixed, mesic	Aquic Argiudolls	Mollisols.
Fox	Fine-loamy over sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Granby	Sandy, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Hebron	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Hochheim	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Houghton	(2)	(2)	Histosols.
Keowns	Coarse-loamy, mixed, noncalcareous, mesic	Mollic Haplaquepts	Inceptisols.
Kewaunee	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Knowles	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.
Knowles, mottled subsoil variant.	Fine-silty, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Lorenzo	Fine-loamy over sandy-skeletal, mixed, mesic	Typic Argiudolls	Mollisols.
Manawa	Fine, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Martinton	Fine, illitic, mesic	Aquic Argiudolls	Mollisols.
Matherton	Fine-loamy over sandy-skeletal, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Mequon	Fine, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Muskego	(2)	(2)	Histosols.
Mussey	Fine-loamy over sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Navan	Fine-loamy, mixed, noncalcareous, mesic	Typic Argiaquolls	Mollisols.
Nenno	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Ogden	(2)	(2)	Histosols.
Ozaukee	Fine, mixed, mesic	Typic Hapludalfs	Alfisols.
Palms	(2)	(2)	Histosols.
Pella	Fine-silty, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Poygan	Very fine, mixed, noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Radford	Fine-silty, mixed, nonacid, mesic	Aquic Fluventic Hapludolls	Mollisols.
Ritchey	Loamy, mixed, mesic	Lithic Hapludalfs	Alfisols.
Rodman	Sandy-skeletal, mixed, carbonatic, mesic	Typic Hapludolls	Mollisols.
Rollin	(2)	(2)	Histosols.
Saylesville	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Sebewa	Fine-loamy over sandy-skeletal, mixed, noncalcareous, mesic.	Typic Argiaquolls	Mollisols.
Sisson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Theresa	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Wasepi	Coarse-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Yahara	Coarse-loamy, mixed, mesic	Aquic Hapludolls	Mollisols.
Zurich	Fine-silty, mixed, mesic	Typic Hapludalfs	Alfisols.

[1] Placement of some soil series in the current system of classification, particularly in families, may change as more information becomes available.

[2] Families and subgroups have not been developed for the Histosols order.

SUBGROUPS. Great soil groups are subdivided into subgroups. One of these represents the central, or typic, segment of the group. Other subgroups have properties of the group but have one or more properties of another great group, suborder, or order, and these are called intergrades. Also, subgroups may be established for soils having properties that intergrade outside the range of any other great group, suborder, or order. The names of subgroups are formed by placing one or more adjectives before the name of the great group. An example is Typic Hapludalf.

FAMILIES. Families are separated within a subgroup, primarily on the basis of properties that are important to the growth of plants or to the behavior of soils used for engineering. The main properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. The names of families consist of a series of adjectives that precede the name of a subgroup. The adjectives used are the class names for soil texture, mineralogy, and so on (see table 9). An example is the fine-loamy, mixed, mesic family of Typic Hapludalfs.

SERIES. The series consists of a group of soils that formed from a particular kind of parent material and that have genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

New soil series must be established and concepts of some established series, especially older ones that have been used little in recent years, must be revised in the course of the soil survey program across the country. A proposed new series has tentative status until review of the series concept at State, regional, and national levels of responsibility for soil classification results in a judgment that the new series should be established. Most of the soil series described in this publication have been established earlier. The Aztalan, Hochheim, Keowns, Knowles, Manawa, Mequon, Muskego, Navan, Nenno, Ozaukee, Saylesville, Theresa, Yahara, and Zurich series had tentative status when the survey was sent to the printer.

General Nature of the County

Indians controlled Ozaukee County until the 1830's, when the first permanent settlers came to the area. The county, the smallest in the State, was established in 1853. Its name comes from a Chippewa term meaning, "People of Yellow Earth."

Most of the area was forested at the time of settlement. The remaining acreage consisted of marshes and swamps. The first settlers cleared small areas and farmed them. They burned the timber because there was no demand for it, but later, lumbering became important. During the last half of the nineteenth century many farmers settled in the area. They grew corn, wheat, potatoes and other root crops on the land, for home use, and corn and oats, for the market. Wheat soon became the major crop. Later dairying became the most important enterprise, and remains so, though now industries of various kinds are moving into the county.

The industries are mostly in the cities and villages. Much of the laboring force, however, lives in surrounding farming areas. The main industry is one that makes small outboard gas and electric motors. Others include manufacturers of garden tractors and of plastic and paper containers.

Ozaukee County had a population of 15,682 by 1860. It remained within a thousand or so of this number until about 1940, when 18,985 people were reported in the county. By 1960, the number of people living in the county had increased to 38,441. The increase was partly because of the increase in industries and partly because the county is near Milwaukee, and many people have moved out to suburban areas in Ozaukee County. The city of Mequon, the limits of which touch Milwaukee County, had a population of 8,543 in 1960. In the same year, Port Washington, which is the county seat and is farther north, had a population of 5,984.

Several county, city, and roadside parks are in the county, and other sites are being considered to meet the increasing demand for recreational areas. Most of the present parks are near Lake Michigan or the Milwaukee River and provide areas for golfers, campers, hikers, and others. Private landowners maintain campsites, fish ponds, swimming pools, picnic areas, and other recreational facilities as income producing enterprises. Places of historical interest are the old covered bridge and park in Cedarburg Township and the stone schoolhouse in the township of Fredonia, where Flag Day was established.

Climate[5]

Table 10 gives climatic data representative of Ozaukee County. The data were compiled from records of the U.S. Weather Bureau at Port Washington, in the county, and from those of the Weather Bureau at Germantown, in adjacent Washington County. Port Wash-

[5] MARVIN W. BURLEY, formerly State climatologist for Wisconsin, Weather Bureau, ESSA, U.S. Department of Commerce.

TABLE 10.—*Temperatures and precipitation representative of Ozaukee County, Wis.*

[Average daily maximum and minimum temperatures, degree days, total precipitation, and snowfall or sleet from Germantown, Wis., in Washington County, elevation 880 feet; remaining data from Port Washington, Wis., in Ozaukee County, elevation 600 feet]

Month	Temperature				Average degree days	Precipitation			
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—		Average total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Average snowfall or sleet
	°F.	°F.	°F.	°F.	Number	Inches	Inches	Inches	Inches
January	28.8	11.3	43	−11	1,390	1.12	0.41	3.12	11.2
February	31.9	14.2	45	−7	1,170	.99	.37	2.25	6.3
March	41.4	23.9	61	7	1,000	1.82	1.15	3.67	9.2
April	56.5	35.0	76	22	580	2.87	1.20	4.09	.7
May	67.0	43.4	83	31	320	2.93	1.45	6.01	(1)
June	76.9	53.7	90	42	110	3.86	1.68	6.72	0
July	81.9	58.5	93	49	20	3.19	1.21	6.10	0
August	81.6	58.2	93	48	30	2.93	1.05	6.03	0
September	73.1	49.8	88	37	160	2.60	.59	5.84	0
October	63.4	40.8	79	27	400	1.90	.50	3.92	.1
November	44.8	27.6	63	12	860	2.05	.43	3.37	2.8
December	32.5	16.6	48	−5	1,250	1.31	.65	2.64	6.8
Year	56.7	36.1			7,290	27.57			37.1

[1] Trace.

ington is along Lake Michigan, where the temperature is cooler in summer and warmer in winter than it is away from the lake. The data from Germantown is representative of areas in Ozaukee County away from the lake.

Also given in table 10 are temperatures in terms of degree days (*4*). The number of degree days is the difference between the average temperature for a given day and 65° F. It is a measure of the amount of heat needed to keep the temperature on a specific day at 65°. For example, on a day having an average temperature of 50°, 15 degree days would be counted. A knowledge of accumulated degree days for a stated time is helpful in calculating the amount of fuel needed for heating buildings and for determining the rate of growth and the maturity date of crops.

Ozaukee County has a continental climate, modified somewhat by Lake Michigan. The effects of the lake are most pronounced in spring and early in summer, when the prevailing wind is off the lake. They are least pronounced in winter, when the prevailing wind is westerly. The area also is influenced by the pressure systems that move from Canada across the county from west to east, and that move northeastward across the county from the southwestern states.

Winters in Ozaukee County are long, snowy, and cold. Streams and small lakes generally are frozen from late in November until early in April. The summers are warm and generally include several short periods when the weather is hot and humid. Cool periods are likely to occur any month of the summer. Dew forms on most summer mornings, and it often is heavy. Spring and fall generally are short. Spring is slow in coming. Snowfall decreases, and by the end of March most precipitation falls as rain. Cool, northeast winds blowing off Lake Michigan prevail in spring. Nearly every fall has one or more periods when the days are warm, the skies are cloudless but hazy, and the nights are cool. Temperatures at night in fall generally are somewhat warmer near the lake than farther inland.

Temperatures in the county vary considerably from day to day, from season to season, and also from year to year. The number of days when the temperature has reached 90° or higher has ranged from 30 to zero. The number of days when the temperature was zero or lower has ranged from 40 to less than 5. In one year out of 10, the temperature has been 100° or higher on 1 or more days, and it has been 20° below zero or colder on 1 or more days. In spring and early in summer, the temperature near Lake Michigan frequently drops as much as 15° during the day when the wind shifts from the west to one blowing off the lake.

Annual precipitation generally is adequate for the crops grown. The supply of moisture in July and August generally is low, but a severe drought that damages all crops is rare. About 55 percent of the rainfall normally comes during the months of May through September, when the main crops are grown. About 1 inch of rain is needed each 7 days in summer for good crop growth. The probability of receiving this amount of rain during a 7-day period is greatest early in June and early in August; the chance is that this amount of rain will fall at least as often as 4 years in 10.

The driest part of the growing season is during the last parts of July and August, when much of the harvesting is done. During these periods, in nearly 2 years in 10, the probability is that only a trace or less of moisture will be received during a 7-day period. The number of days when 0.01 inch or more of precipitation falls averages 118. It has ranged from 108 to 128 days in 2 years out of 3. The occurrence of dry days, or days that have less than 0.10 inch of rain is important. For example, in making field-cured hay that is of top quality, 3 or more consecutive dry days are needed. The probability of having 3 such days in a row is about 50 percent in June, and 55 percent in July and August.

The growing season, which is the number of days between the last freezing temperature in spring and the first in fall, averages 146 days. The probabilities of freezing temperatures are shown in table 11. Because of the location of the Weather Bureau Station in Germantown, however, the data are more nearly representative of the western part of the county than of areas near the lake. Near the lake, probable dates for the several minimum temperatures shown in table 11 are about 8 days earlier in spring and 8 days later in fall.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
2 years in 10 later than	March 26	April 3	April 21	May 7	May 22.
4 years in 10 later than	March 18	March 26	April 13	May 1	May 15.
6 years in 10 later than	March 12	March 20	April 7	April 24	May 9.
8 years in 10 later than	March 5	March 12	March 31	April 17	May 2.
Fall:					
2 years in 10 earlier than	November 6	November 1	October 19	October 7	September 24.
4 years in 10 earlier than	November 14	November 8	October 27	October 15	October 2.
6 years in 10 earlier than	November 21	November 14	November 3	October 21	October 8.
8 years in 10 earlier than	November 28	November 22	November 11	October 29	October 15.

TABLE 12.—*Growing-degree-days for specified months*

Month	Base 40°	Base 45°	Base 50°
April	220	130	70
May	470	340	220
June	760	610	460
July	940	780	630
August	930	770	620
September	640	500	350
October	380	260	160
Total	4,340	3,390	2,510

During the growing season, the average number of growing-degree-day units above a base temperature of 40° is 3,670. Above a base temperature of 45°, it is 2,960, and above a base temperature of 50°, it is 2,220. Growing-degree-days are based on the concept that plant growth and insect development begin at the time certain critical temperatures are reached, and that the amount of plant growth or insect development is roughly proportional to the number of accumulated degree days. The number of growing-degree-days is computed by subtracting the daily average temperature from a chosen base. The most common temperature bases used are 40 to 50 degrees. An average temperature of 60 degrees, for example, is 20 growing degrees above a base of 40 degrees, 15 degrees above a base of 45 degrees, and 10 degrees above a base of 50 degrees. On days when the average temperature is the same or lower than the base temperature, the number of growing-degree-days is zero. The growing-degree-days for specified months are given in table 12. The figures are representative of areas in Ozaukee County that are away from Lake Michigan. Near the lake, the growing-degree-days are between two and three hundred less annually.

A knowledge of annual precipitation and of daily amounts of precipitation of 0.5 inch or more is useful in estimating the hazard of erosion. Less intensive rainfall than 0.5 inch a day is not likely to cause gullying. Table 13 gives a summary of the amount of precipitation, lasting for a specified length of time from 30 minutes to 10 days, that can be expected once in the return periods indicated. The data used were for a 24-hour observation period and not for 24 consecutive hours. The amounts therefore are somewhat low. No distinction between rain and snow was made. In this county the number of days that have 0.5 inch or more of precipitation is 19. About 59 percent of the annual precipitation falls at an intensity of 0.5 inch or more.

The total annual snowfall has ranged from only 15 inches to more than 100 inches. The average date of the first snowfall of 1 inch or more is December 1. The chance that 1 inch or more of snow will fall by November 6 is 1 year in 10, and the chance that this amount will fall by December 27, is 9 years in 10. A depth of 1 inch or more of snow can be expected 10 percent of the time in November, 50 percent in December, 70 percent in January, 75 percent in February, 40 percent in March, and 1 percent in April. A depth of 5 inches or more can be expected 1 percent of the time in November, 10 percent in December, 35 percent in January, 40 percent in February, and 20 percent in March. A depth of 10 inches or more can be expected 5 percent of the time in December and March, 10 percent of the time in January, and 15 percent of the time in February.

Freezing of the ground generally begins late in November or early in December and lasts until early in April. If 10 inches or more of snow covers the ground before it has frozen deeply and such cover remains throughout the winter, frost penetrates to a depth of only a few inches regardless of how low the temperature drops. In years when temperatures are low and the ground freezes before the snow comes and the snow cover is light and does not remain on the ground, the soil is likely to freeze to a depth of 36 inches or more.

Thunderstorms occur on an average of 37 days a year. In some years they have occurred as few as 20 days, and in other years as many as 50 days. Severe storms occur most frequently in July, between 2:00 and 7:00 p.m. Hail has fallen on an average of 2 days a year, generally in late afternoon. Damage from hailstones occurs most often in the middle of July. The hail generally occurs locally and lasts for only a few minutes.

TABLE 13.—*Amount of precipitation of stated duration to be expected once in the specified number of years*

Duration	Return period of—						
	1 year	2 years	5 years	10 years	25 years	50 years	100 years
30 minutes	0.9	1.1	1.3	1.5	1.7	1.9	2.2
1 hour	1.2	1.4	1.7	1.9	2.2	2.4	2.7
2 hours	1.4	1.6	2.0	2.3	2.6	2.8	3.2
3 hours	1.5	1.7	2.2	2.4	2.8	3.1	3.5
6 hours	1.8	2.0	2.5	2.9	3.4	3.8	4.0
12 hours	2.0	2.4	3.0	3.4	3.9	4.3	4.9
24 hours	2.3	2.6	3.3	3.9	4.5	5.0	5.5
2 days	----------	3.0	4.0	4.5	5.2	6.0	6.4
4 days	----------	3.6	4.7	5.2	6.3	6.9	7.8
7 days	----------	4.0	5.2	6.0	7.0	7.9	8.8
10 days	----------	4.5	5.9	6.7	8.0	9.0	9.8

Prevailing winds are from the northwest from November through March, from the northeast from April through June, and from the southwest from July through October. The strongest winds blow in March, April, and November when the windspeed averages 14 miles per hour. The months of June and July are the least windy. During these months the average windspeed is 10 miles per hour. At some time in about 50 percent of the years, windspeeds, other than gusts, can be expected to reach 55 miles per hour at about 30 feet above the ground and 45 miles per hour at about 10 feet. About once in 50 years, windspeeds can be expected to reach 100 miles per hour at about 30 feet above the ground and 85 miles per hour at about 10 feet. Because of surface friction, windspeed at plant height will be considerably less than that at either 30 or 10 feet.

About 40 percent of the possible amount of sunshine is received in the months of November through February, between 50 and 60 percent, from March through May and in October, and 60 percent or more from June through September. Only in July is more than 70 percent of possible sunshine received.

Relative humidity generally varies from hour to hour, day to day, and season to season. It is highest near daybreak and lowest early in the afternoon.

Annual evaporation from lakes is nearly 28 inches. About 77 percent of the evaporation each year occurs from May through October.

Drainage

Drainage in Ozaukee County is provided mainly by the Milwaukee River and by smaller streams, all of which eventually flow into Lake Michigan. These streams all are young, geologically, and were established after the Wisconsin glaciation. As a result, the drainage system is imperfect, and many marshes and small lakes are scattered throughout the county. The Cedarburg Bog, in Saukville Township, is the largest marsh in the county. It once was a lake, which was held in its shallow basin by moraine deposits. Most of the present streams in the county flow over glacial drift that is many feet thick. Some of the streams, however, have cut through the drift and flow over bedrock.

The general slope of the county is eastward to Lake Michigan. Most of the streams, however, parallel the lakeshore because the valleys and ridges in the county generally are parallel to the lake. An example is the course of the Milwaukee River. This river rises to the north of Ozaukee County and enters the county west of Fredonia. Near Fredonia, about 9 miles from the lake, the river bends to the right and flows southward for almost 30 miles. Not until it reaches the valley of the Menomonee River, at Milwaukee, can the river enter Lake Michigan, even though it flows only 1 mile from the lake in the southern part of the county. Other streams that drain the county are Sauk Creek, which flows into Lake Michigan at Port Washington, and Sucker Creek, which enters the lake about 3 miles farther north. Also draining the county are Cedar, Ulao, and Pigeon Creeks, which are tributaries of the Milwaukee River.

Vegetation

Forests originally covered about 94 percent of the land area of Ozaukee County. The remainder was in swamps and marshes, and these were mainly in the area now comprising Cedarburg, Fredonia, and Saukville Townships.

The original forests consisted mainly of maple, beech, basswood, and hemlock. They included some walnut, however, and a few scattered pines. Early logging removed nearly all of the merchantable timber, and only about 11 percent of the county is now wooded. The present woodland consists mainly of lowland hardwoods. These wooded areas add to the esthetic and recreational values of the county and also provide shelter and food for wildlife.

In the swamps of the county, the vegetation was mainly black ash, elm, cedar, tamarack, and other trees that could tolerate wetness. Grasses, sedges, cattails, and similar plants grew in the marsh openings. Many bogs and marshes still remain in the county. The largest is the Cedarburg Bog, in Saukville Township.

Farming

Farming, based on dairying, is the most important enterprise in Ozaukee County. Milk, sold mostly as whole milk, accounts for much of the farm income.

In 1964, according to the U.S. Census of Agriculture, the total land in farms was 108,205 acres. Of this, 66 percent, or 71,281 acres, was cropland, and about 9 percent, or 9,345 acres, was wooded. Only 3,779 acres was used solely for pasture, but 4,018 acres of woodland was grazed, and 8,957 acres of cropland was being used as pasture. Thus the total area pastured amounted to 16,754 acres.

The number of farms in the county in 1964 was 871, and the average size of the farms was 124.2 acres. Most of the farms, or 522, were operated by owners; 259 farms were operated by part owners; 86, by tenants; and only 4 by managers. Cash tenants, which are increasing in the county, were the most common. They were mostly owners who farm part of the time and also work in the cities and villages.

Dairy cattle are the chief livestock in the county, though the number of milk cows decreased somewhat in recent years. Total milk production, however, has increased because of selective breeding and improvements in feeding. The number of beef cattle and of hogs and sheep have increased somewhat. Chickens, however, have declined sharply in number. The numbers of livestock on farms in the county in 1964 were as follows:

	Number
All cattle	26,711
Milk cows	13,778
Hogs	9,121
Sheep	770
Chickens	65,635

The climate and the soils in Ozaukee County are favorable for grain crops and hay, which occupy the largest acreage in crops. These crops are mostly fed on the farms to the dairy cattle or to other kinds of livestock. Because of the increasing use of farmland for nonfarm purposes, and resulting increase in land values, cash crops are becoming increasingly important. The acreage of the main crops grown in 1964 follows:

	Acres
Corn	17,571
Oats	17,424
Alfalfa hay	23,896
Clover-timothy hay	1,899

More than half of the corn crop is harvested for grain. Most of the rest is cut for silage.

The acreage in hay has varied little in the last 10 years. Alfalfa and bromegrass make up about 90 percent of the tame hay grown. Clover, timothy, and mixtures of clover and grasses make up the balance.

The acreage in oats has been decreasing, but it remains the principal small grain crop grown. Wheat, barley, buckwheat, rye, and soybeans were grown on small acreages in 1964. The small grains were mostly fed to the livestock.

Vegetables were grown for cash on 3,522 acres in 1964. Of these, sweet corn, green peas, and snap beans occupied the largest acreages. The sweet corn and green peas were grown mainly for canning. Beets, tomatoes, cabbage, cucumbers, and other vegetables also were grown for the market on some of the farms. More than 3½ million pounds of apples were harvested from 17,731 trees in 1964.

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Glossary

Acidity. See Reaction.

Alluvium. Soil or rock material, such as gravel, sand, silt, or clay, deposited by a stream.

Available moisture capacity. The difference between the amount of water in a soil at field capacity and the amount in the same soil at the permanent wilting point. Commonly expressed as inches of water per inch depth of soil.

Blinding. The practice of placing permeable material, such as sawdust, woodchips, or coarse aggregate, around newly installed drainage tile to filter out sand, silt, and clay but allow water to enter the tile freely.

Bottom land. Nearly level land on the bottom of a valley that has a stream flowing through it. Subject to flooding and often referred to as a flood plain.

Calcareous. A soil that contains enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) when treated with cold, dilute hydrochloric acid.

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.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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; will 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.

Contour stripcropping. Growing crops in strips that follow the contour or that are parallel to terraces or diversions; strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Diversion. A broad-bottomed ditch that serves to divert runoff water so that it will flow around the slope to a safe outlet.

Dolomite. A calcium-magnesium carbonate mineral. Limestone that contains magnesium carbonate is commonly called dolomitic limestone.

Drainage, natural. Refers to the conditions that existed during the development of the soil, 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 different classes of natural drainage are recognized.

Excessively drained soils commonly are very porous and rapidly permeable and have low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and commonly have a texture intermediate between that of coarse-textured soils and fine-textured soils.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time; the water table is within 12 to 24 inches of the surface for part of the year; and in some of the soils mottles are below a depth of 6 to 16 inches in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally are mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind, moving water, or ice and by such processes as landslides and creep.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active, and it is therefore marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A horizon to the underlying C horizon. The B horizon also has (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. The combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. This layer, commonly called the soil parent material is presumed to be like that from which the overlying horizons were formed in most soils. If the underlying material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath the A or B horizon.

Humus. The well-decomposed, more or less stable, dark-colored part of the organic matter in mineral soils.

Massive. Large uniform masses of cohesive soil, in some places with ill-defined and irregular breakage, as in some of the fine-textured alluvial soils; structureless.

Mottled. Irregularly marked with different colors that vary in number and size. Mottling in soils generally indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* or *many;* size—*fine, medium,* or *coarse;* contrast—*faint, distinct,* or *prominent.*

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Neutral, soil. See Reaction, soil.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Ped. An individual natural soil aggregate, such as a crumb, prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a soil that enables it to transmit air and water. The following relative classes of soil permeability refer to estimated rates of movement of water in inches per hour through saturated undisturbed cores under a one-half inch head of water:

	Inches per hour
Very slow	Less than 0.05
Slow	0.05 to 0.20
Moderately slow	0.20 to 0.80
Moderate	0.80 to 2.50
Moderately rapid	2.50 to 5.00
Rapid	5.00 to 10.00
Very rapid	10 or more.

Profile, soil. A vertical section of a soil through all its horizons and extending into the parent material. See also Horizon, soil.

Reaction. The degree of acidity or alkalinity of soil expressed in pH values or in words as follows:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6–7.3
Very strongly acid	4.5–5.0	Mildly alkaline	7.4–7.8
Strongly acid	5.1–5.5	Moderately alkaline.	7.9–8.4
Medium acid	5.6–6.0	Strongly alkaline	8.5–9.0
Slightly acid	6.1–6.5	Very strongly alkaline.	9.1 and higher.

Relief. The elevations and inequalities of the land surface, considered collectively.

Sand. Individual fragments of rocks and minerals that have diameters ranging from 0.05 millimeter (0.002 inch) to 2.0 millimeters (0.079 inch). Most sand grains consist of quartz, but they may be of any mineral composition. The term sand also is applied to a soil that contains 85 percent or more of sand and not more than 10 percent of clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material as conditioned by relief over periods of time.

Solum, soil. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons.

Structure, soil. The arrangement of primary soil particles into lumps, granules, or other aggregates. Structure is described by grade (weak, moderate, or strong) that is, the distinctness and durability of the aggregates; by the size of the aggregates (very fine, fine, medium, coarse, or very coarse); and their shape (platy, prismatic, columnar, blocky, granular, or crumb). A soil is described as structureless if there are no observable aggregates. Structureless soils may be massive (coherent) or single grain (noncoherent).

Blocky, angular.—Aggregates are block shaped; they may have flat or rounded surfaces that join at sharp angles.

Blocky, subangular.—Aggregates have some rounded and some plane surfaces; vertices are rounded.

Columnar.—Aggregates are prismatic and are rounded at the upper ends.

Crumb.—Generally soft, small, porous aggregates, irregular, but tending toward a spherical shape.

Granular.—Roughly spherical, firm, small aggregates that may be either hard or soft but that generally are firmer than crumb and lack the distinct faces of blocky structure.

Platy.—Soil particles are arranged around a plane that is generally horizontal.

Prismatic.—Soil particles are arranged around a vertical line; aggregates have flat, vertical faces.

Subsidence. Depression or lowering of the surface of a soil as the result of oxidation, drying, or compaction.

Subsoil. The B horizon of soils with distinct profiles. Generally, that portion of the profile that is between the plow layer and the unweathered layers below.

Substratum. Any layer beneath the solum, either conforming (C or R) or unconforming.

Surface, soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil.

Terrace, stream. An area that is fairly level and formerly was the flood plain of a stream but now lies above the present flood plain; the area is underlain by stratified stream sediments.

Terracing. Construction of shallow, nearly level ditches that have broad slopes suitable for farming; used for controlling runoff water on sloping land.

Texture. The relative proportion of sand, silt, and clay particles in a soil. The basic textural classes in increasing proportions of fine particles are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of a soil or seedbed in relation to the growth of plants, especially soil structure.

Upland. Land that lies above the stream terraces and that is underlain by bedrock at fairly shallow depths; generally, all areas that are not on terraces or bottom land.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. The physical and chemical disintegration and decomposition of rocks and minerals. Soil is the result of weathering and other chemical, physical, and biological alterations that have changed the upper part of the earth's crust through various periods of time.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Predicted yields, table 2, p. 46.
Engineering uses of the soils, tables, 3, 4, 5, and 6, pp. 50 through 75.
Recreation groups, table 7, p. 78.
Planting groups, table 8, p. 82.

Map symbol	Mapping unit	Described on page	Capability unit	
			Symbol	Page
Ak	Adrian mucky peat	8	IVw-7	45
Am	Alluvial land	8	IIw-13	42
As	Ashkum silt loam	9	IIw-1	41
AzA	Aztalan loam, 1 to 3 percent slopes	9	IIw-2	41
BmB2	Boyer loamy sand, 1 to 6 percent slopes, eroded	10	IVs-3	45
BmD2	Boyer loamy sand, 6 to 20 percent slopes, eroded	10	IVe-9	44
BnA	Boyer sandy loam, 0 to 3 percent slopes	10	IIIs-2	44
BoB	Boyer sandy loam, loamy substratum, 1 to 6 percent slopes	10	IIIe-4	43
BsA	Brookston silt loam, 0 to 3 percent slopes	11	IIw-1	41
CcB2	Casco sandy loam, 1 to 6 percent slopes, eroded	12	IIIe-4	43
CcC2	Casco sandy loam, 6 to 12 percent slopes, eroded	12	IVe-4	44
CeB2	Casco loam, 2 to 6 percent slopes, eroded	12	IIIe-4	43
CeC2	Casco loam, 6 to 12 percent slopes, eroded	12	IVe-4	44
CrD2	Casco-Rodman complex, 12 to 20 percent slopes, eroded	12	VIe-4	45
CrE2	Casco-Rodman complex, 20 to 35 percent slopes, eroded	12	VIIe-4	46
Cv	Clayey land	12	VIIIs-10	46
Cw	Colwood silt loam	13	IIIw-3	43
DaA	Darroch fine sandy loam, neutral variant, 0 to 3 percent slopes	14	IIIw-3	43
DcA	Darroch silt loam, neutral variant, 0 to 3 percent slopes	14	IIIw-3	43
DsA	Dresden silt loam, 1 to 3 percent slopes	15	IIs-1	43
FaA	Fabius loam, 1 to 3 percent slopes	15	IIw-5	41
FmB	Fox sandy loam, 1 to 6 percent slopes	16	IIIe-4	43
FoA	Fox loam, 0 to 2 percent slopes	16	IIs-1	43
FoB	Fox loam, 2 to 6 percent slopes	16	IIe-2	41
Ge	Granby loamy sand, loamy substratum	16	IVw-5	44
HeB	Hebron loam, 1 to 6 percent slopes	17	IIe-6	41
HmA	Hochheim loam, 0 to 2 percent slopes	17	I-1	40
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	17	IIe-1	41
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	17	IIIe-1	43
HmD2	Hochheim loam, 12 to 20 percent slopes, eroded	18	IVe-1	44
HsA	Hochheim-Sisson-Casco complex, 0 to 2 percent slopes	18	I-1	40
HsB2	Hochheim-Sisson-Casco complex, 2 to 6 percent slopes, eroded	18	IIe-1	41
HsC2	Hochheim-Sisson-Casco complex, 6 to 12 percent slopes, eroded	18	IIIe-1	43
HsD2	Hochheim-Sisson-Casco complex, 12 to 20 percent slopes, eroded	19	IVe-1	44
HsE2	Hochheim-Sisson-Casco complex, 20 to 35 percent slopes, eroded	19	VIe-1	45
Hu	Houghton mucky peat	19	IIIw-9	44
Km	Keowns silt loam	20	IIIw-3	43
KnA	Kewaunee silt loam, 0 to 2 percent slopes	20	IIs-7	43
KnB	Kewaunee silt loam, 2 to 6 percent slopes	20	IIe-6	41
KoB2	Kewaunee silty clay loam, 2 to 6 percent slopes, eroded	21	IIe-6	41
KoC2	Kewaunee silty clay loam, 6 to 12 percent slopes, eroded	21	IIIe-6	43
KrC3	Kewaunee silty clay, 6 to 12 percent slopes, severely eroded	21	IVe-6	44
KrD3	Kewaunee silty clay, 12 to 20 percent slopes, severely eroded	21	VIe-6	45
KwA	Knowles silt loam, 0 to 2 percent slopes	22	IIs-1	43
KwB2	Knowles silt loam, 2 to 6 percent slopes, eroded	22	IIe-2	41
KyA	Knowles silt loam, mottled subsoil variant, 0 to 2 percent slopes	22	IIw-5	41
Lu	Loamy land	22	VIIIs-10	46
LyA	Lorenzo loam, 1 to 3 percent slopes	23	IIIs-2	44
MaA	Manawa silt loam, 1 to 3 percent slopes	23	IIw-2	41
Mf	Marsh	24	VIIIw-15	46
MgA	Martinton silt loam, 1 to 3 percent slopes	24	IIw-2	41
MkA	Matherton loam, 0 to 2 percent slopes	25	IIw-5	41
MmA	Matherton silt loam, 1 to 3 percent slopes	25	IIw-5	41
MtA	Mequon silt loam, 1 to 3 percent slopes	26	IIw-2	41
Mzg	Muskego muck	26	IIIw-9	44
Mzk	Mussey loam	27	IIw-5	41
Na	Navan silt loam	27	IIw-1	41
NnA	Nenno silt loam, 1 to 3 percent slopes	28	IIw-2	41
Od	Ogden mucky peat	28	IIIw-9	44
OuA	Ozaukee silt loam, 0 to 2 percent slopes	29	IIs-7	43
OuB	Ozaukee silt loam, 2 to 6 percent slopes	29	IIe-6	41
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	29	IIe-6	41
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	29	IIIe-6	43
OuD2	Ozaukee silt loam, 12 to 20 percent slopes, eroded	29	IVe-6	44
OuE	Ozaukee silt loam, 20 to 30 percent slopes	29	VIe-6	45
OzC3	Ozaukee clay loam, 6 to 12 percent slopes, severely eroded	29	IVe-6	44
OzD3	Ozaukee clay loam, 12 to 20 percent slopes, severely eroded	30	VIe-6	45
Pc	Palms mucky peat	30	IIw-8	42
Ph	Pella silt loam	31	IIw-1	41
Py	Poygan silty clay loam	31	IIw-1	41
RaA	Radford silt loam, 0 to 3 percent slopes	32	IIw-2	41
RkB	Ritchey silt loam, 0 to 6 percent slopes	32	IIIe-4	43
RkD2	Ritchey silt loam, 6 to 20 percent slopes, eroded	32	VIe-4	45
Rw	Rollin mucky peat	33	IVw-7	45
Ry	Rough broken land	33	VIIIs-10	46
Sf	Sandy and gravelly land	34	VIIIs-10	46
Sfb	Sandy lake beaches	34	VIIIs-10	46
ShA	Saylesville silt loam, 0 to 2 percent slopes	34	IIs-7	43
ShB2	Saylesville silt loam, 2 to 6 percent slopes, eroded	34	IIe-6	41
Sm	Sebewa silt loam	35	IIw-5	41
SrB2	Sisson fine sandy loam, 1 to 6 percent slopes, eroded	35	IIe-1	41
ThB	Theresa silt loam, 2 to 6 percent slopes	36	IIe-1	41
WmA	Wasepi sandy loam, 1 to 3 percent slopes	37	IIw-5	41
Ww	Wet alluvial land	37	Vw-14	45
YhA	Yahara very fine sandy loam, 1 to 3 percent slopes	37	IIIw-3	43
ZuA	Zurich silt loam, 0 to 2 percent slopes	38	I-1	40
ZuB2	Zurich silt loam, 2 to 6 percent slopes	38	IIe-1	41

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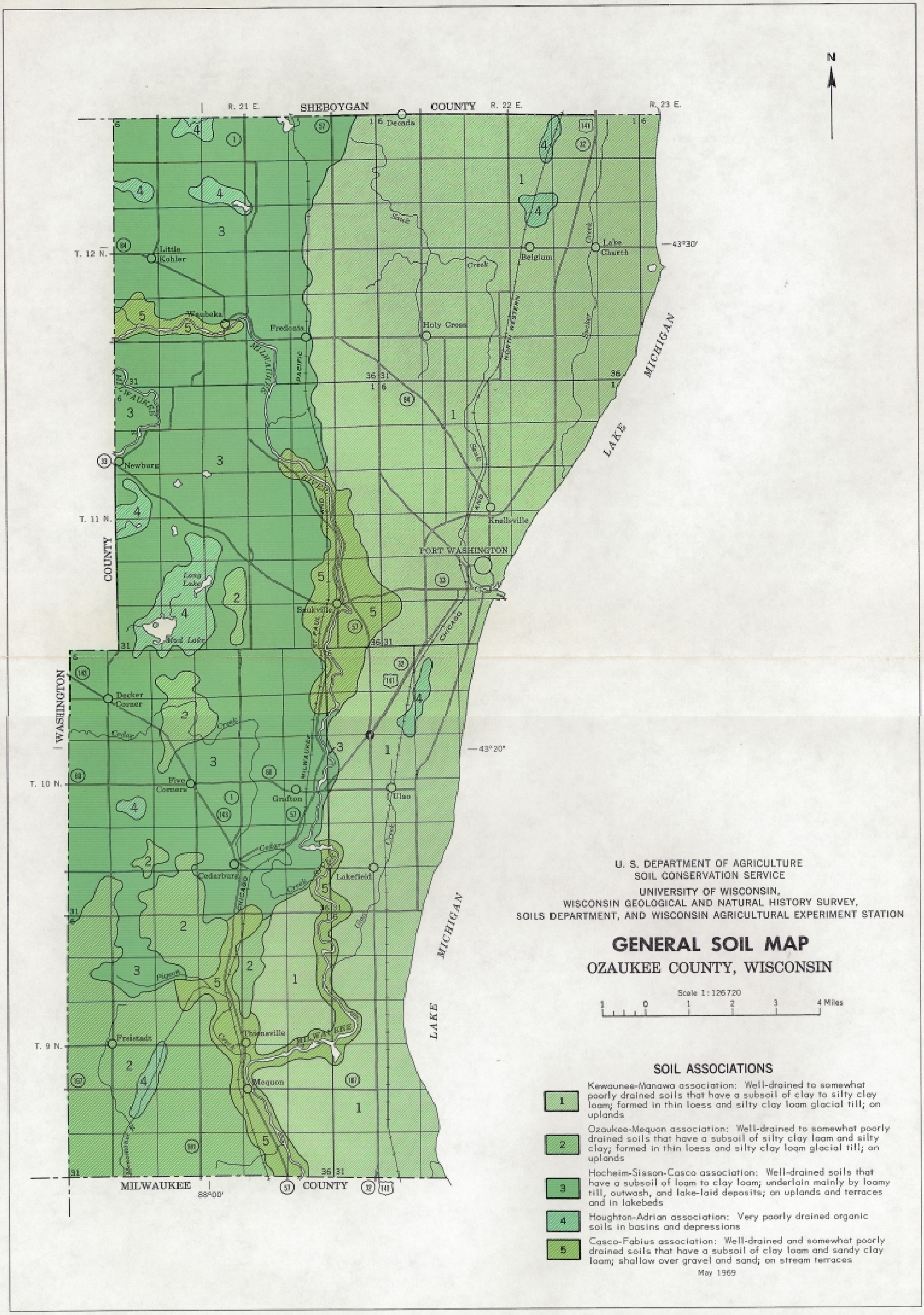
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF WISCONSIN,
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY,
SOILS DEPARTMENT, AND WISCONSIN AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
OZAUKEE COUNTY, WISCONSIN
Scale 1:126720
1 0 1 2 3 4 Miles
SOIL ASSOCIATIONS
1 Kewaunee-Manawa association: Well-drained to somewhat poorly drained soils that have a subsoil of clay to silty clay loam; formed in thin loess and silty clay loam glacial till; on uplands
2 Ozaukee-Mequon association: Well-drained to somewhat poorly drained soils that have a subsoil of silty clay loam and silty clay; formed in thin loess and silty clay loam glacial till; on uplands
3 Hochheim-Sisson-Casco association: Well-drained soils that have a subsoil of loam to clay loam; underlain mainly by loamy till, outwash, and lake-laid deposits; on uplands and terraces and in lakebeds
4 Houghton-Adrian association: Very poorly drained organic soils in basins and depressions
5 Casco-Fabius association: Well-drained and somewhat poorly drained soils that have a subsoil of clay loam and sandy clay loam; shallow over gravel and sand; on stream terraces
May 1969
N
SHEBOYGAN COUNTY
R. 21 E.
R. 22 E.
R. 23 E.
T. 12 N.
T. 11 N.
T. 10 N.
T. 9 N.
WASHINGTON COUNTY
MILWAUKEE COUNTY
LAKE MICHIGAN
43°30′
43°20′
88°00′
Decade
Little Kohler
Belgium
Lake Church
Waubeka
Fredonia
Holy Cross
Newburg
Knellsville
PORT WASHINGTON
Long Lake
Mud Lake
Saukville
Decker Corner
Five Corners
Grafton
Ulao
Cedarburg
Lakefield
Freistadt
Thiensville
Mequon
MILWAUKEE RIVER
Cedar Creek
Sauk Creek
Pigeon Creek
CHICAGO AND NORTH WESTERN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OZAUKEE COUNTY, WISCONSIN

UNIVERSITY OF WISCONSIN
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, SOILS DEPARTMENT
WISCONSIN AGRICULTURAL EXPERIMENT STATION

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils or land types, but some are for soils or land types that have a considerable range in slope. The final number, 2 or 3, in a symbol indicates that the soil is eroded or severely eroded.

SYMBOL	NAME
Ak	Adrian mucky peat
Am	Alluvial land
As	Ashkum silt loam
AzA	Aztalan loam, 1 to 3 percent slopes
BmB2	Boyer loamy sand, 1 to 6 percent slopes, eroded
BmD2	Boyer loamy sand, 6 to 20 percent slopes, eroded
BnA	Boyer sandy loam, 0 to 3 percent slopes
BoB	Boyer sandy loam, loamy substratum, 1 to 6 percent slopes
BsA	Brookston silt loam, 0 to 3 percent slopes
CcB2	Casco sandy loam, 1 to 6 percent slopes, eroded
CcC2	Casco sandy loam, 6 to 12 percent slopes, eroded
CeB2	Casco loam, 2 to 6 percent slopes, eroded
CeC2	Casco loam, 6 to 12 percent slopes, eroded
CrD2	Casco-Rodman complex, 12 to 20 percent slopes, eroded
CrE2	Casco-Rodman complex, 20 to 35 percent slopes, eroded
Cv	Clayey land
Cw	Colwood silt loam
DaA	Darroch fine sandy loam, neutral variant, 0 to 3 percent slopes
DcA	Darroch silt loam, neutral variant, 0 to 3 percent slopes
DsA	Dresden silt loam, 1 to 3 percent slopes
FaA	Fabius loam, 1 to 3 percent slopes
FmB	Fox sandy loam, 1 to 6 percent slopes
FoA	Fox loam, 0 to 2 percent slopes
FoB	Fox loam, 2 to 6 percent slopes
Ge	Granby loamy sand, loamy substratum
HeB	Hebron loam, 1 to 6 percent slopes
HmA	Hochheim loam, 0 to 2 percent slopes
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded
HmD2	Hochheim loam, 12 to 20 percent slopes, eroded
HsA	Hochheim-Sisson-Casco complex, 0 to 2 percent slopes
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HsC2	Hochheim-Sisson-Casco complex, 6 to 12 percent slopes, eroded
HsD2	Hochheim-Sisson-Casco complex, 12 to 20 percent slopes, eroded
HsE2	Hochheim-Sisson-Casco complex, 20 to 35 percent slopes, eroded
Hu	Houghton mucky peat
Km	Keowns silt loam
KnA	Kewaunee silt loam, 0 to 2 percent slopes
KnB	Kewaunee silt loam, 2 to 6 percent slopes
KoB2	Kewaunee silty clay loam, 2 to 6 percent slopes, eroded
KoC2	Kewaunee silty clay loam, 6 to 12 percent slopes, eroded
KrC3	Kewaunee silty clay, 6 to 12 percent slopes, severely eroded
KrD3	Kewaunee silty clay, 12 to 20 percent slopes, severely eroded
KwA	Knowles silt loam, 0 to 2 percent slopes
KwB2	Knowles silt loam, 2 to 6 percent slopes, eroded
KyA	Knowles silt loam, mottled subsoil variant, 0 to 2 percent slopes
Lu	Loamy land
LyA	Lorenzo loam, 1 to 3 percent slopes
MaA	Manawa silt loam, 1 to 3 percent slopes
Mf	Marsh
MgA	Martinton silt loam, 1 to 3 percent slopes
MkA	Matherton loam, 0 to 2 percent slopes
MmA	Matherton silt loam, 1 to 3 percent slopes
MtA	Mequon silt loam, 1 to 3 percent slopes
Mzg	Muskego muck
Mzk	Mussey loam
Na	Navan silt loam
NnA	Nenno silt loam, 1 to 3 percent slopes
Od	Ogden mucky peat
OuA	Ozaukee silt loam, 0 to 2 percent slopes
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OzC3	Ozaukee clay loam, 6 to 12 percent slopes, severely eroded
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Pc	Palms mucky peat
Ph	Pella silt loam
Py	Poygan silty clay loam
RaA	Radford silt loam, 0 to 3 percent slopes
RkB	Ritchey silt loam, 0 to 6 percent slopes
RkD2	Ritchey silt loam, 6 to 20 percent slopes, eroded
Rw	Rollin mucky peat
Ry	Rough broken land
Sf	Sandy and gravelly land
Sfb	Sandy lake beaches
ShA	Saylesville silt loam, 0 to 2 percent slopes
ShB2	Saylesville silt loam, 2 to 6 percent slopes, eroded
Sm	Sebewa silt loam
SrB2	Sisson fine sandy loam, 1 to 6 percent slopes, eroded
ThB	Theresa silt loam, 2 to 6 percent slopes
WmA	Wasepi sandy loam, 1 to 3 percent slopes
Ww	Wet alluvial land
YhA	Yahara very fine sandy loam, 1 to 3 percent slopes
ZuA	Zurich silt loam, 0 to 2 percent slopes
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CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

- National or state
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- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
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- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony; Very stony
- Rock outcrops
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- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

Soil map constructed 1969 by Cartographic Division, Soil Conservation Service, USDA, from 1963 aerial photographs. Controlled mosaic based on Wisconsin plane coordinate system, south zone, Lambert conformal conic projection, 1927 North American datum.

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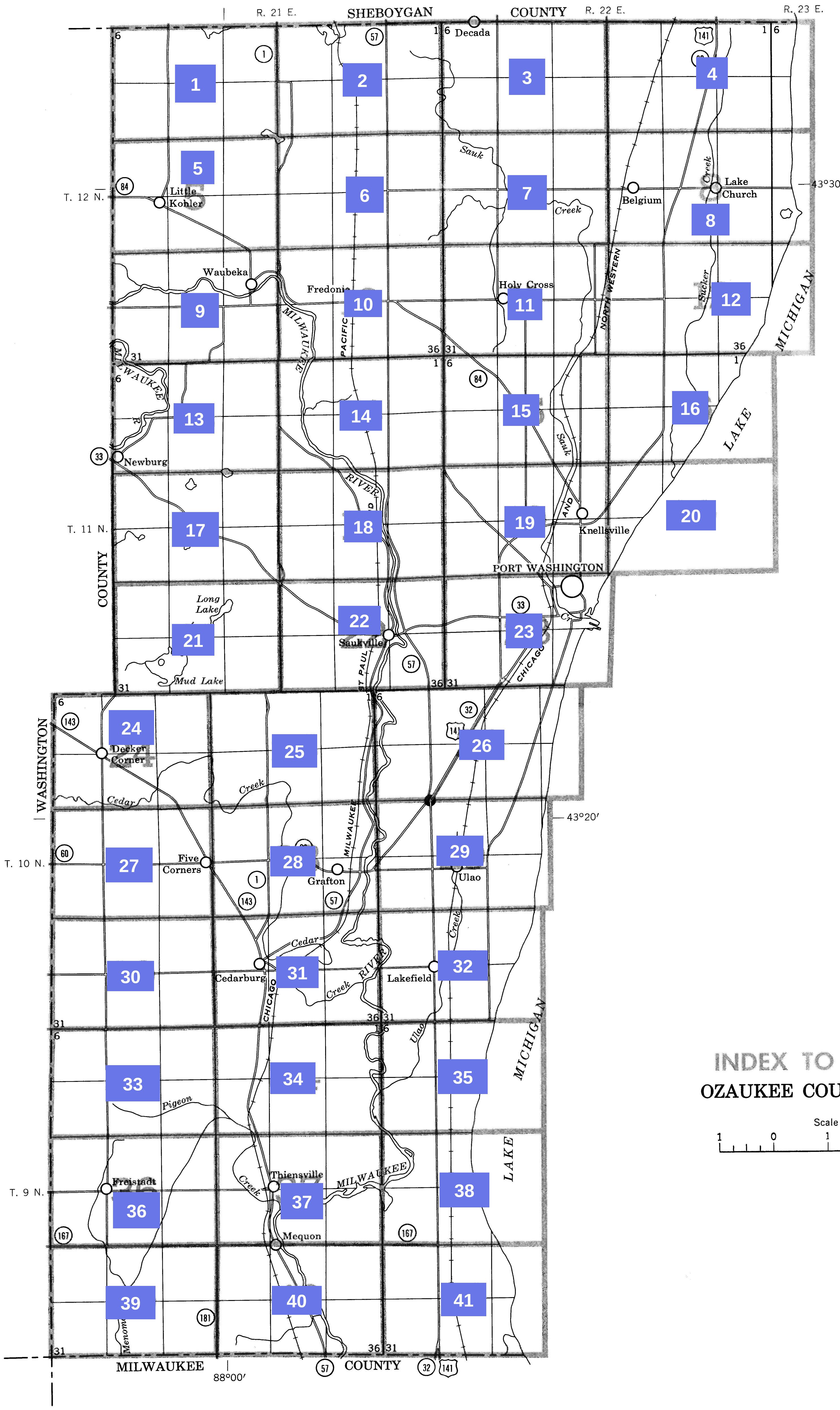

INDEX TO MAP SHEETS

OZAUKEE COUNTY, WISCONSIN

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